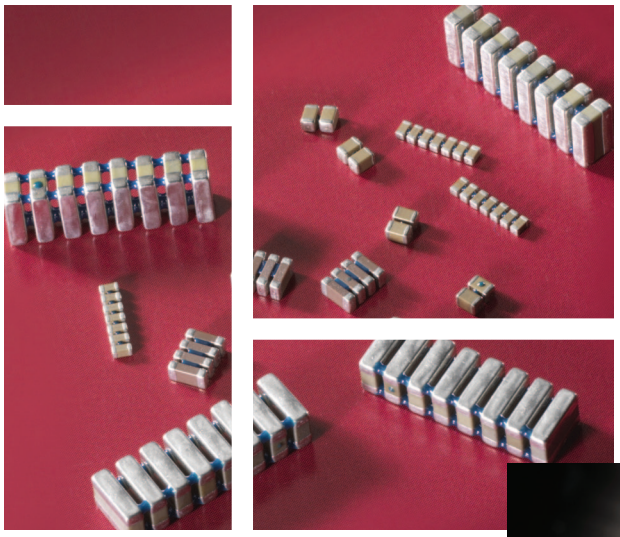
Multilayer Ceramic Capacitors



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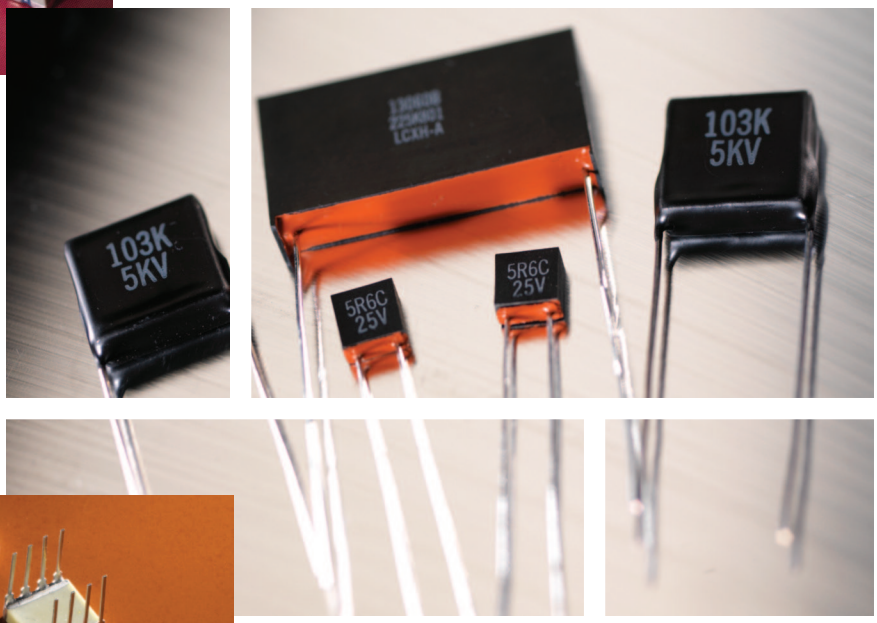
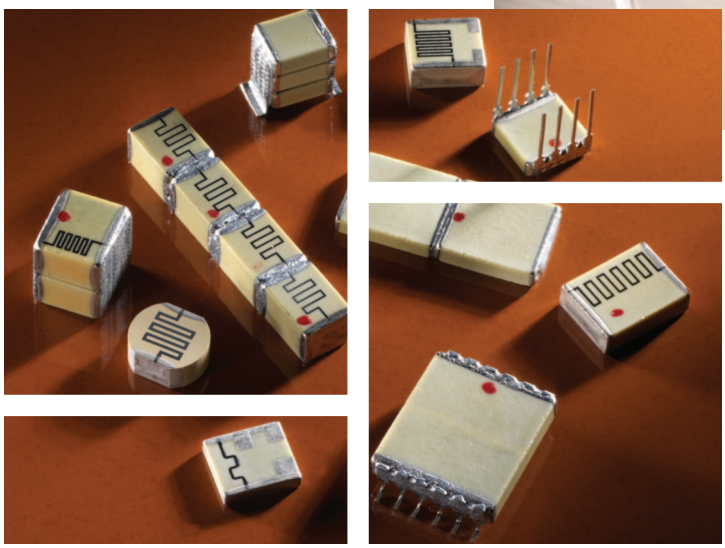
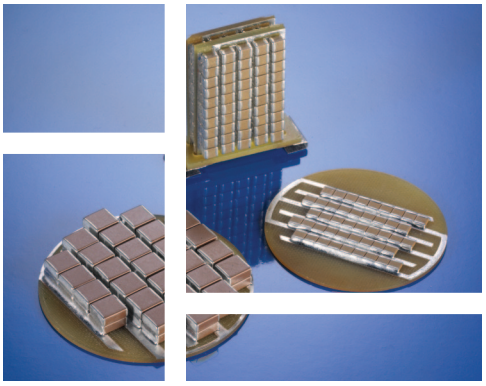
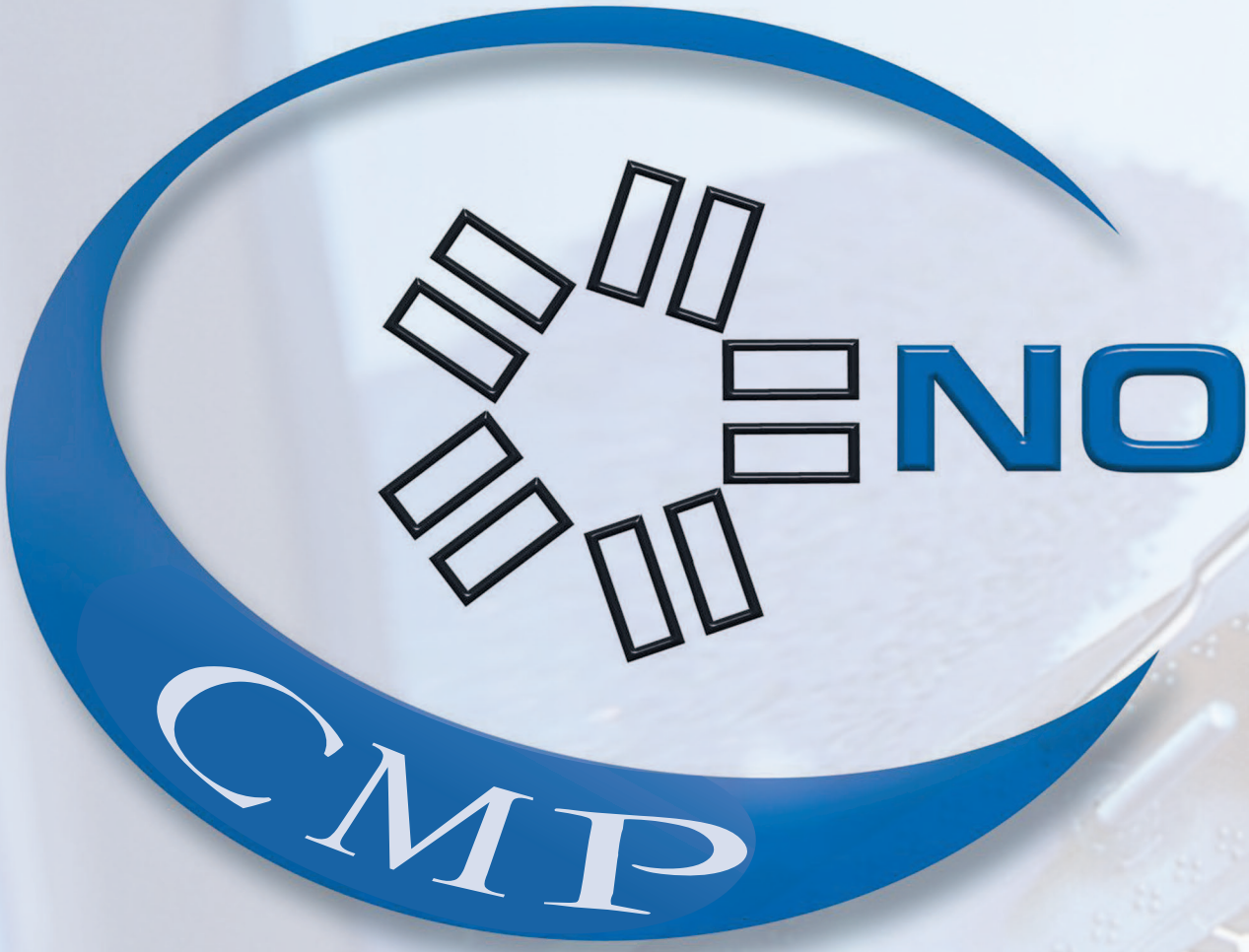






- Aerospace & Avionics
- Military & Defense
- Tele/Datacom
- Power Conversion
- Oil Exploration
- Medical
- Automotive



QUALITY DELIVERY P


VACAP
A DOVER COMPANY
Over 25 years serving the Electronics Industry
ERFORMANCE SERVICE

THE PREMIER SOURCE FOR APPLICATION SPECIFIC MULTILAYER CAPACITORS

Products by Market	AEROSPACE & AVIONICS	AUTOMOTIVE	MEDICAL	MILITARY & DEFENSE	OIL EXPLORATION	POWER CONVERSION	TELE/DATACOM
COG -COMMERCIAL - 16Vdc to 10KVdc - 12		●	●	●		●	●
X7R- COMMERCIAL - 16Vdc to 10KVdc - 14		●	●	●		●	●
HIGH CAP VALUE MLC - X7R & X5R - 16			●	●		●	●
Z5U & Y5V DIELECTRIC - 18		●				●	●
BX DIELECTRIC - 19	●	●		●			
HIGH RELIABILITY TESTING 20	●		●	●	●	●	
MIL-FRP SCREENING FLOWCHARTS - 21	●		●	●		●	
COG - HIGH RELIABILITY-16Vdc to 10KVdc - 22	●		●	●		●	
X7R - HIGH RELIABILITY-16Vdc to 10KVdc - 24	●		●	●		●	
FLEXICAP® POLYMER TERMINATION - 26	●	●	●	●		●	●
200°C HIGH TEMPERATURE - COG - 28	●	●		●	●		
200°C HIGH TEMPERATURE - CLASS II - 29	●	●		●	●		
LEADED HIGH TEMP.- ENCAPSULATED - 30	●	●		●	●		
HIGH TEMPERATURE EPOXY COATED - 31	●	●		●	●		
X8R HIGH TEMPERTURE - 150°C - 33		●		●			
PULSED POWER CAPACITORS - 34			●	●	●		
DETONATOR & PULSE ENERGY - 36				●	●		
Y3 CERTIFIED SAFETY - 38							●
Y2 CERTIFIED SAFETY - 39							●
TIP & RING CAPACITORS - 40							●
THIN PROFILE CAPACITORS - 41		●	●	●			●
CAPACITOR ARRAYS - 42	●	●	●	●		●	●
AXIAL LEADED - COMMERCIAL 44		●	●	●		●	●
RADIAL LEADED - COMMERCIAL - 46		●	●	●		●	●
RADIAL LEAD H.V.- COMMERCIAL - 48		●	●	●		●	●
RADIAL LEAD H.V.-HIGH RELIABILITY - 50	●		●	●		●	●
DSCC APPROVED - RADIAL LEAD HV - 52	●			●		●	
DSCC 87106 - CAPACITOR ASSEMBLIES - 53	●			●		●	
ST & SM - CAPACITOR ASSEMBLIES - 54	●		●	●		●	●
APPLICATION SPECIFIC - 56	●	●	●	●	●	●	●

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THE PREMIER SOURCE FOR APPLICATION SPECIFIC MULTILAYER CAPACITORS

NOVACAP is part of the Ceramic Products Group (CPG) within Dover Corporation. This recently formed group includes three other specialty capacitor companies; Syfer Technology located in the UK, Dielectric Laboratories located in New York and Voltronics located in New Jersey. The combined offerings of these companies provide the broadest range of application specific capacitors available in the world. With manufacturing facilities in America, Mexico and Europe, CPG is the recognized premier source for specialty capacitor products and is globally situated to provide quick support and service to our customers.

NOVACAP operates from a modern manufacturing facility located in Valencia California and a new manufacturing facility in Guaymas Mexico. Products include surface mount capacitors from 0402 to larger high voltage units (up to 10kV) for commercial or high reliability. Specialties include: Capacitor Arrays, Radial Leaded Capacitors. Pulsed Power Capacitors for detonation circuitry, oil exploration circuitry, photo flash, laser, power interruption and power storage modules. Certified Safety (Y^2,Y^3) and Ring Detect Capacitors for Telecom. High Temperature including X8R for harsh environments such as oil exploration and Automotive/Avionics engine compartment circuitry. Thin Profile for smart cards. Surge Protection and High Voltage designed for commercial / industrial / military use to 10 KV, with application in power supply and voltage multiplier circuits. Stacked Capacitor Assemblies for input and output filters in switch mode power supplies, high capacitance discharge circuits, and high temperature filtering/decoupling. High Reliability capacitors for use in medical implantable and life support systems. NOVACAP will manufacture custom product to customer SCD. Please consult the factory with your particular requirements.

NOVACAP QUALITY POLICY

Quality at NOVACAP is conformance to requirements in all our dealings with: Our Customers - Our Vendors - The Environment. The system for quality is prevention of defects, and to attain continuous improvements in every activity. Every employee is committed to doing the job right, the first time. NOVACAP maintains an ongoing training program for all of its employees, to create quality awareness, develop communication skills and provide formal capacitor processing education. The primary focus of the training program is on revision controlled procedures and work instructions to assure conformance to our customer's requirements.

TECHNICAL INFORMATION

NOVACAP provides Applications Notes in this catalog as a user's guide to chip selection and attachment methods. For more details on MLC products, please refer to the NOVACAP Technical Brochure, available on the NOVACAP website. The Technical Brochure describes capacitor applications, the nature of capacitance, dielectric properties and behavior, classes of dielectrics, ferroelectric behavior, electrical properties, test standards, high reliability testing, visual criteria and detailed user guidelines. Please do not hesitate to contact the factory for any product or technical assistance.

NOVACAP'S "GREEN" POLICY

It is Novacap's policy to comply with the global environmental directives pertaining to the use of hazardous materials in manufacturing. Novacap can supply products meeting RoHS standards. See our catalog for details.

IMPORTANT NOTICE

NOVACAP reserves the right to make changes in product designs and/or pricing. Sales are subject to NOVACAP's terms and conditions.

WARRANTY

NOVACAP warrants that its product(s) will be free from defects in workmanship or materials at the time of delivery, subject to the provisions of this Limited Warranty. Any claims by Buyer that any product fails to conform to this warranty must be made within ninety (90) days after delivery of such product and shall describe the alleged non-conformity. Buyer shall retain allegedly non-conforming product for inspection by an authorized representative of NOVACAP or, if requested by NOVACAP, shall return such products to NOVACAP promptly upon receiving NOVACAP's written return authorization and instructions.

If product(s) are found by NOVACAP not to conform to this warranty, NOVACAP's entire liability and Buyer's exclusive remedy whether in contract, tort or otherwise, for any claim related to or arising out of breach of the warranty covering products shall be correction of defects by repair, replacement, or credit, at NOVACAP's discretion. Refurbished product may be used to repair or replace the product. Buyer shall have no claim to product which was replaced. NOVACAP assumes no liability with respect to (a) defects caused by modification, repair, installation, operation or maintenance; (b) damage not caused by NOVACAP; or, (c) negligent or other improper use of the product. No agent, distributor, or representative is authorized to make any warranties on behalf of NOVACAP or to assume for NOVACAP any other liability in connection with any product.

WITH RESPECT TO ALL PURCHASES OF PRODUCT BY BUYER FROM NOVACAP, THE ABOVE WARRANTY IS THE ONLY WARRANTY MADE BY NOVACAP TO BUYER AND REPLACES ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND ALL OTHER OBLIGATIONS OF NOVACAP, INCLUDING ANY WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, ARE SPECIFICALLY DISCLAIMED AND EXCLUDED BY NOVACAP.

This sets forth the Buyer's sole remedy in connection with any warranty matter.

LIMITATION OF LIABILITY

NOVACAP shall not in any event be liable, whether as a result of breach of contract, warranty, tort (including negligence) or other grounds, for incidential, special, or consequential damages, including but not limited to loss of profits, loss of use of product or associated goods, cost of capital, cost of substitute products, or claims of buyer's customers. NOVACAP's liability for any claim for loss or damage arising out of this contract of from the performance or breach thereof or connected to any product supplied hereunder, whether based upon contract, warranty, tort (including negligence) or other grounds, shall not exceed the price allocable to such product or part thereof included in the claim, regardless of cause or fault.

WEBSITE

The NOVACAP Website outlines the product offerings in catalog format. These catalogs are updated on a routine basis, and presented in pdf format for easy viewing and downloading. All capacitance values are shown as maximum values. Please refer to the Webpage for the most up to date information related to this catalog.

CERTIFICATIONS AND APPROVALS

NOVACAP is certified to ISO 9001:2000, 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, TUV and CSA approvals for Isolation Surge Protection Capacitors, Class Y2 and Y3 in both COG and X7R dielectrics.

ISO 9001:2000
FM 75371

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APPLICATION NOTES

CHIP SELECTION

Multilayer capacitors (MLC) are categorized by dielectric performance with temperature, or "temperature coefficient", as these devices vary in behavior over temperature. The choice of component is thus largely determined by the temperature stability required of the device, i.e. type of dielectric, and the size necessary for a given capacitance and voltage rating. The following items are pertinent to chip selection:

DIELECTRIC TYPE

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

The military specification for ceramic chip capacitors (MIL-PRF-55681) also defines the Mid-K stable dielectric and is designated as "BX" characteristic. The BX specification has voltage temperature limits in addition to the standard temperature limits of X7R. The BX dielectric is limited to a ±15% maximum capacitance change from -55°C to 125°C, and to a +15% -25% maximum change with working voltage applied. In effect, the BX characteristic is similar to the X7R designation, with the added condition that the voltage coefficient and temperature coefficient combined do not exceed +15% / -25% change.

X7R: Stable Class II dielectric, with predictable change in properties with temperature, voltage, frequency and time. Used as blocking, de-coupling, bypassing and frequency discriminating elements. This dielectric is ferroelectric, and provides higher capacitance than Class I

Z5U/Y5V: General purpose Class III dielectrics with higher dielectric constant and greater variation of properties with temperature and test conditions. Very high capacitance per unit volume is attainable for general purpose applications where stability is not important.

CAPACITOR SIZE

Size selection is based primarily on capacitance value and voltage rating. Smaller units are generally less expensive; 0603 is the most economical size. Because mass affects the thermal shock behavior of chips, size selection must 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.

TERMINATION MATERIAL

Nickel barrier termination, with exceptional solder leach resistance is recommended for all applications involving solder. Novacap offers two versions of the nickel barrier termination. The "N" termination is a nickel barrier with 100% matte tin for a lead free capacitor. The "Y" termination is a nickel barrier with 90/10 tin/lead for military applications. Silver palladium termination is required for epoxy attachment, also for solder reflow below 230°C . Silver termination, which is most ductile, yet leaches readily in solder, is often preferred for units to be leaded, to minimize thermal cycle stresses.

PACKAGING

Units are available in bulk, reeled or in waffle pack. Bar coding is standard for bulk and reeled packaging.

ATTACHMENT METHODS

Bonding of capacitors to substrates can be categorized into two methods, those involving solder, which are prevalent, and those using other materials, such as epoxies and thermo-compression or ultrasonic bonding with wire.

SOLDERING

Soldering methods commonly used in the industry and recommended are Reflow Soldering, Wave Soldering, and to a lesser extent, Vapor Phase Soldering. All these methods involve thermal cycling of the components and therefore the rate of heating and cooling must be controlled to preclude thermal shocking of the devices. In general, rates which do not exceed 120°C per minute and a ΔT spike of 100°C maximum for any soldering process on sizes 1812 and smaller is advisable. Other precautions include post soldering handling, primarily avoidance of rapid cooling with contact with heat sinks, such as conveyors or cleaning solutions.

Large chips are more prone to thermal shock as their greater bulk will result in sharper thermal gradients within the device during thermal cycling. Units larger than 1812 experience excessive stress if processed through the fast cycles typical of solder wave or vapor phase operations. Solder reflow is most applicable to the larger chips as the rates of heating and cooling can be slowed within safe limits. In general, rates that do not exceed 60°C per minute and a ΔT spike of 50°C maximum for any soldering process on sizes larger than 1812 is advisable.

Attachment using a soldering iron requires extra care, particularly with large components, as thermal gradients are not easily controlled and may cause cracking of the chip. Precautions include preheating of the assembly to within 100°C of the solder flow temperature, the use of a fine tip iron which does not exceed 30 watts, and limitation of contact of the iron to the circuit pad areas only.

BONDING

Hybrid assembly using conductive epoxy or wire bonding requires the use of silver palladium or gold terminations. Nickel barrier termination is not practical in these applications, as intermetallics will form between the dissimilar metals. The ESR will increase over time and may eventually break contact when exposed to temperature cycling.

CLEANING

Chip capacitors can withstand common agents such as water, alcohol and degreaser solvents used for cleaning boards. Ascertain that no flux residues are left on the chip surfaces as these diminish electrical performance.

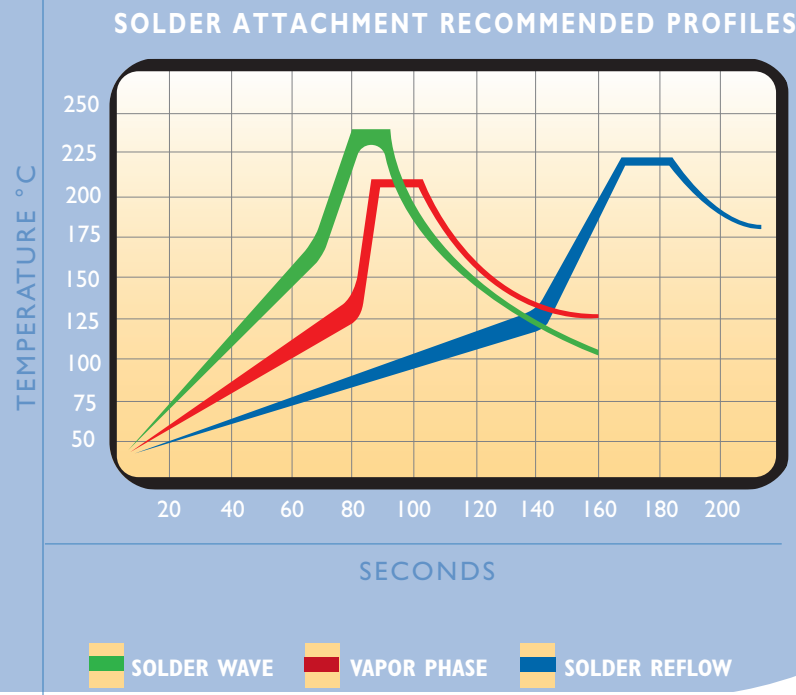
BOARD DESIGN CONSIDERATIONS

The amount of solder applied to the chip capacitor will influence the reliability of the device. Excessive solder can create thermal and tensile stresses on the component which could lead to fracturing of the chip or the solder joint itself. Insufficient or uneven solder application can result in weak bonds, rotation of the device off line or lifting of one terminal off the pad (tombstoning).

The volume of solder is process and board pad size dependent. WAVE SOLDERING exposes the devices to a large solder volume, hence the pad size area must be restricted to accept an amount of solder which is not detrimental to the chip size utilized. Typically the pad width is 66% of the component width, and the length is .030" (.760 mm) longer than the termination band on the chip. An 0805 chip which is .050" wide and has a .020" termination band therefore requires a pad .033" wide by .050" in length. Opposing pads should be identical in size to preclude uneven solder fillets and mismatched surface tension forces which can misalign the device. It is preferred that the pad layout results in alignment of the long axis of the chips at right angles to the solder wave, to promote even wetting of all terminals. Orientation of components in line with the board travel direction may require dual waves with solder turbulence to preclude cold solder joints on the trailing terminals of the devices, as these are blocked from full exposure to the solder by the body of the capacitor.

Restrictions in chip alignment do not apply to SOLDER REFLOW or VAPOR PHASE processes, where the solder volume is controlled by the solder paste deposition on the circuit pads. NOVACAP has adopted the IPC-SM-782 methodology for solder reflow land patterns. The NOVACAP recommended solder pads brochure is available for reference on the NOVACAP Website.

There are practical limitations on capacitor sizes that prohibit reliable direct mounting of chip capacitors larger than 2225 to a substrate. Without mechanical restriction, thermally induced stresses are released once the capacitor attains a steady state condition, at any given temperature. Capacitors bonded to substrates, however, will retain some stress, due primarily to the mismatch of expansion of the component to the substrate; the residual stress on the chip is also influenced by the ductility and hence the ability of the bonding medium to relieve the stress. Unfortunately, the thermal expansions of chip capacitors differ significantly from those of substrate materials. At 25°C to 300°C, capacitors typically range in expansion coefficient from 8.3 x 10-6 to 12.2 x 10-6 in/in/°C, while 99% Alumina is approximately 6.0 x 10-6 in/in/°C and P.C. board is typically 16.0 x 10-6 in/in/°C.



NOVACAP publishes a Technical Brochure which provides detailed information on the properties of ceramic chip capacitors, dielectric behavior, product classifications, test and quality standards, and other information relevant to their use. The NOVACAP Technical Brochure is available upon request. For quick reference see the brochure on the NOVACAP Website at www.novacap.com.

RECOMMENDATIONS

Preheat/Cooling rates not to exceed 120°C/minute with ΔT spikes to max temperature not to exceed 100°C for 1812 size and smaller.

Preheat/Cooling rates not to exceed 60°C /minute for over 1812 size .

DIELECTRIC CHARACTERISTICS

NOVACAP produces capacitors with dielectric characteristics COG (NPO), X7R, BX, Z5U and Y5V, per EIA RS 198, as outlined in the text and graphs following. High temperature versions of COG and X7R dielectrics are described in separate data sheets for those products. Also available are dielectrics with positive voltage and temperature characteristics such as PLZT Pulse Power.

NOVACAP performs sample testing on production representative products, for all dielectric materials, as verification of conformance to the General Specifications. Following the guidelines of MIL-PRF-55681; periodic Group C inspections are performed on capacitor lots manufactured, with qualified materials, according to documented procedures. The inspection data is generated following Electrical, Mechanical and Environmental test methods and specifications of MIL-STD-202 and EIA-198. The data records are maintained and utilized as assurance of our capability to meet the stated performance requirements.

GENERAL SPECIFICATIONS - ENVIRONMENTAL

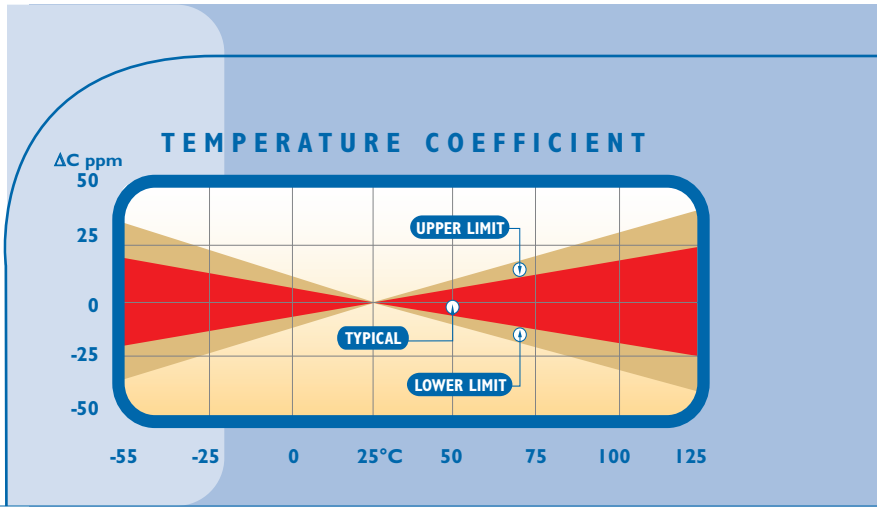
Thermal Shock:	MIL-STD-202, Method 107, Condition A (125°C)
Immersion:	MIL-STD-202, Method 104, Condition B
Humidity Steady State (Low Voltage):	MIL-STD-202, Method 103, Condition A 85°C, 85% RH, DC bias 1.3 +/- 0.25 Vdc.
Life:	MIL-STD-202, Method 108 Condition F (2000 hours)

GENERAL SPECIFICATIONS - MECHANICAL

Terminal Strength:	MIL-STD-202, Method 211 Condition A. Force 4 lbs Min. Adhesion
Resistance to Soldering Heat:	MIL-STD-202, Method 210, Test Condition B 260°C

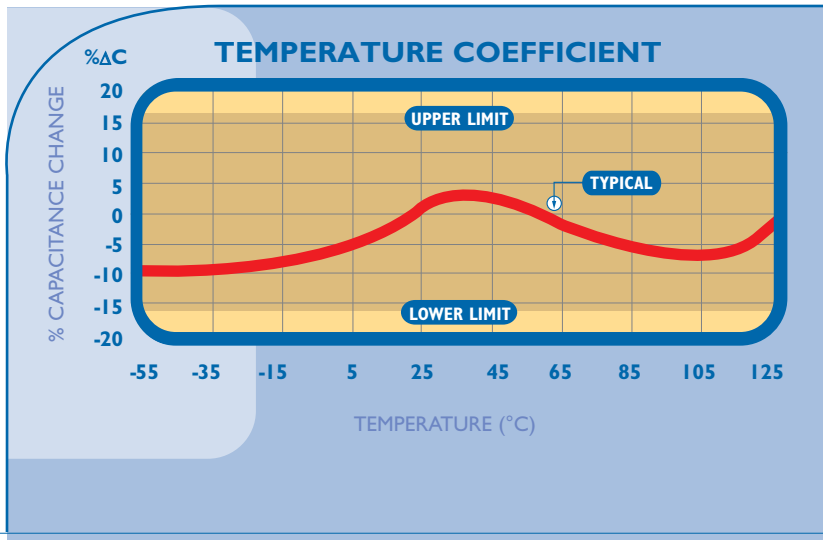
DIELECTRIC CHARACTERISTICS - COG

OPERATING TEMPERATURE RANGE:	-55 °C to 125 °C
TEMPERATURE COEFFICIENT:	0 +/- 30 ppm/°C
DISSIPATION FACTOR:	.001 (0.1%) max @ 25°C
INSULATION RESISTANCE, 25°C 125°C	> 100GΩ or >1000ΩF > 10GΩ or >100ΩF
DIELECTRIC WITHSTANDING VOLTAGE:	< 200V, 250% 201-500V, 150% or 500V* > 500V, 120%, or 750V* *WHICHEVER IS GREATER
AGING RATE:	0% per decade
TEST PARAMETERS:	1KHz, 1.0 +/- 0.2 VRMS, 25°C 1MHZ for Capacitance <100pF



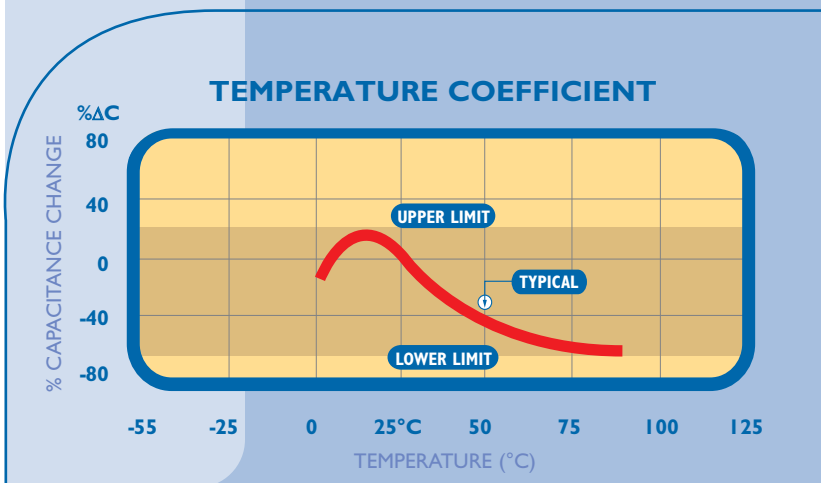
DIELECTRIC CHARACTERISTICS - X7R/BX

OPERATING TEMPERATURE RANGE:	-55°C to 125°C
TEMPERATURE COEFFICIENT (X7R):	+/-15% ΔC Max.
TEMP-VOLTAGE COEFFICIENT (BX):	+15% -25% ΔC Max.
DISSIPATION FACTOR:	2.5% max @ >25V rating 3.5% max @ ≤25V rating
INSULATION RESISTANCE, 25°C 125°C	> 100GΩ or >1000ΩF > 10GΩ or >100ΩF
DIELECTRIC WITHSTANDING VOLTAGE:	< 200V, 250% 201-500V, 150% or 500V* > 500V, 120%, or 750V* *WHICHEVER IS GREATER
AGING RATE:	< 2.0% per decade
TEST PARAMETERS:	1KHz, 1.0 +/- 0.2 VRMS, 25°C



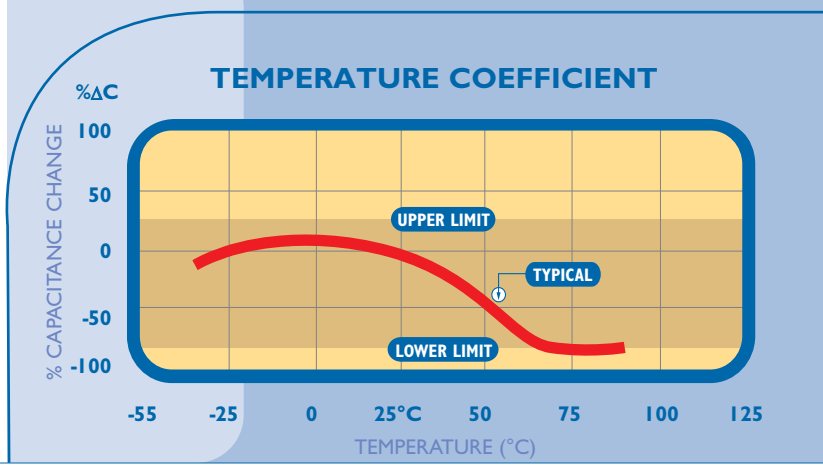
DIELECTRIC CHARACTERISTICS - Z5U

OPERATING TEMPERATURE RANGE:	+ 10°C to 85°C
TEMPERATURE COEFFICIENT:	+ 22%-56% ΔC Max.
DISSIPATION FACTOR:	4.0% max @ 25°C
INSULATION RESISTANCE, 25°C	> 10GΩ or >100ΩF
DIELECTRIC WITHSTANDING VOLTAGE:	< 200V, 250% 250V, 150%
AGING RATE:	~ 2.0% per decade
TEST PARAMETERS:	1KHz, 0.5 +/- 0.2 VRMS, 25°C



DIELECTRIC CHARACTERISTICS - Y5V

OPERATING TEMPERATURE RANGE:	-30°C to 85°C
TEMPERATURE COEFFICIENT:	+ 22%-82% ΔC Max.
DISSIPATION FACTOR:	5.0% max @ >25V rating 7.0% max @ ≤25V rating
INSULATION RESISTANCE, 25°C	> 10GΩ or >100ΩF
DIELECTRIC WITHSTANDING VOLTAGE:	< 200V, 250% 250V, 150%
AGING RATE:	~ 2.0% per decade
TEST PARAMETERS:	1KHz, 1.0 +/- 0.2 VRMS, 25°C



STANDARD SMT CHIP P/N BREAKDOWN

1206 N 472 J 101 N X050 H T M - HB

Case Size

Dielectric Code

Code	EIA	Class
N	COG/NP0	Ultra Stable
B	X7R	Stable
X	BX	MIL
Y	Y5V	General Purpose
Z	Z5U	General Purpose
S	X8R	High Temp up to 150°C
D	COG/NPO	High Temp up to 200°C
E	Class II (Stable)	High Temp up to 200°C
F	160°	High Temp up to 160°C
G	160°	High Temp up to 160°C
W	X5R	Stable
P	85°	Pulse Power
R	200°	Pulse Energy

Capacitance

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

Examples:

1R0 = 1.0 pF
120 = 12 pF
471 = 470 pF
102 = 1,000 pF
273 = .027 µF
474 = 0.47 µF
105 = 1.0 µF

Capacitance Tolerance

Code		COG NPO	X7R	BX	Z5U Y5V	X8R 150°C	D/F	E/G	W X5R
Cap Value < 10pF: 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%								

Marking

M = Marked
None = Unmarked
Marking not available on sizes 0603 and below

Packaging

T= Tape and Reel
W = Waffle Pack
None = Bulk

High Reliability Testing

H = High Reliability Testing Required
None = Standard SMT, no High-Rel
HB = MIL-PRF-55681 Group A
HK = MIL-PRF-38534 Class K
HS = MIL-PRF-123 Group A

Special Thickness

X in the part number denotes a special thickness other than standard. Specify in mils if required. (As shown above X=.050")
If no **X** in the part number then thickness is standard per Novacap catalog specifications.

Termination

N = Nickel Barrier (100% Tin) (RoHS)
P = Palladium Silver
PR = Palladium Silver (RoHS)
Y = Nickel Barrier (90%Tin/10%Lead)
S = Silver
C = Polymer with Nickel Barrier (100% Tin) (RoHS)
D = Polymer with Nickel Barrier (90%Tin/10%Lead)
V = Non-Solderable Silver (RoHS)
NG = Nickel Gold

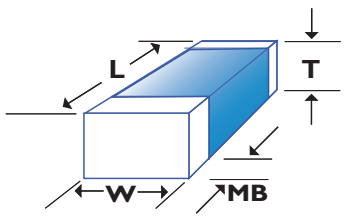
Voltage

Examples:

160 = 16 Volts
101 = 100 Volts
501 = 500 Volts
102 = 1000 Volts
502 = 5000 Volts
103 = 10,000 Volts

This ordering information relates to NOVACAP's standard surface mount capacitors. Please refer to the specific catalog pages for ordering information for our application specific products; ie: Stacked, Leaded, Capacitor Arrays, Pulsed Power capacitors and other specialty products.

PART NUMBER PREFIX DEFINITIONS



CODE COMBINATIONS

Dielectric Code	Max. Temp. Rated	Terminations (allowed)
N (COG/NPO)	125°	N, P, Y, S, V, NG, PR
B (X7R)	125°	N, P, Y, C, D, S, V, NG, PR
X (BX)	125°	N, P, Y, C, D, S, V, NG, PR
Y (Y5V)	85°	N, Y, C, D
Z (Z5U)	85°	N, Y, C, D
D (NPO-HIGH TEMP)	200°	P, S, V, PR
E (CLASS II-HIGH TEMP)	200°	P, S, V, PR
F (NPO-HIGH TEMP)	160°	N, P, Y, S, V, C, D, PR
G (CLASS II-HIGH TEMP)	160°	N, P, Y, S, V, C, D, PR
S (X8R)	150°	N, P, Y, S, V, C, D, PR
P (PULSE POWER)	85°	P, PR
R (R2D)	200°	P, PR
W (X5R)	85°	N, Y, NG

DIMENSIONS INCHES (MM)

TOLERANCE +/- INCHES (MM)

SIZE	0402	0504	0603	0805	0907	1005	1206	1210	1515	1808	1812	1825
LENGTH L	.040 (1.02)	.050 (1.27)	.060 (1.52)	.080 (2.03)	.090 (2.29)	.100 (2.54)	.125 (3.18)	.125 (3.18)	.150 (3.81)	.180 (4.57)	.180 (4.57)	.180 (4.57)
WIDTH W	.020 (.508)	.040 (1.02)	.030 (.762)	.050 (1.27)	.070 (1.78)	.050 (1.27)	.060 (1.52)	.100 (2.54)	.150 (3.81)	.080 (2.03)	.125 (3.18)	.250 (6.35)
T MAX.	.024 (.610)	.044 (1.12)	.035 (.889)	.054 (1.37)	.054 (1.37)	.054 (1.37)	.064 (1.63)	.065 (1.65)	.130 (3.30)	.065 (1.65)	.065 (1.65)	.080 (2.03)
MB	.010 (.254)	.014 (.356)	.014 (.356)	.020 (.508)	.020 (.508)	.020 (.508)	.020 (.508)	.020 (.508)	.030 (.762)	.024 (.610)	.024 (.610)	.024 (.610)
LENGTH	.004 (.102)	.006 (.152)	.006 (.152)	.008 (.203)	.008 (.203)	.008 (.203)	.008 (.203)	.008 (.203)	.015 (.381)	.012 (.305)	.012 (.305)	.012 (.305)
WIDTH	.004 (.102)	.006 (.152)	.006 (.152)	.008 (.203)	.008 (.203)	.008 (.203)	.008 (.203)	.008 (.203)	.015 (.381)	.008 (.203)	.008 (.203)	.015 (.381)
MB	.006 (.152)	.006 (.152)	.006 (.152)	.010 (.254)	.010 (.254)	.010 (.254)	.010 (.254)	.010 (.254)	.015 (.381)	.014 (.356)	.014 (.356)	.014 (.356)

DIMENSIONS INCHES (MM)

TOLERANCE +/- INCHES (MM)

SIZE	2020	2221	2225	2520	3333	3530	4040	4540	5440	5550	6560	7565
LENGTH L	.200 (5.08)	.220 (5.59)	.220 (5.59)	.250 (6.35)	.330 (8.38)	.350 (8.89)	.400 (10.2)	.450 (11.4)	.540 (13.7)	.550 (14.0)	.650 (16.5)	.750 (19.1)
WIDTH W	.200 (5.08)	.210 (5.33)	.250 (6.35)	.200 (5.08)	.330 (8.38)	.300 (7.62)	.400 (10.2)	.400 (10.2)	.400 (10.2)	.500 (12.7)	.600 (15.2)	.650 (16.5)
T MAX.	.180 (4.57)	.080 (2.03)	.080 (2.03)	.180 (4.57)	.250 (6.35)	.250 (6.35)	.300 (7.62)	.300 (7.62)	.300 (7.62)	.300 (7.62)	.300 (7.62)	.300 (7.62)
MB	.024 (.610)	.030 (.762)	.030 (.762)	.030 (.762)	.030 (.762)	.030 (.762)	.040 (1.02)	.040 (1.02)	.040 (1.02)	.040 (1.02)	.040 (1.02)	.040 (1.02)
LENGTH	.015 (.381)	.015 (.381)	.015 (.381)	.015 (.381)	.017 (.432)	.018 (.457)	.020 (.508)	.023 (.584)	.027 (.686)	.028 (.711)	.033 (.838)	.038 (.965)
WIDTH	.015 (.381)	.015 (.381)	.015 (.381)	.015 (.381)	.017 (.432)	.015 (.381)	.020 (.508)	.020 (.508)	.020 (.508)	.025 (.635)	.030 (.762)	.033 (.838)
MB	.014 (.356)	.015 (.381)	.015 (.381)	.015 (.381)	.015 (.381)	.015 (.381)	.020 (.508)	.020 (.508)	.020 (.508)	.020 (.508)	.020 (.508)	.020 (.508)

COG - COMMERCIAL - 16Vdc to 10KVdc

Ultra stable Class I dielectric (EIA COG) or NPO: linear temperature coefficient, low loss, stable electrical properties with time, voltage and frequency. Designed for surface mount application with nickel barrier termination suitable for solder wave, vapor phase or reflow solder board attachment. Also available with silver-palladium terminations for hybrid use with conductive epoxy. COG chips are used in precision circuitry requiring Class I stability.

CAPACITANCE & VOLTAGE SELECTION FOR POPULAR CHIP SIZES

3 digit code: two significant digits, followed by number of zeros eg: 183 = 18,000 pF. R denotes decimal, eg. 2R7 = 2.7 pF

MAX CAP & VOLTAGE

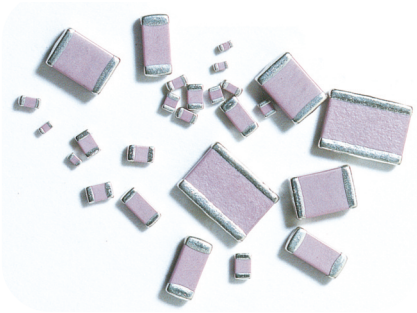
SIZE	0402	0504	0603	0805	1005	1206	1210	1515	1808		1812		1825	
Min Cap	0R3	0R5	0R3	0R5	0R5	3R0	5R0	3R0	5R0	5R0	100	100	150	150
Tmax	.024	.044	.035	.054	.054	.064	.065	.130	.065	.080[x]	.065	.100[x]	.080	.140[x]
16V	271	222	152	562	822	153	273	473	393	393	563	563	104	104
25V	221	182	122	472	682	123	273	393	333	333	563	563	104	104
50V	181	152	102	392	562	123	223	333	223	273	393	393	104	104
100V	181	152	102	392	562	103	183	333	153	223	273	393	683	823
200V	101	821	561	182	272	562	103	223	103	153	183	273	473	683
250V	560	561	331	152	222	392	822	223	682	103	153	223	393	563
300V	•	•	•	821	122	272	472	153	472	562	103	153	223	473
400V	•	•	•	821	122	182	472	103	472	472	103	123	223	333
500V	•	•	•	821	122	182	472	822	472	472	103	123	223	273
600V	•	•	•	681	102	152	392	682	392	472	822	103	183	183
800V*	•	•	•	681	102	152	392	682	392	472	822	103	183	183
1000V*	•	•	•	471	391	102	222	562	222	332	472	822	103	153
1500V*	•	•	•	•	•	561	122	392	122	182	272	472	562	103
2000V*	•	•	•	•	•	391	821	272	821	122	182	272	272	562
3000V*	•	•	•	•	•	•	•	122	391	471	821	122	122	222
4000V*	•	•	•	•	•	•	•	681	221	271	471	821	681	122
5000V*	•	•	•	•	•	•	•	•	•	•	•	•	391	821
6000V*	•	•	•	•	•	•	•	•	•					
7000V*	•	•	•	•	•	•	•	•	•					
8000V*	•	•	•	•	•	•	•	•	•					
9000V*	•	•	•	•	•	•	•	•	•					
10000V*	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Note: "x" denotes a special thickness (see Tmax row above). An X is required in the part number. Please refer to page 10 for how to order.

* Units rated above 800V may require conformal coating in use to preclude arcing over the chip surface

NOTE: REFER TO PAGES 10 & 11 FOR ORDERING INFORMATION

COG - COMMERCIAL - 16Vdc to 10KVdc



See chart for standard EIA case sizes and available capacitance and voltage ratings. Special sizes, thicknesses and other voltage ratings are available, see other NOVACAP product offerings. High reliability testing is available refer to pages 20-21. Please consult the factory with your requirements. NOVACAP has complete testing facilities at your disposal.

CAPACITANCE & VOLTAGE SELECTION FOR POPULAR CHIP SIZES

3 digit code: two significant digits, followed by number of zeros eg: 183 = 18,000 pF. R denotes decimal, eg. 2R7 = 2.7 pF

MAX CAP & VOLTAGE

SIZE	2020	2221	2225		2520	3333	3530	4040	4540	5440	5550	6560	7565
Min Cap	270	270	270	270	390	390	390	390	390	390	390	560	101
Tmax	.180	.080	.080	.150[x]	.180	.250	.250	.300	.300	.300	.300	.300	.300
16V	683	104	124	124						•	•	•	•
25V	683	104	124	124						•	•	•	•
50V	683	104	124	124						•	•	•	•
100V	563	683	823	104						•	•	•	•
200V	563	473	563	823	•	•	•	•	•	•	•	•	•
250V	473	393	473	683	•	•	•	•	•	•	•	•	•
300V	393	223	273	563	•	•	•	•	•	•	•	•	•
400V	333	223	273	393	•	•	•	•	•	•	•	•	•
500V	273	223	273	333	393	473	683	104	124	154	184	274	334
600V	153	183	273	273	223	393	393	823	823	104	154	224	274
800V*	153	183	273	273	183	333	333	563	683	823	124	184	224
1000V*	103	103	153	223	123	273	273	563	563	683	104	154	184
1500V*	822	562	822	153	103	183	223	393	393	393	563	823	124
2000V*	472	272	392	822	562	153	153	273	333	333	473	683	104
3000V*	222	122	182	332	272	822	103	183	223	223	333	473	683
4000V*	122	681	102	182	152	332	562	123	123	123	183	273	393
5000V*	821	391	561	122	102	222	332	682	822	822	123	183	223
6000V*	•	•	•	•	•	182	182	392	392	472	562	103	123
7000V*	•	•	•	•	•	•	122	272	272	332	472	682	822
8000V*	•	•	•	•	•	•	102	222	222	272	332	562	682
9000V*	•	•	•	•	•	•	821	152	182	182	272	392	472
10000V*	•	•	•	•	•	•	681	122	152	152	222	332	392

Note: "x" denotes a special thickness (see Tmax row above). An X is required in the part number. Please refer to page 10 for how to order.

* Units rated above 800V may require conformal coating in use to preclude arcing over the chip surface

NOTE: REFER TO PAGES 10 & 11 FOR ORDERING INFORMATION

X7R - COMMERCIAL - 16Vdc to 10KVdc

Stable EIA Class II dielectric, with +/-15% temperature coefficient and predictable variation of electrical properties with time, temperature and voltage. These chips are designed for surface mount application with nickel barrier terminations suitable for solder wave, vapor phase or reflow solder board attachment. Also available in silver-palladium terminations for hybrid use with conductive epoxy. Class II X7R chips are used as decoupling, by-pass, filtering and transient voltage suppression elements.

CAPACITANCE & VOLTAGE SELECTION FOR POPULAR CHIP SIZES

3 digit code: two significant digits, followed by number of zeros eg: 183 = 18,000 pF. R denotes decimal, eg. 2R7 = 2.7 pF

MAX CAP & VOLTAGE

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	151	471	471
Tmax	.024	.044	.035	.054	.054	.064	.065	.130	.065	.080[x]	.065	.100[x]	.080	.140[x]
16V	562	393	273	124	154	334	474	125	684	824	125	155	185	225
25V	472	333	223	104	124	274	474	105	564	564	105	125	155	225
50V	472	333	223	104	124	274	474	824	394	564	824	125	155	225
100V	472	333	223	683	823	184	334	684	274	394	564	824	125	185
200V	222	153	103	333	473	104	184	564	184	224	334	564	824	155
250V	152	103	682	273	393	683	124	394	124	154	224	394	684	125
300V	•	•	•	153	183	473	823	274	823	104	154	224	474	824
400V	•	•	•	123	123	273	563	224	563	823	104	184	334	564
500V	•	•	•	123	822	223	563	154	563	683	104	154	334	474
600V	•	•	•	822	822	183	393	124	393	563	683	124	224	394
800V*	•	•	•	472	472	103	273	823	273	333	473	683	124	274
1000V*	•	•	•	272	272	682	153	563	153	223	273	473	823	154
1500V*	•	•	•	•	•	222	472	183	472	682	822	153	273	563
2000V*	•	•	•	•	•	102	222	822	272	332	472	682	123	273
3000V*	•	•	•	•	•	•	•	152	561	821	122	122	472	103
4000V*	•	•	•	•	•	•	•	122	331	391	681	122	152	272
5000V*	•	•	•	•	•	•	•	•	•	•	•	•	821	182
6000V*	•	•	•	•	•	•	•	•	•					
7000V*	•	•	•	•	•	•	•	•	•					
8000V*	•	•	•	•	•	•	•	•	•					
9000V*	•	•	•	•	•	•	•	•	•					
10000V*	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Note: "x" denotes a special thickness (see Tmax row above). An X is required in the part number. Please refer to page 10 for how to order.

* Units rated above 800V may require conformal coating in use to preclude arcing over the chip surface

NOTE: REFER TO PAGES 10 & 11 FOR ORDERING INFORMATION

X7R - COMMERCIAL - 16Vdc to 10KVdc

See chart for standard EIA case sizes and available capacitance and voltage ratings. Special sizes, thicknesses and other voltage ratings are available, see other NOVACAP product offerings. High reliability testing is available refer to pages 22-23. Please consult the factory with your requirements. NOVACAP has complete testing facilities at your disposal.

CAPACITANCE & VOLTAGE SELECTION FOR POPULAR CHIP SIZES

3 digit code: two significant digits, followed by number of zeros eg: 183 = 18,000 pF. R denotes decimal, eg. 2R7 = 2.7 pF

MAX CAP & VOLTAGE

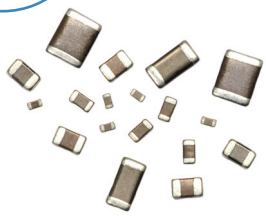
SIZE	2020	2221	2225		2520	3333	3530	4040	4540	5440	5550	6560	7565
Min Cap	102	471	471	471	102	102	102	102	102	102	102	222	222
Tmax	.180	.080	.080	.150[x]	.180	.250	.250	.300	.300	.300	.300	.300	.300
16V	185	155	225	275						•	•	•	•
25V	155	125	185	225						•	•	•	•
50V	155	125	185	225						•	•	•	•
100V	155	125	155	225						•	•	•	•
200V	125	684	105	185	•	•	•	•	•	•	•	•	•
250V	105	564	824	155	•	•	•	•	•	•	•	•	•
300V	824	394	474	105	•	•	•	•	•	•	•	•	•
400V	564	274	394	684	•	•	•	•	•	•	•	•	•
500V	474	274	334	564	684	105	105	185	185	185	225	335	475
600V	274	224	274	474	394	684	684	155	155	155	225	275	395
800V*	224	124	154	334	274	474	394	684	824	105	155	225	275
1000V*	154	823	104	224	184	334	334	564	684	684	105	155	225
1500V*	473	273	333	683	563	124	124	274	334	334	474	684	824
2000V*	273	123	153	333	273	823	683	154	184	184	274	394	474
3000V*	103	472	562	123	123	333	273	683	683	823	124	184	224
4000V*	272	152	152	332	472	183	153	223	333	393	473	823	104
5000V*	152	821	102	222	272	123	103	123	183	223	333	473	563
6000V*	•	•	•	•	•	682	562	822	123	153	223	333	393
7000V*	•	•	•	•	•	•	472	562	822	103	153	223	273
8000V*	•	•	•	•	•	•	332	472	682	822	123	153	223
9000V*	•	•	•	•	•	•	272	332	472	562	103	123	183
10000V*	•	•	•	•	•	•	182	272	392	472	682	103	123

Note: "x" denotes a special thickness (see Tmax row above). An X is required in the part number. Please refer to page 10 for how to order.

* Units rated above 800V may require conformal coating in use to preclude arcing over the chip surface

NOTE: REFER TO PAGES 10 & 11 FOR ORDERING INFORMATION

High Capacitance Value MLC - X7R & X5R



NOVACAP offers RoHS Compliant, High Capacitance Value MLC capacitors in values up to 100 Microfarads. This product is ideal to replace tantalum and Low ESR electrolytic capacitors without polarity concerns. The low ESR characteristics allow for comparable circuit designs to be achieved at typically one-third to one-fifth of the capacitance values. Parts are suitable for reflow soldering process. Applications include digital circuits, power supply bypass capacitor, LCD modules, smoothing capacitors, Input/Output filters in DC-DC Converters.

DIMENSIONS

DIMENSIONS INCHES (MM)

TOLERANCE +/- INCHES (MM)

SIZE	0402	0603	0805	1206	1210	1812
LENGTH L	.040 (1.02)	.063(1.60)	.080 (2.03)	.126 (3.20)	.126 (3.20)	.180 (4.57)
WIDTH W	.020 (.508)	.032 (.813)	.050 (1.27)	.063 (1.62)	.100 (2.54)	.125 (3.18)
T MAX.	.024 (.610)	.035 (.889)	.054 (1.37)	.072 (1.83)*	.085 (2.16)*	.110 (2.79)*
MB	.010 (.254)	.014 (.356)	.020 (.508)	.020 (.508)	.024 (.607)	.035 (.889)
LENGTH	.004 (.102)	.006 (.152)	.008 (.203)	.008 (.203)	.012 (.305)	.016 (.406)
WIDTH	.004 (.102)	.006 (.152)	.008 (.203)	.008 (.203)	.012 (.305)	.012 (.305)
MB	.004 (.102)	.010 (.254)	.010 (.254)	.012 (.305)	.012 (.305)	.020 (.508)

Dimensions in inches; bracketed dimensions in millimeters.

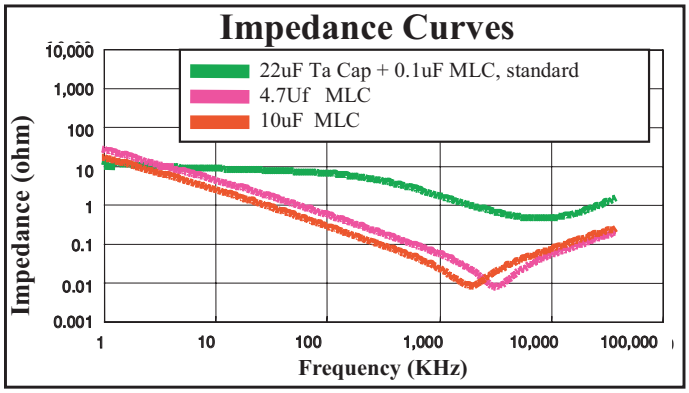
CAP & TOLERANCE® VOLTAGE

	X7R	X5R	X7R	X5R	X7R	X5R	X7R	X5R	X7R	X5R	X7R	X5R
Cap & Tolerance	682K	104K	104K	104K	154K	224K	474K	105K	105K	225M	105K	•
Voltage	25V	25V	50V	50V	50V	50V	50V	25V	100V	35V	100V[1]	
Cap & Tolerance	103K	224K	333K	154K	334K	474K	684K	335K	225K	475K	225K	•
Voltage	25V	16V	16V	25V	35V	50V	35V	25V	100V	25V	100V[1]	
Cap & Tolerance	153K	474K	473K	224K	105K	225K	105K	475K	105K	106M	•	•
Voltage	16V	10V	16V	25V	25V	25V	35V	25V	50V	50V[1]		
Cap & Tolerance	223K	105K	683K	334K	474K	475K	334K	106K	225M	226M	•	•
Voltage	16V	10V	16V	25V	16V	16V	25V	25V	25V	16V[1]		
Cap & Tolerance	333K	•	104K	474K	684K	106K	684K	225K	335M	476M	•	•
Voltage	16V		16V	25V	16V	16V	25V	16V	25V	10V[1]		
Cap & Tolerance	473K	•	224K	105K	105K	335K	225K	226M	106K	107M	•	•
Voltage	16V		16V	25V	16V	10V	25V	10V	25V[1]	6.3V[1]		
Cap & Tolerance	104K	•	105K	684K	225K	226M	335K	685K	475M	•	•	•
Voltage	16V		16V	10V	16V	6.3V	16V	6.3V	16V			
Cap & Tolerance	•	•	•	225K	•	•	475K	476M	106M	•	•	•
Voltage				10V			10V	6.3V	10V			
Cap & Tolerance	•	•	•	335K	•	•	106K	107M	•	•	•	•
Voltage				6.3V			10V	4.0V				
Cap& Tolerance	•	•	•	475M	•	•	•	•	•	•	•	•
Voltage				6.3V								
Cap & Tolerance	•	•	•	106M	•	•	•	•	•	•	•	•
Voltage				4.0V								

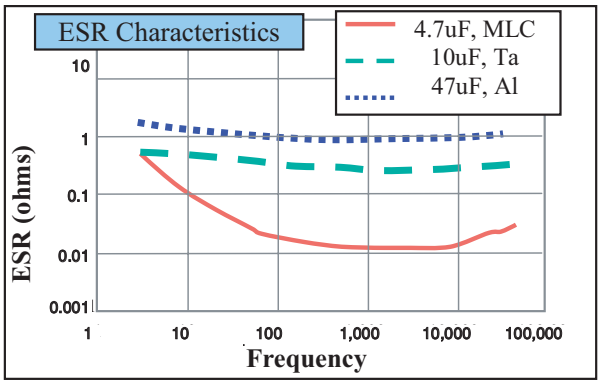
Notes:

* Denotes maximum thickness (Tmax). An X072 (1206), X085 (1210), X110 (1812) is required in the part number when ordering. (ie. 1206B474K500NX072T or 1210B475M160NX085T) or 1812B225K101NX110T)

[1] Thickness Maximum (Tmax) is .110" (2.79 mm) - (ie. 1210B106K250NX110T)



TYPICAL DATA



TYPICAL DATA

DIELECTRIC CHARACTERISTICS - X7R

OPERATING TEMPERATURE RANGE:	-55°C to 125°C
TEMPERATURE COEFFICIENT (X7R):	+/-15% ΔC Max.
DISSIPATION FACTOR:	3.5% max Except:: 0805 ≥ 1.0µF = 5% 1206 ≥ 4.7µF = 5% 1206 ≥ 22µF = 10% 1210 ≥ 10µF = 5%
INSULATION RESISTANCE, 25°C	> 10GΩ or >500ΩF whichever is less
DIELECTRIC WITHSTANDING VOLTAGE:	250%
TEST PARAMETERS, 25°C	1KHz, 1.0 +/- 0.2 VRMS

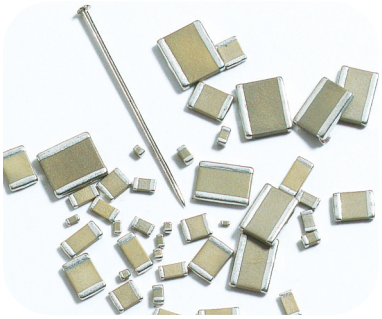
DIELECTRIC CHARACTERISTICS - X5R

OPERATING TEMPERATURE RANGE:	-55°C to 85°C
TEMPERATURE COEFFICIENT (X5R):	+/-15% ΔC Max.
DISSIPATION FACTOR:	5% max Except: 0603 ≥ 2.2µF = 10% 0805 ≥ 10µF = 10% 1206 ≥ 22µF = 10% 1210 ≥ 47µF = 10% 1812 at 100µF = 10%
INSULATION RESISTANCE, 25°C	> 10GΩ or >500ΩF whichever is less
DIELECTRIC WITHSTANDING VOLTAGE:	250%
TEST PARAMETERS, 25°C	1KHz, 1.0 +/- 0.2 VRMS Except: 22µF, 47µF and 100 µF 120 Hz, 0.5 +/- 0.1 VRMS

HOW TO ORDER

1206	W	476	M	6R3	N	X072	T
SIZES 0402 0603 0805 1206 1210 1812	**DIELECTRIC** B = X7R W = X5R	**CAPACITANCE** Value in Picofarads Two significant figures,followed by number of zeros: 47,000,000 pF 476 = 47µF	**TOLERANCE** K = +/- 10 % M = +/- 20 %	**VOLTAGE-VDCW** 160 = 16V 250 = 25V 500 = 50V 100 = 10V 6R3 = 6.3V 4R0 = 4.0V	**TERMINATION** N = Nickel Barrier (100% Tin) Y = Nickel Barrier (90% Tin/10% Lead) NG =Nickel Barrier Gold Flash	**THICKNESS OPTION** X= Denotes thickness maximum (Tmax), See NOTES on previous page for further explanation.	**PACKING OPTION** T=Reeled (Blank)= Bulk

Z5U & Y5V DIELECTRICS



General purpose EIA Class III dielectrics with +22% to -56% (Z5U) and +22% -82% (Y5V) temperature coefficients and very high capacitance density. The NOVACAP Z5U and Y5V formulations are very stable with time, typically aging less than 2% per decade. General purpose chips are used in by-pass and decoupling functions and other applications where capacitance change over the operating temperature range is not critical.

Note: Flexicap® is the preferred termination for Class III Z5U and Y5V dielectrics to reduce the chance of mechanical cracking due to board flexure.

COMMERCIAL SMT CHIPS

CAPACITANCE & VOLTAGE SELECTION

3 digit code: two significant digits, followed by number of zeros eg: 473 = 47,000 pF

Z5U / Y5V DIELECTRIC

MAX CAP & VOLTAGE

SIZE	0402	0504	0603	0805	1005	1206	1210	1808	1812	1825	2221	2225
Min Cap	121	121	121	471	681	681	681	222	332	103	103	103
16V	563	474	334	125	185	225	475	565	106	226	186	226
25V	473	394	224	105	155	225	395	395	685	186	156	226
50V	333	224	154	684	105	185	335	335	565	156	126	186
100V	103	823	563	224	334	474	105	105	185	395	395	475
200V	682	223	153	563	823	154	334	334	564	155	155	185
250V	222	183	123	473	683	104	224	224	394	105	105	125

HOW TO ORDER (Z5U/Y5V)

1206	Y	104	M	250	C	X	T	M
SIZE See Chart	**DIELECTRIC** Y = Y5V Z = Z5U	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 104=100,000 pF	**TOLERANCE** M = +/- 20% Z=+80%, -20% P=+100%, -0%	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 250=25V	**TERMINATION** C=Polymer w/Nickel Barrier (100% Tin) D=Polymer w/Nickel Barrier (90% Tin/ 10% Lead)	**THICKNESS OPTION** X=Non-standard thickness. Specify in Mils if non-standard is required. Standard items are any thickness to Max. shown in charts.	**PACKING OPTION** T = Reeled	**MARKING OPTION** M = Marked See Marking Specification

NOTE: REFER TO PAGES 10 & 11 FOR ORDERING INFORMATION

BX characteristics are identical to X7R dielectric, with the added restriction that the Temperature-Voltage Coefficient (TVC) is not to exceed -25% ΔC at rated voltage, over the operating temperature range (-55°C to 125°C). NOVACAP manufactures chips using dielectrics with minimal voltage coefficient and layer thickness designed to meet BX requirements.

COMMERCIAL & HIGH RELIABILITY

CAPACITANCE & VOLTAGE SELECTION

3 digit code: two significant digits, followed by number of zeros eg: 473 = 47,000 pF

MAX CAP & VOLTAGE

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
Tmax	.024	.044	.035	.054	.054	.064	.065	.065	.065	.080	.080	.080
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

HOW TO ORDER

2225	X	124	K	302	N	X	H	T	M	-HB
SIZE See Chart	**DIELECTRIC** X = BX	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 103=10,000 pF	**TOLERANCE** J= +/- 5% K= +/- 10% M= +/- 20%	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 302=3000V	**TERMINATION** N=Nickel Barrier (100% Tin) P=Palladium Silver Y=Nickel Barrier (90 Tin/10 Lead)	**THICKNESS OPTION** X=Non-standard thickness. Specify in Mils if non-standard is required. Standard items are any thickness to Max. shown in charts.	**HIGH REL TESTING** (Optional) Specify test criteria if required	**PACKING OPTION** T=Reeled	**MARKING OPTION** M = Marked See Marking Specification	**TESTING OPTION** HB = MILPRF-55681 GROUP A HK = MIL-PRF-38534 CLASS K HS = MIL-PRF-123 GROUP A

HIGH RELIABILITY TESTING

NOVACAP has the ability to test High Reliability COG, BX, X7R and other dielectric types in surface mount or leaded versions in accordance with MIL-PRF-55681, MIL-PRF-123, MIL-PRF-49467, MIL-PRF-49470 (DSCC 87106), MIL-PRF-39014, and MIL-PRF-38534 or customer SCD. Product is designed for optimum reliability, burned in at elevated voltage and temperature, and 100% electrically inspected to ascertain conformance to strict performance criteria. Applications for High Reliability products include medical implanted devices, aerospace, airborne and various military applications, and consumer uses requiring safety margins not attainable with conventional product. Please refer to the NOVACAP High Reliability product offering on the following pages.

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 on the following page. Contact the factory with any requirements or deviations that are not covered below.

MILITARY PERFORMANCE SPECIFICATIONS

MIL-PRF-55681 General purpose military high reliability specification for surface mount sizes 0805 through 2225 in 50V and 100V.

MIL-PRF-123 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.

MIL-PRF-39014 The specification covers general military purpose radial / axial leaded and encapsulated product in 50V, 100V, and 200V ratings.

MIL-PRF-49467 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.

MIL-PRF-49470 (DSCC 87106) 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.

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.

MIL-PRF SCREENING FLOWCHARTS

MIL-PRF-55681 (GROUP A)

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)

THERMAL SHOCK, 5 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)

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)

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)

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

NOVACAP TEST VOLTAGE (VDC)

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
≥700	1.2X Rated	1.0X Rated

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

*V/C Is Voltage Conditioning

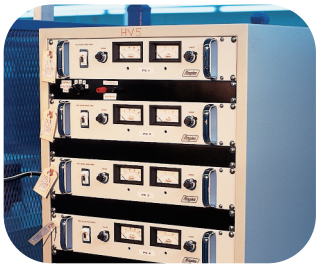
1) **MIL-PRF-123** DPA shall be per TABLE XIV AQL requirements unless otherwise specified.
2) **MIL-PRF-123** allowable PDA shall be 3% overall and 0.1% in the last 48 hours for capacitance/voltage values listed in MIL-PRF-123. The allowable PDA shall be 5% overall and 0.2% in the last 48 hours for capacitance/voltage 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.

ENVIRONMENTAL

NOVACAP has the capability to perform all the Environmental Group B, Group C, and Qualification testing to the above reference military specifications. Contact the factory for any specialty testing not covered by the 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

COG - HIGH RELIABILITY - 16Vdc to 10KVdc



NOVACAP manufactures and tests COG chips in accordance with MIL-PRF-55681, MIL-PRF-123, MIL-PRF-49467, or customer SCD. Product is designed for optimum reliability, burned in at elevated voltage and temperature, and 100% physically and electrically inspected to ascertain conformance to strict performance criteria. Voltage ratings from 16VDC to 10,000VDC are available on standard EIA case sizes. Applications for High Reliability products include medical implanted devices, aerospace, airborne and various military applications, and consumer uses requiring safety margins not attainable with conventional product.

CAPACITANCE & VOLTAGE SELECTION FOR POPULAR CHIP SIZES

3 digit code: two significant digits, followed by number of zeros eg: 183 = 18,000 pF. R denotes decimal, eg. 2R7 = 2.7 pF

MAX CAP & VOLTAGE

SIZE	0402	0504	0603	0805	1005	1206	1210	1515	1808		1812		1825	
Min Cap	0R3	0R5	0R3	0R5	0R5	3R0	5R0	3R0	5R0	5R0	100	100	150	150
Tmax	.024	.044	.035	.054	.054	.064	.065	.130	.065	.080[x]	.065	.100[x]	.080	.140[x]
16V	181	152	102	392	562	103	223	393	223	273	473	473	104	104
25V	181	152	102	392	562	123	223	393	223	273	473	473	104	104
50V	181	152	102	392	562	123	223	333	183	223	393	393	104	104
100V	101	821	561	222	332	682	123	273	123	183	273	273	683	823
200V	101	561	331	152	222	392	822	223	822	103	153	273	473	683
250V	390	391	271	102	152	272	562	183	562	682	123	183	273	473
300V	•	•	•	681	681	182	392	123	392	472	822	123	223	273
400V	•	•	•	681	561	152	392	822	392	472	822	103	183	183
500V	•	•	•	681	561	152	392	682	392	392	822	103	183	183
600V	•	•	•	•	•	122	392	682	392	392	822	103	183	183
800V*	•	•	•	•	•	102	222	472	222	222	472	682	123	153
1000V*	•	•	•	•	•	681	152	392	152	152	332	562	822	123
1500V*	•	•	•	•	•	271	681	222	681	102	152	222	392	682
2000V*	•	•	•	•	•	151	391	122	391	391	821	122	222	392
3000V*	•	•	•	•	•	•	•	561	181	181	391	561	102	182
4000V*	•	•	•	•	•	•	•	•	•	•	•	•	391	681
5000V*	•	•	•	•	•	•	•	•	•	•	•	•	221	471
6000V*	•	•	•	•	•	•	•	•	•					
7000V*	•	•	•	•	•	•	•	•	•					
8000V*	•	•	•	•	•	•	•	•	•					
9000V*	•	•	•	•	•	•	•	•	•					
10000V*	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Note: "x" denotes a special thickness (see Tmax row above). An X is required in the part number. Please refer to page 10 for how to order.

* Units rated above 800V may require conformal coating in use to preclude arcing over the chip surface

NOTE: REFER TO PAGES 10 & 11 FOR ORDERING INFORMATION

COG - HIGH RELIABILITY - 16Vdc to 10KVdc

Ultra stable Class I dielectric (EIA COG) or NPO: linear temperature coefficient, low loss, stable electrical properties with time, voltage and frequency. Designed for surface mount application with nickel barrier termination suitable for solder wave, vapor phase or reflow solder board attachment. Also available with silver-palladium terminations for hybrid use with conductive epoxy. COG chips are used in precision circuitry requiring Class I stability.

CAPACITANCE & VOLTAGE SELECTION FOR POPULAR CHIP SIZES

3 digit code: two significant digits, followed by number of zeros eg: 183 = 18,000 pF. R denotes decimal, eg. 2R7 = 2.7 pF

MAX CAP & VOLTAGE

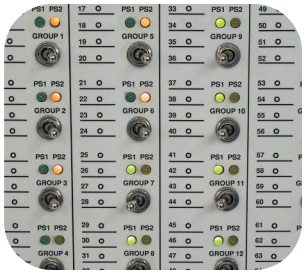
SIZE	2020	2221	2225		2520	3333	3530	4040	4540	5440	5550	6560	7565
Min Cap	270	270	270	270	390	390	390	390	390	390	390	560	101
Tmax	.180	.080	.080	.150[x]	.180	.250	.250	.300	.300	.300	.300	.300	.300
16V	683	104	124	124						•	•	•	•
25V	683	104	124	124						•	•	•	•
50V	683	104	124	124						•	•	•	•
100V	563	683	823	104						•	•	•	•
200V	473	393	473	823	•	•	•	•	•	•	•	•	•
250V	393	223	273	563	•	•	•	•	•	•	•	•	•
300V	333	183	273	473	•	•	•	•	•	•	•	•	•
400V	223	183	273	273	•	•	•	•	•	•	•	•	•
500V	153	183	273	273	183	473	473	823	823	104	124	224	274
600V	153	183	273	273	183	393	393	683	823	823	124	184	274
800V*	103	103	153	223	123	333	333	563	683	683	104	154	184
1000V*	103	822	123	183	123	273	273	473	563	563	823	124	184
1500V*	682	392	562	103	822	183	183	333	393	393	563	823	124
2000V*	392	182	272	562	472	153	153	223	273	333	473	683	823
3000V*	182	821	122	272	222	682	682	153	183	183	273	393	473
4000V*	681	331	471	102	102	272	272	562	682	822	103	153	223
5000V*	391	221	331	681	561	182	182	392	472	472	682	103	123
6000V*	•	•	•	•	•	152	152	272	332	332	472	822	822
7000V*	•	•	•	•	•	•	821	152	182	182	272	392	472
8000V*	•	•	•	•	•	•	•	102	122	122	182	272	392
9000V*	•	•	•	•	•	•	•	•	821	102	122	222	272
10000V*	•	•	•	•	•	•	•	•	681	821	122	182	222

Note: "x" denotes a special thickness (see Tmax row above). An X is required in the part number. Please refer to page 10 for how to order.

* Units rated above 800V may require conformal coating in use to preclude arcing over the chip surface

NOTE: REFER TO PAGES 10 & 11 FOR ORDERING INFORMATION

X7R - HIGH RELIABILITY - 16Vdc to 10KVdc



NOVACAP manufactures and tests X7R chips in accordance with MIL-PRF-55681, MIL-PRF-123, MIL-PRF-49467, or customer SCD. Product is designed for optimum reliability, burned in at elevated voltage and temperature, and 100% physically and electrically inspected to ascertain conformance to strict performance criteria. Voltage ratings from 16 VDC to 10,000 VDC are available on standard EIA case sizes. Applications for High Reliability products include medical implanted devices, aerospace, airborne and various military applications, and consumer uses requiring safety margins not attainable with conventional product.

CAPACITANCE & VOLTAGE SELECTION FOR POPULAR CHIP SIZES

3 digit code: two significant digits, followed by number of zeros eg: 183 = 18,000 pF. R denotes decimal, eg. 2R7 = 2.7 pF

MAX CAP & VOLTAGE

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	151	471	471
Tmax	.024	.044	.035	.054	.054	.064	.065	.130	.065	.080[x]	.065	.100[x]	.080	.140[x]
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
1000V*	•	•	•	122	821	222	562	183	562	822	103	183	333	563
1500V*	•	•	•	•	•	102	222	822	272	332	392	822	123	273
2000V*	•	•	•	•	•	471	102	392	122	152	182	332	682	123
3000V*	•	•	•	•	•	•	•	152	391	471	821	152	222	392
4000V*	•	•	•	•	•	•	•	•	181	271	391	681	821	182
5000V*	•	•	•	•	•	•	•	•	•	•	•	•	561	102
6000V*	•	•	•	•	•	•	•	•	•					
7000V*	•	•	•	•	•	•	•	•	•					
8000V*	•	•	•	•	•	•	•	•	•					
9000V*	•	•	•	•	•	•	•	•	•					
10000V*	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Note: "x" denotes a special thickness (see Tmax row above). An X is required in the part number. Please refer to page 10 for how to order.

* Units rated above 800V may require conformal coating in use to preclude arcing over the chip surface

NOTE: REFER TO PAGES 10 & 11 FOR ORDERING INFORMATION

X7R - HIGH RELIABILITY - 16Vdc to 10KVdc

Stable EIA Class II dielectric, with +/-15% temperature coefficient and predictable variation of electrical properties with time, temperature and voltage. These chips are designed for surface mount application with nickel barrier terminations suitable for solder wave, vapor phase or reflow solder board attachment. Also available in silver-palladium terminations for hybrid use with conductive epoxy. Class II X7R chips are used as decoupling, by-pass, filtering and transient voltage suppression elements.

CAPACITANCE & VOLTAGE SELECTION FOR POPULAR CHIP SIZES

3 digit code: two significant digits, followed by number of zeros eg: 183 = 18,000 pF. R denotes decimal, eg. 2R7 = 2.7 pF

MAX CAP & VOLTAGE

SIZE	2020	2221	2225		2520	3333	3530	4040	4540	5440	5550	6560	7565
Min Cap	102	471	471	471	102	102	102	102	102	102	102	222	222
Tmax	.180	.080	.080	.150[x]	.180	.250	.250	.300	.300	.300	.300	.300	.300
16V	185	125	185	275						•	•	•	•
25V	155	125	185	225						•	•	•	•
50V	155	125	155	225						•	•	•	•
100V	125	824	125	185						•	•	•	•
200V	105	474	564	125	•	•	•	•	•	•	•	•	•
250V	684	394	394	684	•	•	•	•	•	•	•	•	•
300V	564	224	334	684	•	•	•	•	•	•	•	•	•
400V	334	154	184	394	•	•	•	•	•	•	•	•	•
500V	224	154	154	334	274	684	684	155	155	155	185	275	395
600V	154	823	104	224	184	474	474	824	824	105	155	225	275
800V*	104	563	683	124	124	334	334	564	684	824	125	185	225
1000V*	563	273	393	823	683	184	184	394	474	474	684	105	125
1500V*	123	123	153	333	333	823	823	184	184	224	274	474	564
2000V*	123	562	822	153	153	473	473	104	104	124	184	224	334
3000V*	472	182	222	562	562	223	223	393	473	473	683	104	154
4000V*	182	821	102	222	272	123	123	183	223	273	393	563	823
5000V*	102	561	561	122	182	682	822	103	153	183	273	393	473
6000V*	•	•	•	•	•	472	562	682	103	123	183	273	333
7000V*	•	•	•	•	•	•	392	472	682	822	123	183	273
8000V*	•	•	•	•	•	•	272	392	562	682	103	153	183
9000V*	•	•	•	•	•	•	222	272	392	472	682	123	153
10000V*	•	•	•	•	•	•	152	222	332	392	562	822	123

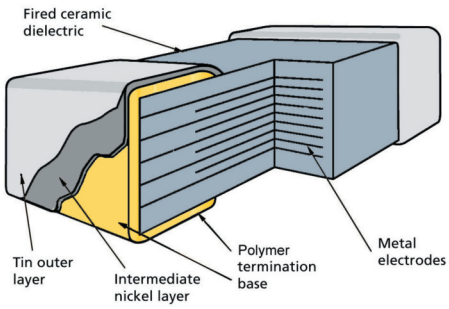
Note: "x" denotes a special thickness (see Tmax row above). An X is required in the part number. Please refer to page 10 for how to order.

* Units rated above 800V may require conformal coating in use to preclude arcing over the chip surface

NOTE: REFER TO PAGES 10 & 11 FOR ORDERING INFORMATION

FLEXICAP® POLYMER TERMINATION

NOVACAP offers polymer terminated capacitors, which are able to accommodate a significantly increased degree of board flexure compared with standard terminated capacitors. These devices will afford a wider process window, increased safety margin, and substantially reduce the cracks from mechanical stress.[1] These devices require no change to the assembly process, equipment set up, or storage procedures. The polymer terminated capacitors are offered in all dielectrics but the most significant benefit occurs with X7R and Y5V dielectrics. All combination of voltage ratings and capacitance offerings listed in the catalog for case sizes 0603 through 3640 are available.



Polymer MLCC cross section

PCB BEND TEST RESULTS

Size/Dielectric	Mean Bend Standard Term. INCHES (MM)	Mean Bend Polymer Term. INCHES (MM)	Improvement with Polymer
0603 X7R	.079 (2.0)	.252 (6.4)	+220%
0805 X7R	.142 (3.6)	.248 (6.3)	+ 75%
1206 X7R	.134 (3.4)	.252 (6.4)	+ 88%
1812 X7R	.161 (4.1)	.335 (8.5)	+108%
2225 X7R	.076 (1.9)	.143 (3.6)	+ 88%
3333 X7R	.070 (1.8)	.104 (2.6)	+ 49%
1812 Y5V	.116 (2.9)	.232 (5.9)	+100%
3015 Y5V	.040 (1.0)	.068 (1.7)	+ 70%

X7R CAPACITANCE & VOLTAGE SELECTION FOR POPULAR CHIP SIZES

3 digit code: two significant digits, followed by number of zeros eg: 473 = 47,000 pF

MAX CAP & VOLTAGE

SIZE	0504	0603	0805	1005	1206	1210	1808	1812	1825	2221	2225
Min Cap	121	121	121	121	121	121	121	151	151	471	471
16V	393	273	124	154	334	474	684	125	185	155	225
25V	333	223	104	124	274	474	564	105	155	125	185
50V	333	223	104	124	274	474	394	824	155	125	185
100V	333	223	683	823	184	334	274	564	125	125	155
200V	153	103	333	473	104	184	184	334	824	684	105
250V	103	682	273	393	683	124	124	224	684	564	824
500V	•	•	123	822	223	563	563	104	334	274	334
1000V*	•	•	272	272	682	153	153	273	823	823	104
2000V*	•	•	•	•	102	222	272	472	123	123	153
3000V*	•	•	•	•	•	•	821	152	472	472	562
4000V*	•	•	•	•	•	•	331	681	152	152	152

*Units rated above 800V may require conformal coating in use to preclude arcing over the chip surface.

1- The user must not assume use of the polymer terminated capacitors will totally eliminate mechanical cracking. Good process controls are still required for this objective to be achieved.

Y5V CAPACITANCE & VOLTAGE SELECTION FOR POPULAR CHIP SIZES

3 digit code: two significant digits, followed by number of zeros eg: 473 = 47,000 pF

MAX CAP & VOLTAGE

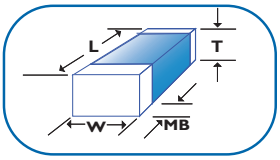
SIZE	0504	0603	0805	1005	1206	1210	1808	1812	1825	2221	2225
Min Cap	121	121	471	681	681	681	222	332	103	103	103
16V	474	334	125	185	225	475	565	106	226	186	226
25V	394	224	105	155	225	395	395	685	186	156	226
50V	224	154	684	105	185	335	335	565	156	126	186
100V	823	563	224	334	474	105	105	185	395	395	475
200V	223	153	563	823	154	334	334	564	155	155	185
250V	183	123	473	683	104	224	224	394	105	105	125

DIMENSIONS - INCHES (MM)

SIZE	0504	0603	0805	1005	1206	1210	1808	1812	1825	2221	2225
LENGTH L	.050 (1.27)	.060 (1.52)	.080 (2.03)	.100 (2.54)	.125 (3.18)	.125 (3.18)	.180 (4.57)	.180 (4.57)	.180 (4.57)	.220 (5.59)	.220 (5.59)
WIDTH W	.040 (1.02)	.030 (.760)	.050 (1.27)	.050 (1.27)	.060 (1.52)	.100 (2.54)	.080 (2.03)	.125 (3.18)	.250 (6.35)	.210 (5.33)	.250 (6.35)
T MAX.	.044 (1.12)	.035 (.889)	.054 (1.37)	.054 (1.37)	.064 (1.63)	.065 (1.65)	.065 (1.65)	.065 (1.65)	.080 (2.03)	.080 (2.03)	.080 (2.03)
MB	.014 (.355)	.014 (.355)	.020 (.508)	.020 (.508)	.020 (.508)	.020 (.508)	.024 (.610)	.024 (.610)	.024 (.610)	.030 (.760)	.030 (.760)

TOLERANCES +/- INCHES (MM)

LENGTH	.006 (.152)	.006 (.152)	.008 (.203)	.008 (.203)	.008 (.203)	.008 (.203)	.012 (.305)	.012 (.305)	.012 (.305)	.015 (.380)	.015 (.380)
WIDTH	.006 (.152)	.006 (.152)	.008 (.203)	.008 (.203)	.008 (.203)	.008 (.203)	.008 (.203)	.008 (.203)	.015 (.380)	.015 (.380)	.015 (.380)
MB	.006 (.152)	.006 (.152)	.010 (.254)	.010 (.254)	.010 (.254)	.010 (.254)	.014 (.355)	.014 (.355)	.014 (.355)	.015 (.380)	.015 (.380)



HOW TO ORDER

0805	B	273	M	251	C	X	T	M
SIZE See Chart	**DIELECTRIC** B = X7R Y = Y5V	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 104=100,000 pF	**TOLERANCE** J = +/- 5% K = +/- 10% M = +/- 20% Z = +80% -20% P = +100% -0%	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 251 = 250V	**TERMINATION** C = Polymer with Nickel Barrier (100% Tin) D = Polymer with Nickel Barrier (90Tin/10Lead)	**THICKNESS OPTION** X=Non-standard thickness. Specify in Mils if non-standard is required. Standard items are any thickness to maximum shown	**PACKING OPTION** T=Reeled	**MARKING OPTION** M=Marked

200°C HIGH TEMPERATURE - COG

NOVACAP manufactures COG chip capacitors designed and tested to operate from -55°C to 200°C. Product applications include harsh environments such as oil exploration and automotive/avionics engine compartment circuitry. Product is available as surface mount chips in sizes 0805 to 7565. Please refer to our Leaded encapsulated devices in sizes 1515 to 7565 for additional high temperature capacitors. Consult Novacap if your specific requirements exceed our catalog maximums (size, cap. value, and voltage).

COG

CAPACITANCE & VOLTAGE SELECTION

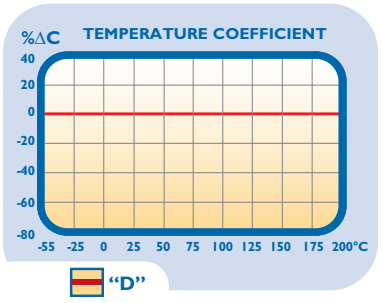
3 digit code: two significant digits, followed by number of zeros eg: 473 = 47,000 pF

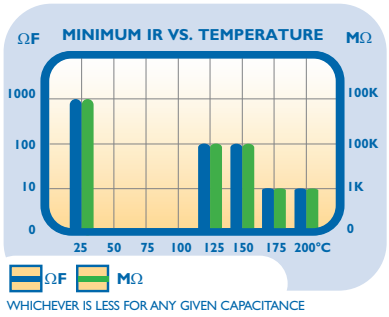
MAX CAP & VOLTAGE

SIZE	0805	1206	1210	1515	1808	1812	1825	2225	3530	4540	6560	7565
Min Cap	0R5	1R0	5R0	5R0	120	220	330	470	221	390	560	101
Tmax	.054	.064	.065	.130	.065	.065	.080	.080	.250	.300	.300	.300
25V	272	562	123	223	123	223	563	563	104	184	334	394
50V	182	392	822	183	822	153	393	473	823	154	274	334
100V	681	182	332	103	332	822	153	183	563	104	224	274
250V	471	102	222	392	222	562	123	183	333	563	124	154
500V	181	391	821	272	102	222	392	562	123	273	563	683
1000V	470	101	221	821	221	561	821	102	562	153	333	393
2000V	•	270	560	181	560	121	181	271	152	332	822	103
3000V	•	•	•	820	220	560	820	101	561	152	332	392
4000V	•	•	•	470	120	270	330	470	331	821	182	222

COG DIELECTRIC CHARACTERISTICS

Operating Temperature Range:	-55°C to 200°C
Temperature Coefficient up to 200°C:	0 +/- 30 ppm/°C
Dissipation Factor @ 25°C:	.001 (0.1%) Max
Insulation Resistance at 25°C:	>100GΩ or >1000ΩF
at 200°C:	> 1GΩ or >10ΩF
Dielectric Withstanding Voltage:	< 200V, 250%
*whichever is greater	201-500V, 150% or 500V* > 500V, 120% or 750V*
Aging Rate:	0% per decade
Test Parameters:	1KHz, 1.0 +/-0.2 VRMS, 25°C 1MHz for Capacitance <100pf





WHICHEVER IS LESS FOR ANY GIVEN CAPACITANCE

HOW TO ORDER

1812	D	822	K	251	P	X	H	T	M
SIZE See Chart	**DIELECTRIC** D = 200°C COG F = up to 160°C COG	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 822 = 8,200 pF	**TOLERANCE** F = 1% G = 2% J = +/- 5 % K = +/- 10 % M = +/- 20 %	**VOLTAGE-VDCW** Two significant figures followed by number of zeros: 251 = 250V	**TERMINATION** P = Palladium Silver F Dielectric Code Only up to 160°C C=Polymer/Nickel Barrier/100% Tin D=Polymer/Nickel Barrier 90% Tin/10% Lead N=Nickel Barrier 100% Tin Y=Nickel Barrier 90% Tin/10% Lead	**THICKNESS OPTION** X=Non-standard thickness. Specify in Mils if non- standard is required. Standard items are any thickness to Max. shown in charts.	**HIGH TEMP SCREENING** Novacap High Temp Screen	**PACKING OPTION** T=Reeled	**MARKING OPTION** M = Marked (See Marking Specification)

NOTE: REFER TO PAGE 11 FOR DIMENSIONS

200°C HIGH TEMPERATURE - CLASS II

NOVACAP manufactures Class II chip capacitors designed and tested to operate from -55°C to 200°C. Product applications include harsh environments such as oil exploration and automotive/avionics engine compartment circuitry. Product is available as surface mount chips in sizes 0805 to 7565. Please refer to our Leaded encapsulated devices in sizes 1515 to 7565 for additional high temperature capacitors. Consult Novacap if your specific requirements exceed our catalog maximums (size, cap. value, and voltage).

CLASS II

CAPACITANCE & VOLTAGE SELECTION

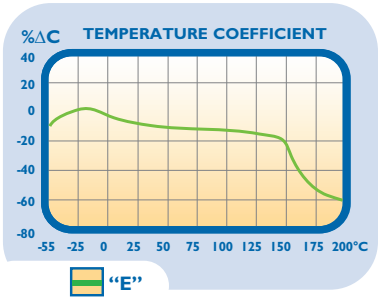
3 digit code: two significant digits, followed by number of zeros eg: 473 = 47,000 pF

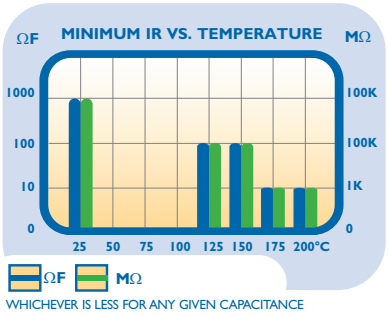
MAX CAP & VOLTAGE

SIZE	0805	1206	1210	1515	1808	1812	1825	2225	3530	4540	6560	7565
Min Cap	121	121	121	151	151	151	471	471	102	102	222	222
Tmax	.054	.064	.065	.130	.065	.065	.080	.080	.250	.300	.300	.300
25V	823	224	394	824	334	684	155	185	395	565	156	186
50V	473	124	224	684	274	474	105	125	275	475	126	156
100V	183	473	104	274	823	154	474	474	225	335	825	126
250V	472	103	273	822	223	473	124	154	564	125	275	395
500V	102	222	562	183	562	103	273	333	124	334	684	824
1000V	181	391	821	272	821	152	472	562	273	683	154	224
2000V	•	•	151	561	•	221	561	681	682	183	393	473
3000V	•	•	•	•	•	•	•	•	272	682	153	183
4000V	•	•	•	•	•	•	•	•	122	272	562	822

CLASS II DIELECTRIC CHARACTERISTICS

Operating Temperature Range:	-55°C to 200°C
Temperature Coefficient up to 200°C:	+15 -65% ΔC Max
Dissipation Factor @ 25°C:	.025 (2.5%) Max
Insulation Resistance at 25°C:	>100GΩ or >1000ΩF
at 200°C:	> 1GΩ or > 10ΩF
Dielectric Withstanding Voltage:	< 200V, 250%
*whichever is greater	201-500V, 150% or 500V* > 500V, 120% or 750V*
Aging Rate:	2% per decade
Test Parameters:	1KHz, 1.0 +/-0.2 VRMS, 25°C





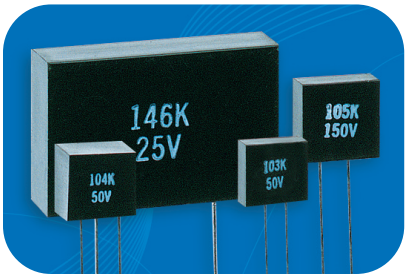
WHICHEVER IS LESS FOR ANY GIVEN CAPACITANCE

HOW TO ORDER

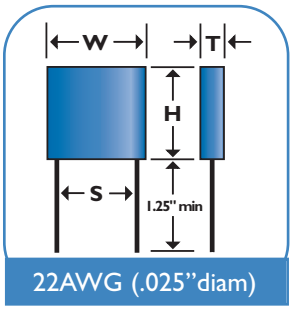
1825	E	124	K	251	P	X	H	T	M
SIZE See Chart	**DIELECTRIC** E = 200°C Class II G= up to 160°C Class II	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 124 = 120,000 pF	**TOLERANCE** J = +/- 5 % K = +/- 10 % M= +/- 20 %	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 251 = 250V	**TERMINATION** P = Palladium Silver G Dielectric Code Only up to 160°C C=Polymer/Nickel Barrier/100% Tin D=Polymer/Nickel Barrier, 90%Tin/10% Lead N=Nickel Barrier 100% Tin Y=Nickel Barrier 90% Tin/10% Lead	**THICKNESS OPTION** X=Non-standard thickness. Specify in Mils if non- standard is required. Standard items are any thickness to Max. shown in charts.	**HIGH TEMP SCREENING** Novacap High Temp Screen	**PACKING OPTION** T=Reeled	**MARKING OPTION** M = Marked (See Marking Specification)

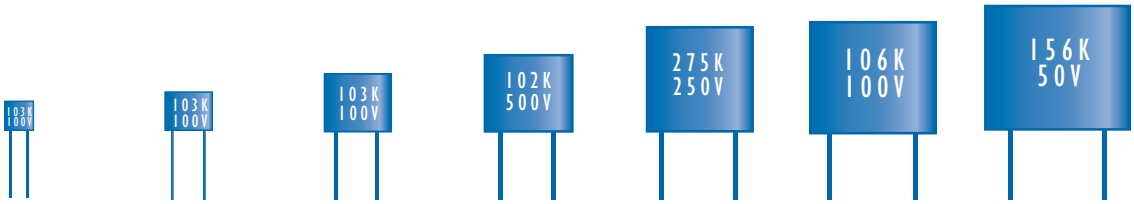
NOTE: REFER TO PAGE 11 FOR DIMENSIONS

LEADED HIGH TEMP. - ENCAPSULATED



NOVACAP manufactures chip capacitors designed and tested to operate from -55°C up to 200°C. Product is available in COG(NP0) a Class I dielectric and in a Class II dielectric operating up to 200°C. These products are for use in very harsh environments, where isolation and protection of the device is required for optimum reliability. Product is available as encapsulated devices with 22 AWG tinned copper leads, in sizes 1515 to 7565, marked with capacitance and voltage ratings. Leaded product is also available without encapsulation. Consult NOVACAP if your specific requirements exceed our catalog maximums (size, cap. value, and voltage).





SIZE	1515	2520	3530	4540	5550	6560	7565
W ± .015	.300 (7.62)	.400 (10.2)	.500 (12.7)	.725 (18.4)	.795 (20.2)	.925 (23.5)	1.125 (28.6)
H ± .015	.300 (7.62)	.400 (10.2)	.500 (12.7)	.500 (12.7)	.745 (18.9)	.750 (19.0)	.750 (19.0)
T ± .015	.150 (3.81)	.200 (5.08)	.265 (6.73)	.325 (8.26)	.370 (9.40)	.350 (8.89)	.375 (9.52)
S ± .030	.170 (4.32)	.280 (7.10)	.380 (9.65)	.480 (12.2)	.580 (14.7)	.680 (17.3)	.780 (19.8)

MAX CAP & VOLTAGE

"D" 200°C - COG DIELECTRIC

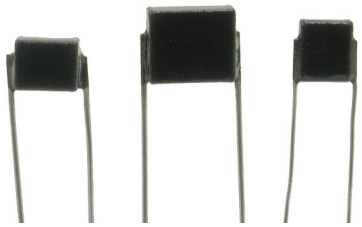
Min Cap	3R0	390	390	390	390	560	101
25V	183	563	104	184	224	334	394
50V	153	563	823	154	184	274	334
100V	562	273	563	104	154	224	274
250V	392	123	273	563	823	124	154
500V	152	562	123	273	393	563	823

"E" 200°C - CLASS II DIELECTRIC

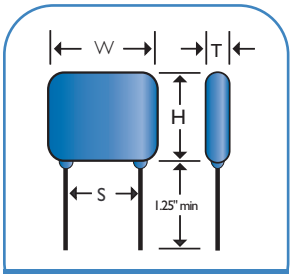
Min Cap	221	102	102	102	102	222	222
25V	564	225	395	565	106	156	186
50V	394	155	275	475	685	126	156
100V	124	824	185	335	565	825	106
250V	393	184	564	125	225	275	395
500V	822	393	823	224	334	474	684

NOTE: REFER TO PAGE 32 FOR HOW TO ORDER

LEADED HIGH TEMP. EPOXY COATED



NOVACAP manufactures chip capacitors designed and tested to operate from -55°C up to 200°C. Product is available in COG(NP0) a Class I dielectric and in a Class II dielectric operating up to 200°C. Product applications include harsh environments such as oil exploration and Automotive/Avionics engine compartment circuitry. Product is available as epoxy coated devices for environmental protection with 22 AWG tinned copper leads, in sizes 1515 to 7565, marked with capacitance and voltage ratings. Leaded product is also available without epoxy. Consult NOVACAP if your specific requirements exceed our catalog maximums (size, cap. value, and voltage).



22AWG (.025" Diam)

SIZE	1515	1812	2520	3530	4540	6560	7565
W Max.	.250 (6.35)	.300 (7.62)	.370 (9.40)	.470 (11.9)	.570 (14.5)	.770 (19.6)	.870 (22.1)
H Max.	.250 (6.35)	.200 (5.08)	.300 (7.62)	.400 (10.2)	.500 (12.7)	.720 (18.3)	.770 (19.6)
T Max.	.190 (4.83)	.160 (4.06)	.240 (6.10)	.310 (7.87)	.360 (9.14)	.360 (9.14)	.360 (9.14)
S +/- .030	.170 (4.32)	.200 (5.08)	.280 (7.11)	.380 (9.65)	.480 (12.2)	.680 (17.3)	.780 (19.8)

CAPACITANCE & VOLTAGE

3 digit code: two significant digits, followed by number of zeros eg: 183 = 18,000 pF. R denotes decimal, eg. 2R7 = 2.7 pF

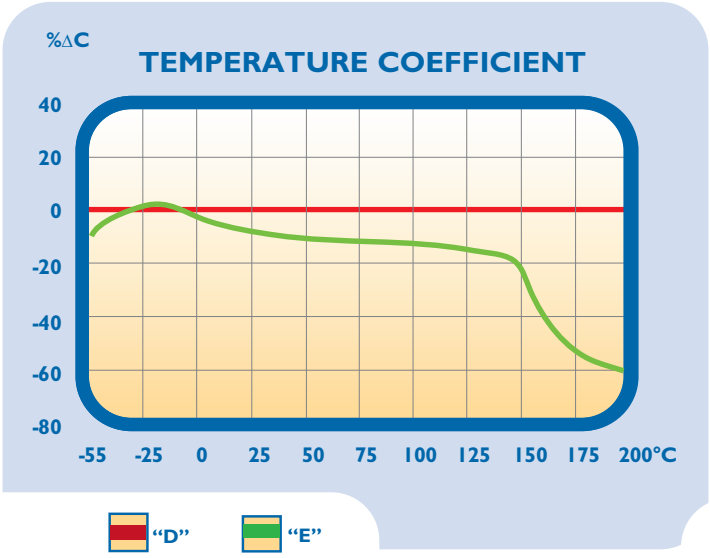
MAX CAP@ VOLTAGE

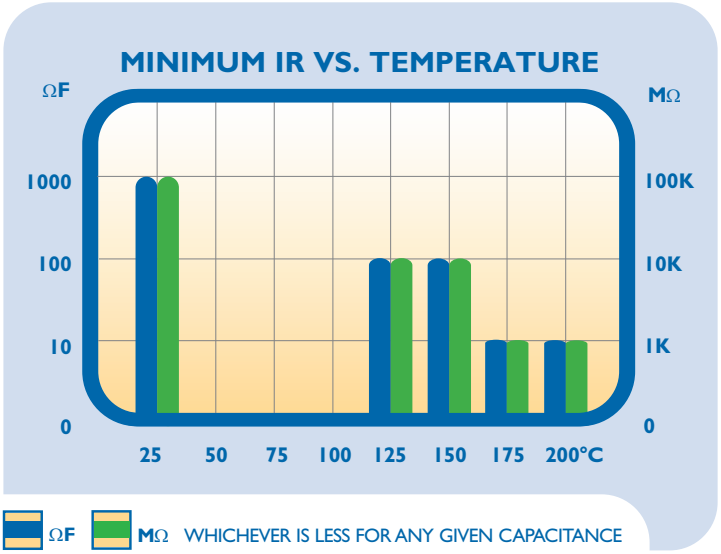
Min Cap	5R0	151	220	151	390	102	221	102	390	102	560	222	101	222
	COG	CLASS II	COG	CLASS II	COG	CLASS II	COG	CLASS II	COG	CLASS II	COG	CLASS II	COG	CLASS II
25V	223	824	273	105	563	225	104	395	184	565	334	156	394	186
50V	183	684	223	684	563	185	823	275	154	475	274	126	334	156
100V	103	274	103	274	333	125	563	225	104	335	224	825	274	126
250V	392	823	682	104	153	274	333	564	563	125	124	275	154	395
500V	272	183	332	223	562	563	123	124	273	334	563	684	683	824
1000V	821	272	102	332	182	123	562	273	153	683	333	154	393	224
2000V	181	561	221	681	391	222	152	682	332	183	822	393	103	473
3000V	820	221	101	221	181	821	561	272	152	682	332	153	392	183
4000V	470	•	•	•	101	221	331	122	821	272	182	562	222	822

NOTE: REFER TO PAGE 32 FOR HOW TO ORDER

200°C - DIELECTRIC CHARACTERISTICS

CHARACTERISTICS	"D" COG DIELECTRIC	"E" CLASS II DIELECTRIC
Operating Temperature Range:	-55°C to 200°C	-55°C to 200°C
Temperature Coefficient up to 200°C:	0 +/- 30 ppm/°C	+15 -65% ΔC Max
Dissipation Factor @ 25°C:	.001 (0.1%) Max	.025 (2.5%) Max
Insulation Resistance, 25°C 200°C	>100GΩ or >1000ΩF > 1GΩ or > 10ΩF	>100GΩ or >1000ΩF > 1GΩ or > 10ΩF
Dielectric Withstanding Voltage: * Whichever is greater	<200V, 250% 201-500V,150% or 500V* >500V, 120%, or 750V*	< 200V, 250% 201-500V,150% or 500V* > 500V, 120%, or 750V*
Aging Rate:	0% per decade	< 2.0% per decade
Test Parameters:	1KHz, 1.0 +/- 0.2 VRMS, 25°C 1MHZ for Capacitance <100pF	1KHz, 1.0 +/- 0.2 VRMS, 25°C





HOW TO ORDER

4540	E	104	M	250	LC	H
SIZE See Chart	**DIELECTRIC** D = 200°C COG E = 200°C Class II	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 104 = 100,000pF	**TOLERANCE** F = 1% G = 2% COG only J = 5% K = 10% M = 20%	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 250 = 25V	**TERMINALS** LC = Radial Leaded with Encapsulation LO = Radial Leaded No Encapsulation LP = Parylene Coating LG = Black Epoxy Coating	**HI TEMP SCREENING** Novacap High Temp Screen

X8R - HIGH TEMPERATURE 150°C

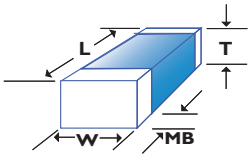
NOVACAP manufactures X8R, Class II dielectric chip capacitors designed to operate from -55°C to 150°C. Product applications include harsh environments such as oil exploration and Automotive/Avionics engine compartment circuitry. Product is available as surface mount chips in sizes 0805 to 7565. Consult Novacap if your specific requirements exceed our catalog maximums (size, cap. value, and voltage).

CAPACITANCE & VOLTAGE SELECTION

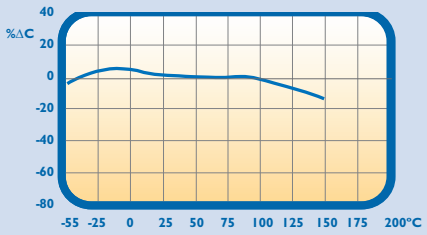
3 digit code: two significant digits, followed by number of zeros eg: 473 = 47,000 pF

MAX CAP & VOLTAGE

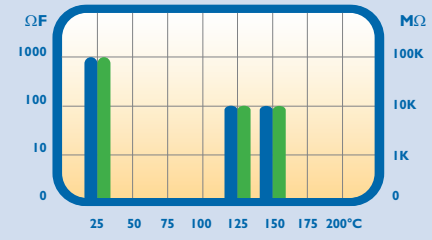
SIZE	0805	1206	1210	1812	1825	2225	4540	7565
Min Cap	121	221	331	221	102	102	102	222
25V	563	184	334	684	125	155	565	156
50V	473	154	274	564	105	125	475	126
100V	333	104	184	394	824	105	395	106
250V	183	333	823	154	474	564	275	685
500V	562	153	393	563	124	154	125	325



TEMPERATURE COEFFICIENT



MINIMUM IR VS. TEMPERATURE



X8R DIELECTRIC CHARACTERISTICS

Operating Temperature Range:	**-55°C to 150°C**
Temperature Coefficient up to 150°C:	**+/- 15% ΔC Max**
Dissipation Factor @ 25°C:	**.025 (2.5%) Max**
Insulation Resistance at 25°C:	**>100GΩ or >1000ΩF**
at 150°C:	**>10GΩ or >100ΩF**
Dielectric Withstanding Voltage: *whichever is greater	**< 200V, 250%** **201-500V, 150% or 500V*** **> 500V, 120% or 750V***
Aging Rate:	**< 2.0% per decade**
Test Parameters:	**1KHz, 1.0 +/-0.2 VRMS, 25°C**

HOW TO ORDER

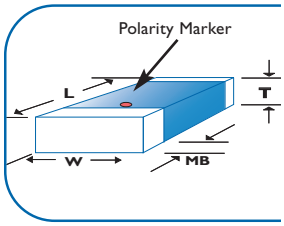
1210	S	104	K	101	P	X	H	T	M
SIZE See Chart	**DIELECTRIC** S = X8R	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 104 = 100,000 pF	**TOLERANCE** J = +/- 5 % K = +/- 10 % M = +/- 20 %	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 101 = 100V	**TERMINATION** N = Nickel Barrier (100% Tin) P = Palladium Silver Y = Nickel Barrier (90% Tin/10% Lead)	**THICKNESS OPTION** X = Non-standard thickness. Specify in Mils if non-standard is required. Standard items are any thickness to Max. shown in charts.	**HIGH TEMP SCREENING** Novacap High Temp Screen	**PACKING OPTION** T = Reeled	**MARKING OPTION** M = Marked (See Marking Specification)

PULSED POWER CAPACITORS

NOVACAP offers a line of MLC pulsed power chip capacitors, sizes 1825, 3530, 3640, 7565, which provide exceptional discharge energy at elevated voltages. These devices are manufactured using a unique dielectric formulation which has a positive voltage coefficient and a high dielectric constant. These properties can provide over 7 joules/cc of discharge energy depending on part size, capacitance value and voltage applied, far surpassing conventional X7R or Temperature Compensating Dielectrics, permitting discharge solutions in greatly reduced component footprint and volume. Multiple units can be used in series, parallel or series-parallel arrangements for increased delivered energy. Additional case sizes, custom designed sizes, and assemblies are also available. Consult the factory. 500 Megohm and 1 Gigohm safety bleed resistors are standard, but other values are available.

Applications:

- Detonation circuitry
- Oil field exploration circuitry
- Photo flash
- Laser
- Power interruption
- Ignition circuits
- Power storage modules
- HID Ignition



These are polarized parts and polarity markers must be observed during application

DIMENSIONS

SIZE	3530	3640	5440	7565
DIMENSIONS INCHES (MM) LENGTH L	.350 (8.89)	360 (9.14)	.540 (13.7)	.750 (19.1)
WIDTH W	.300 (7.62)	.400 (10.2)	.400 (10.2)	.650 (16.5)
T MAX.	.250 (6.35)	.200 (5.08)	.250 (6.35)	.300 (7.62)
MB	.030 (.762)	.030 (.762)	.030 (.762)	.040 (1.02)
TOLERANCE +/- INCHES (MM) LENGTH	.018 (.457)	.018 (.457)	.025 (.635)	.038 (.965)
WIDTH	.015 (.381)	.020 (.508)	.025 (.635)	.033 (.838)
MB	.015 (.381)	.015 (.381)	.015 (.381)	.020 (.508)

PULSED POWER

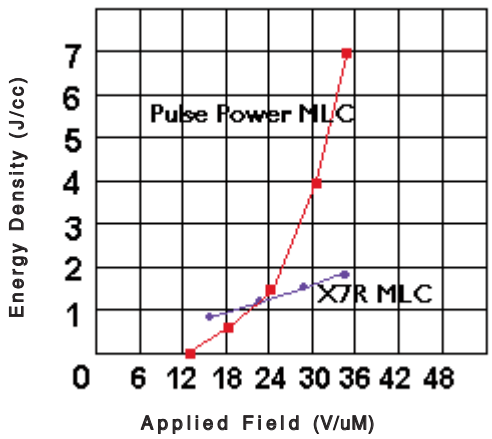
CAPACITANCE & VOLTAGE SELECTION*

3 digit code: two significant digits, followed by number of zeros eg: 473 = 47,000 pF

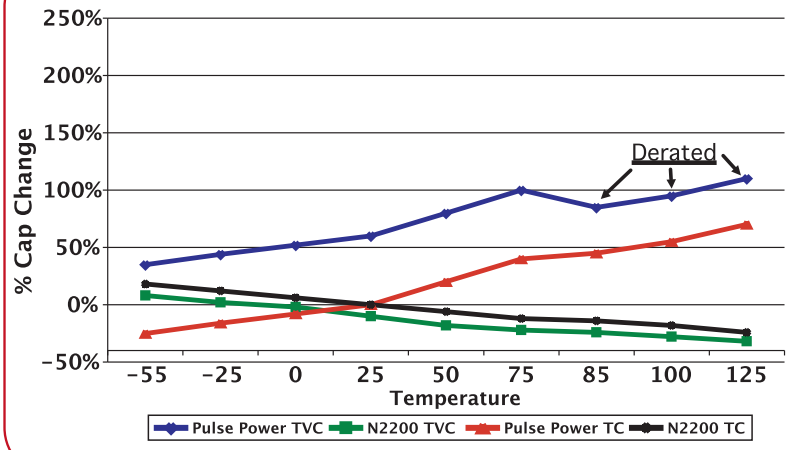
SIZE	3530	3640	5440	7565
MAX CAP & VOLTAGE 800V	114	154	194	584
1000V	104	144	184	544
1200V	953	134	174	514
1400V	903	124	154	484
1600V	553	703	903	294
2000V	473	553	703	234
2500V	403	453	603	184
3000V	203	253	333	114

*** Capacitance values at 25°C, 1vrms & 1kHz. Additional case sizes and voltages available. Listed capacitance values and performance characteristics are for reference only.**

Active Energy Density Performance of Pulsed Power Capacitor Vs. X7R MLC



Temperature-Voltage Coefficient (3640P104K122P)



These devices require a high electric field for maximum energy storage and pulse delivery. Voltage ratings for these components are thus between 500Vdc and 2800Vdc typically, depending on application. Individual chip capacitors can also be assembled into parallel, series or series parallel arrangements for higher voltage and energy requirements. Please consult with NOVACAP to best determine part size needed to meet your application requirements.

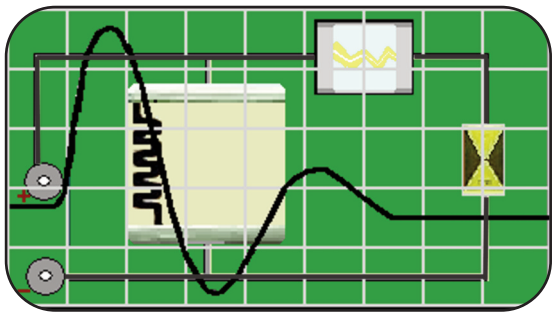
DIELECTRIC CHARACTERISTICS

Operating Temperature Range:	**-55°C to 85°C (Derate at 125°C)**
Temperature Coefficient:	**7000 +/- 1000 ppm/°C (+25°C to +125°C) 3000 +/- 1000 ppm/°C (-55°C to +25°C)**
Dissipation Factor:	**1.0 % max @ 25°C**
Insulation Resistance, 25°C 125°C	**>10GΩ or >100ΩF >1GΩ or >10ΩF**
Operating Voltage:	**Specification Voltage**
Aging Rate:	**<2% per decade**
Voltage Coefficient:	**+60% to +80%, based at application voltage**
Energy Density:	**0.5 to 7.0 joules/cc, based on voltage rating and part size**

HOW TO ORDER

RC	3640	P	803K	122	P	X	T	
STYLE OPTION RC = Bleed Resistor (optional)	**SIZE** See Chart	**DIELECTRIC** P = Pulsed Power	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 803 = 80,000 pF	**TOLERANCE** K = +/- 10 % M = +/- 20 % P= +100%/-0%	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 122 = 1200V	**TERMINATION** P = Palladium Silver	**THICKNESS OPTION** X = Non-standard thickness. Specify in Mils. if non-standard is required. Standard items are any thickness to Maximum shown in charts.	**PACKING OPTION** T=Reeled

DETONATOR & PULSE ENERGY



NOVACAP offers a line of High Temperature detonator and pulse energy capacitors designed for oil field exploration and perforation. The high energy capacitors are manufactured with a dielectric formulation designed for reliable operation under single or multiple pulse firing applications. Energy density exceeds that of conventional Class I materials and offers excellent short duration pulse delivery at temperatures to 200° C. Discharge pulse width which is typically less than 100 nanoseconds will vary with load conditions which are influenced by inductive and resistive load components.

All parts are 100% tested to NOVACAP High Reliability Pulse Screening tests and are evaluated at temperature extremes up to 200°C consistent with munitions and oil field exploration/seismic detonation conditions. Other sizes, voltages and capacitance ratings are available in single, series, and series/parallel arrangement for custom applications. As an added safety feature, these pulse discharge capacitors can be supplied with integral bleed resistors at various resistance values. With exceptionally low ESR and low signal distortion, additional applications at high temperature include power supply filtering, energy storage and coupling/decoupling. When operated at temperatures less than 200°C, higher capacitance values are available. 500 Megohm safety bleed resistor are standard, but other values are available.

DIMENSIONS

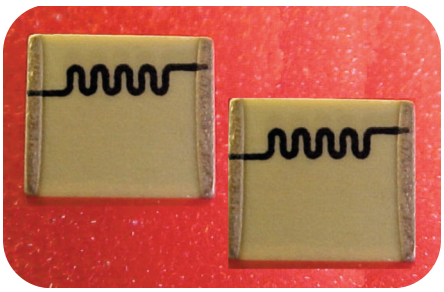
	SIZE	1825	2225	3040	3640	6560
DIMENSIONS INCHES (MM)	LENGTH L	.180 (4.57)	.220 (5.59)	.300 (7.62)	.360 (9.14)	.650 (16.5)
	WIDTH W	.250 (6.35)	.250 (6.35)	.400 (10.2)	.400 (10.2)	.600 (15.2)
	T MAX.	.150 (3.81)	.150 (3.81)	.250 (6.35)	.200 (5.08)	.300 (7.62)
	MB	.024 (.610)	.030 (.762)	.030 (.762)	.030 (.762)	.040 (1.02)
TOLERANCE +/- INCHES (MM)	LENGTH	.012 (.305)	.015 (.381)	.015 (.381)	.018 (.457)	.033 (.838)
	WIDTH	.015 (.381)	.015 (.381)	.015 (.381)	.020 (.508)	.030 (.762)
	MB	.014 (.356)	.015 (.381)	.015 (.381)	.015 (.381)	.020 (.508)

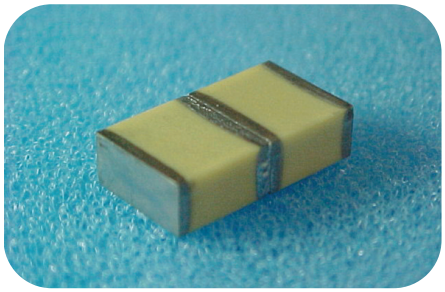
CAPACITANCE & VOLTAGE SELECTION FOR CHIP SIZES*

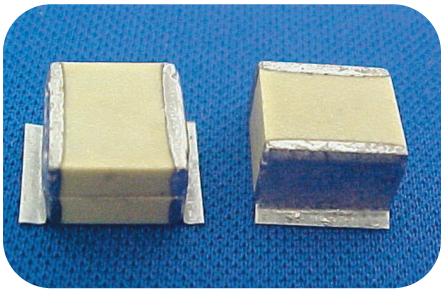
3 digit code: two significant digits, followed by number of zeroes eg: 473 - 47,000 pF,

MAX CAP @ VOLTAGE	SIZE	1825	2225	3040	3640	6560
	1000V	473	683	174	204	594
	1500V	223	393	124	144	404

***Additional case sizes and voltages are available. Please contact the factory directly to discuss your requirements.**

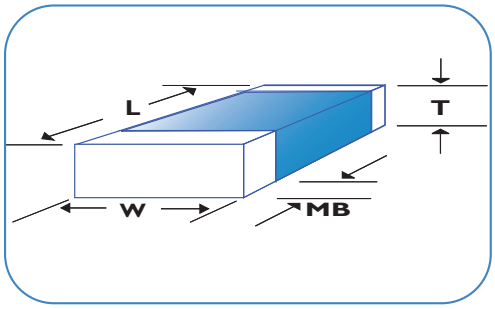




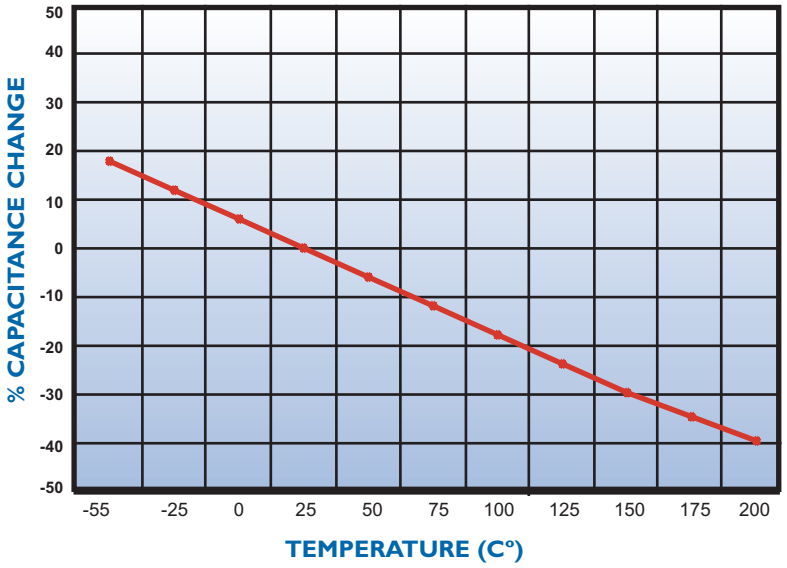


R2D
DIELECTRIC CHARACTERISTICS

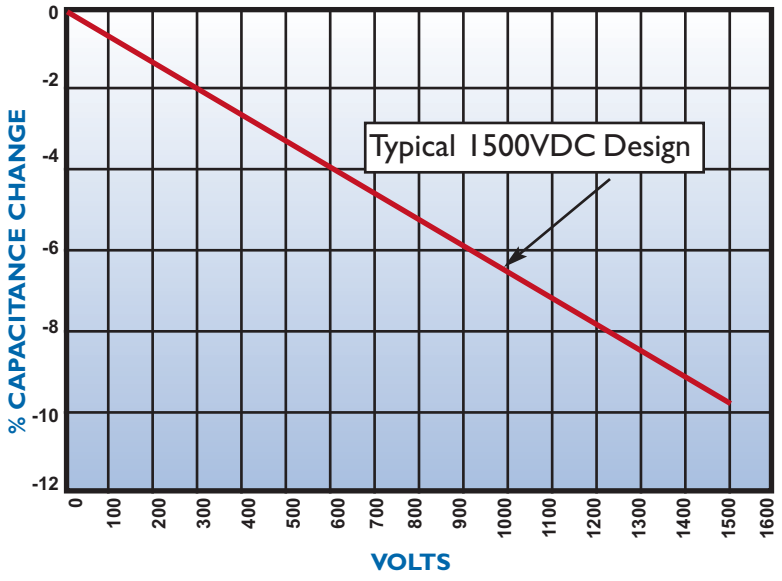
Operating Temperature Range	- 55°C to 200°C
Temperature Coefficient	- 2200 ppm/°C +/- 250 ppm/°C
Dissipation Factor	0.1% max. @ 25°C
Insulation Resistance, 25°C * whichever is less	100GΩ or 1000ΩF *
Insulation Resistance, 125°C * whichever is less	10GΩ or 100ΩF *
Dielectric Withstanding Voltage	1.2 x rated VDC
Aging Rate	0% per decade
Test Parameters	1KHz, 1.0 +/- 0.2 VRMS, 25°C



TEMPERATURE COEFFICIENT



VOLTAGE COEFFICIENT



HOW TO ORDER

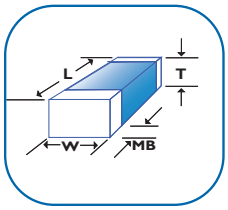
RC	3640	R	124K	102	P	X	T	M	
STYLE OPTION RC = Bleed Resistor (optional)	**SIZE** See Chart	**DIELECTRIC** R = R2D	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 124 = 120,000 pF	**TOLERANCE** J = +/- 5.0% K = +/- 10 % M = +/- 20 % Z = +80%-20% P = +100%-0%	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 102 = 1000V	**TERMINATION** P = Palladium Silver	**THICKNESS OPTION** Size 1825 & 2225 require an X in the part number	**PACKING OPTION** T=Reeled	**MARKING OPTION** M = Marked (See Marking Specification)	

Y3 - CERTIFIED SAFETY CAPACITORS

NOVACAP offers a line of MLC chip capacitors, sizes LS 1808, LS 1812, X^2, Y^3 Class Compliant* specifically designed for use in modem, facsimile, telephone and other electronic equipment where lightning or overvoltage surges can occur. These parts are rated at 250 Vac safety approved and certified to EN 60950. The product is compliant to Standards EN 132400: 1994/A2: 1998/IEC60384-14, Second Edition: 1993/A1:1995, and meet the requirements of EN61000-4-5, IEC1000-4-5, and IEC801-4-5. Capacitors are available in COG (NP0) and X7R dielectrics.

SIZE	LS 1808 (Y^3)	LS 1812 (Y^3)
LENGTH L	.180 (4.57)	.180 (4.57)
WIDTH W	.080 (2.03)	.125 (3.18)
T MAX	See Chart	See Chart
MB	.024 (.609) Typical	.024 (.609) Typical
CREEPAGE	.102 (2.60) Min	.102 (2.60) Min

Dimensions are in inches, bracketed dimensions in millimeters.
Tolerances for length and width are .015" (0.38 mm).



TUV	(LS 1808N) R9972698.01,.02,.03 (LS1808B) R2272835.01,.02 (LS1812N) R9972698.05
STANDARDS	EN 132400, EN 60950, IEC 60384-14 Second Edition, Class $X^2 Y^3$.
UL	NWGQ2.E208336 and NWGQ8.E208336

Cap (EIA)	LS 1808 COG/NPO	LS 1808 X7R	LS 1812 COG/NPO
5R0			
6R8			
8R2			
100			
120			
150			
180			
220			
270			
330			
390			
470			
560			
680			
820			
101			
121			
151			
181			
221			
271			
331			
391			
471			
561			
681			
821			
102			
122			
152			
182			
222			

Maximum Thickness of .065".
No "X065" required in the part number. ie: LS1808N151K302NT

Maximum Thickness of .080".
"X080" required in the part number. ie: LS1808N102K302NX080T

Maximum Thickness of .100".
"X100" required in the part number. ie: LS1812N202K302NX100T

HOW TO ORDER

LS1808	N	102	K	302	N	X080	T	M
SIZE LS 1808 LS 1812	**DIELECTRIC** N = COG B = X7R	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 102 = 1000 pF	**TOLERANCE** J = +/- 5 % K = +/- 10 % M = +/- 20 %	**VOLTAGE-SURGE** Two significant figures, followed by number of zeros: 302 = 3000 VDC	**TERMINATION** N = Nickel Barrier (100% Tin)	**THICKNESS OPTION** Not required for .065"Max Thickness, X080 or X100 required for thickness >.065" See Chart	**PACKING OPTION** T = Reeled	**MARKING** Parts Marked 'NLS'

*Compliant with Robustness of Termination (cl 4.3) test according to IEC 60384-1 amendment 3 cl 4.34 and 4.35 Resistance to Soldering Heat (cl 4.4) tested according to IEC 60384-1 amendment 3 cl. 4.14.2, Impulse Test made with 2.5 KV or 5.0KV as required according to 6.4.2.1 in EN 60950. The creepage distance between live parts of different polarity meets the requirements of IEC 60950.

Y2 - CERTIFIED SAFETY CAPACITORS

NOVACAP offers a line of MLC chip capacitors, sizes ES 1808, ES 2211, ES 2215 and ES2225, Y^2 Class Compliant specifically designed for use in modem, facsimile, telephone and other electronic equipment where lightning or overvoltage surges can occur. These parts are rated at 250 Vac safety approved and certified to IEC60384-14, Second Edition: 1993/A1:1995. The product is compliant to Standards EN 132400: 1994/A2:1998 and meet the requirements of EN61000-4-5, IEC1000-4-5, and IEC801-4-5. Capacitors are available in COG (NP0) dielectric only.

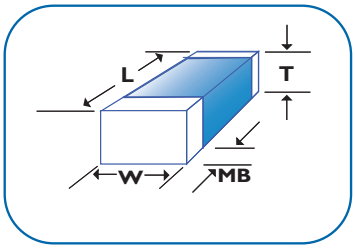
SIZE	ES 1808 (Y^2)	ES 2211 (Y^2)	ES 2215 (Y^2)	ES2225 (Y^2)
LENGTH L	.180 (4.50)	.220 (5.58)	.220 (5.58)	.220 (5.58)
WIDTH W	.080 (2.00)	.110 (2.79)	.150 (3.81)	.250 (6.35)
T MAX	.080 (2.00)	.110 (2.79)	.150 (3.81)	.080 (2.03)
MB	.020 (5.08) Typical	.030 (.762) Typical	.030 (.762) Typical	.030 (.762) Typical
CREEPAGE	.100 (2.50) Min	.157 (4.00) Min	.157 (4.00) Min	.157 (4.00) Min
CAP RANGE	COG 4.7 - 220pF X7R 150 - 1000pF	COG 5-680pF X7R N/A	COG 1000pF X7R N/A	COG 1000pF X7R N/A

Dimensions are in inches, bracketed dimensions in millimeters. Tolerances for 2211, 2215 and 2225 length and width are .015" (0.38 mm). Tolerances for 1808 length are .014" and width are .012".

CERTIFICATION NUMBERS

TUV	(ES2211, ES2215) R2072738.01 (ES2225) R2072738.02 (ES 1808) R60012089
STANDARDS	EN 132400, IEC 60384-14 Second Edition, Class X^1Y^2

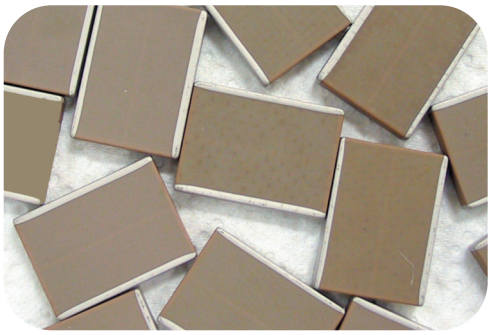
Part Identification Marking will be placed on the reel.



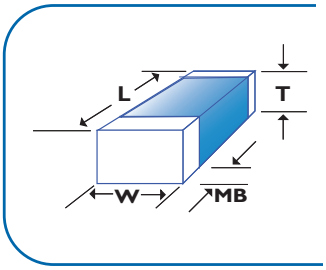
HOW TO ORDER

ES2225	N	102	K	502	N	X	T	M
SIZE ES 1808 ES 2211 ES 2215 ES 2225	**DIELECTRIC** N = COG B = X7R	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 102 = 1000 pF	**TOLERANCE** J = +/- 5 % K = +/- 10 % M = +/- 20 %	**VOLTAGE-SURGE** Two significant figures, followed by number of zeros: 502 = 5000 VDC	**TERMINATION** N = Nickel Barrier (100% Tin)	**THICKNESS OPTION** X = Non-standard thickness. Specify in Mils. if non-standard is required. Standard items are any thickness to Maximum shown in charts.	**PACKING OPTION** T = Reeled	**MARKING** Parts Marked 'NY2'

TIP & RING CAPACITORS



NOVACAP offers a line of low ESR surface mount capacitors ideally suited for "Tip & Ring" applications. These units are designed with 250 VDC rating to withstand the 52 VDC bias and 150 VRMS signal during ring cadence. Chips are offered in X7R dielectric from 0.39µF to 1.5µF in sizes 1812, 1825 and 2225. Product is also available in Z5U and Y5V dielectric from 0.47µF to 1.5µF for other ring detection circuits.



MAX CAPACITANCE @ 250 VDC

3 digit code: two significant digits, followed by number of zeros
eg: 394 = 390,000 pF (0.39µF)

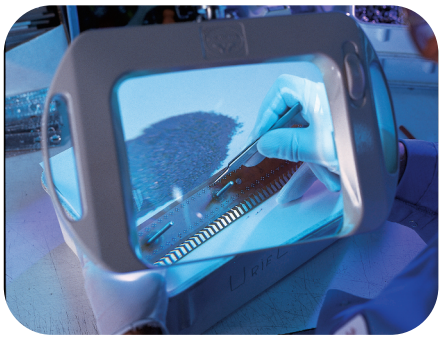
SIZE	1812	1825	2225
LENGTH L	.180 (4.57)	.180 (4.57)	.220 (5.59)
WIDTH W	.125 (3.18)	.250 (6.35)	.250 (6.35)
T MAX	.095 (2.41)	.095 (2.41)	.095 (2.41)
MB	.024 (.610)	.024 (.610)	.030 (.760)

	X7R DIELECTRIC		
MAX CAP @ 250V	474	824	105

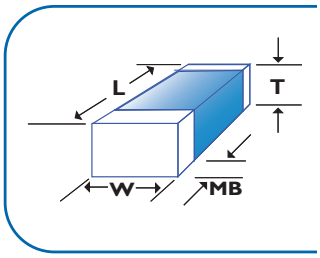
	Y5V/Z5U DIELECTRIC		
MAX CAP @ 250V	564	125	155

HOW TO ORDER

RD1812	Y	474	M	251	N	X	T	M
SIZE RD1812 RD1825 RD2225	**DIELECTRIC** B = X7R Y = Y5V Z = Z5U	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 474=470,000 pF	**TOLERANCE** J = +/- 5 % X7R ONLY K = +/- 10 % M = +/- 20 % Z = +80% -20% P = +100% -0%	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 251 = 250V	**TERMINATION** N = Nickel Barrier (100% Tin) Y = Nickel Barrier (90 Tin/10 Lead)	**THICKNESS OPTION** X=Non-standard thickness. Specify in Mils if non-standard is required. Standard items are any thickness to maximum shown	**PACKING OPTION** T=Reeled	**MARKING OPTION** M = Marked (See Marking Instructions)



Popular EIA size chips are offered in very thin profile configuration with COG, X7R, Z5U and Y5V dielectric characteristics rated at 5 Vdc to 50 Vdc, for use as decoupling capacitors under other circuit elements, or for low profile RFID and "Smart Card" circuitry.



MAX CAPACITANCE AT DISCRETE THICKNESS

3 digit code: two significant digits, followed by number of zeros
eg: 472= 4700 pF. R denotes decimal, eg. 2R7 = 2.7 pF

MAX CAP & VOLTAGE

MAXIMUM THICKNESS								
SIZE	0805		1206			1210		
INCHES	.015	.018	.015	.018	.020	.015	.018	.020
MM	.381	.457	.381	.457	.508	.381	.457	.508
COG DIELECTRIC								
5V	102	152	222	332	392	392	682	682
16V	102	152	222	332	392	392	682	682
25V	821	122	182	272	272	332	472	562
50V	561	821	122	182	222	272	392	472
X7R DIELECTRIC								
5V	223	333	473	683	823	823	124	154
16V	223	333	473	683	683	683	104	124
25V	153	223	333	563	683	683	104	124
50V	153	223	333	563	683	683	104	124
Y5V/Z5U DIELECTRIC								
5V	184	274	274	474	564	564	824	105
16V	184	274	274	474	564	564	824	105
25V	124	224	224	394	394	474	684	824
50V	823	124	184	274	334	394	564	684

HOW TO ORDER

0805	B	103	K	250	N	X015	T
SIZE See Chart	**DIELECTRIC** N = COG B = X7R Y = Y5V Z = Z5U	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 103=10,000 pF	**TOLERANCE** J = +/- 5 % K = +/- 10 % COG, X7R ONLY M = +/- 20 % Z = +80% -20% P = +100% -0%	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 250 = 25V	**TERMINATION** N = Nickel Barrier (100% Tin) P = Palladium Silver Y = Nickel Barrier (90 Tin/10 lead)	**THICKNESS OPTION** X=Non-standard thickness. Specify in Mils if non- standard is required.	**PACKING OPTION *** T=Reeled *(Consult Factory)

CAPACITOR ARRAYS

The Cap-Rack (US Patent 6,058,004) is an assembly of individual chip capacitors, bonded with high temperature epoxy. This construction permits the assembly of dissimilar capacitance values or dielectrics into one single component, providing extended freedom for board space utilization. The design reduces harmful thermal stress during assembly, behaving as individual components, not as a single large ceramic mass. The Cap-Rack also reduces "cross talk" to insignificant levels by elimination of capacitance coupling between adjacent capacitors. Cap-Racks are available as groupings of chip sizes 0603, 0805, 1005, 1206, 1210, 1808, 1812, 1825, 2221 and 2225 from pairs to as many as eight chips. Custom sizes, particularly for high voltage applications, are also available. Footprint dimensions can vary to optimize board space usage. The tables provide typical dimensions and footprints for highest capacitance designs. Consult NOVACAP for your specific requirements.

Advantages:

- Negligible cross talk
- Combine dielectrics
- Capacitor matching
- Combine resistors/inductors
- Mix & match capacitance values
- Reduced placement cost
- Reduced board area
- Easier to handle
- Reduces component stress
- Decreased cycle time

Features:

- Up to 6 capacitors in 0603-1808
- Up to 8 capacitors in 1812-2225
- Barrier termination for soldering
- Palladium/silver termination for conductive epoxy
- High Reliability versions available
- Can be used with traditional pick and place equipment

Applications:

- Multi-line designs
- Mobile phones
- Computer products
- Medical products
- Automotive products
- Network products

Size	0603	0805	1005	1206	1210	1808	1812	1825	2221	2225
Max # of Caps	6	6	6	6	6	6	8	8	8	8

For capacitance values and voltage offerings for the case sizes shown above please refer to the appropriate Dielectric (C0G, X7R, Y5V), High Voltage or High Reliability catalog pages. Custom sizes and voltages are available, please contact the factory for a solution that will meet your specific needs.

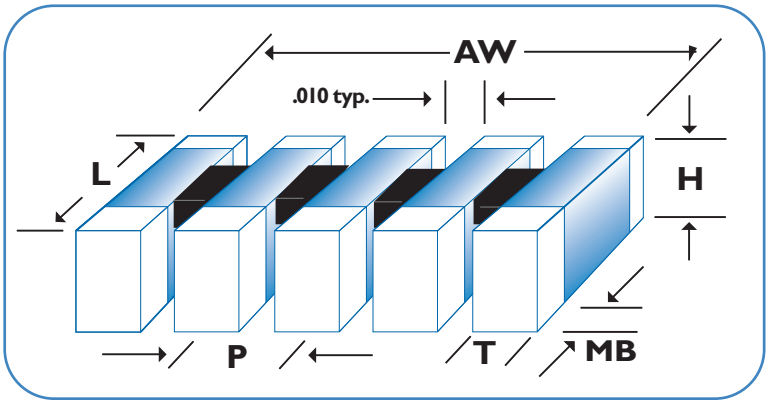
DIMENSIONS - INCHES (MM)

SIZE	0603	0805	1005	1206	1210	1808	1812	1825	2221	2225
LENGTH L	.060 (1.52)	.080 (2.03)	.100 (2.54)	.125 (3.18)	.125 (3.18)	.180 (4.57)	.180 (4.57)	.180 (4.57)	.220 (5.59)	.220 (5.59)
HEIGHT H	.030 (.760)	.050 (1.27)	.050 (1.27)	.060 (1.52)	.100 (2.54)	.080 (2.03)	.125 (3.18)	.250 (6.35)	.210 (5.33)	.250 (6.35)
T MAX.	.035 (.889)	.054 (1.37)	.054 (1.37)	.064 (1.63)	.065 (1.65)	.065 (1.65)	.065 (1.65)	.080 (2.03)	.080 (2.03)	.080 (2.03)
MB	.014 (.355)	.020 (.508)	.020 (.508)	.020 (.508)	.020 (.508)	.024 (.610)	.024 (.610)	.024 (.610)	.030 (.760)	.030 (.760)
P & AW	P & AW dimensions are dependent on the chips utilized in the array. Please contact the factory for a specification sheet that will meet your requirements.									

TOLERANCES +/- INCHES (MM)

LENGTH L	.006 (.152)	.008 (.203)	.008 (.203)	.008 (.203)	.008 (.203)	.012 (.305)	.012 (.305)	.012 (.305)	.015 (.380)	.015 (.380)
HEIGHT H	.006 (.152)	.008 (.203)	.008 (.203)	.008 (.203)	.008 (.203)	.008 (.203)	.008 (.203)	.015 (.380)	.015 (.380)	.015 (.380)
MB	.006 (.152)	.010 (.254)	.010 (.254)	.010 (.254)	.010 (.254)	.014 (.355)	.014 (.355)	.014 (.355)	.015 (.380)	.015 (.380)

Cap Arrays require drawings to specify length and width of array, and chip size used. Contact Novacap to specify your Cap- Rack requirement.

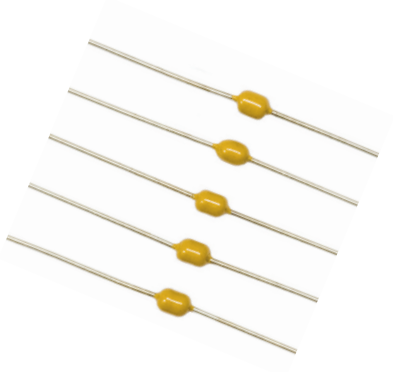


TYPICAL CONSTRUCTION

HOW TO ORDER

CR	1206	N	562	K	101	N	H	T	-4
STYLE Cap-Rack	**SIZE** Size of individual chips that make up the array 1206 = .120 x .060	**DIELECTRIC** N = COG B = X7R Y = Y5V	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 562 = 5600 pF	**TOLERANCE** B = 0.10 pF C = 0.25 pF D = 0.50 pF F = +/- 1.0 % G = +/- 2.0 % H = +/- 3.0 % J = +/- 5.0 % K = +/- 10 % M = +/- 20 % Z = +80% -20% P = +100% -0% (COG)	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 101 = 100V	**TERMINATION** N = Nickel Barrier (100% Tin) P = Palladium Silver Y = Nickel Barrier (90Tin/10Lead)	**HI REL OPTION** Ref: MIL-PRF-55681	**PACKING OPTION** T = Reeled W = Waffle Pack	**NUMBER OF CHIPS**

AXIAL LEADED - COMMERCIAL

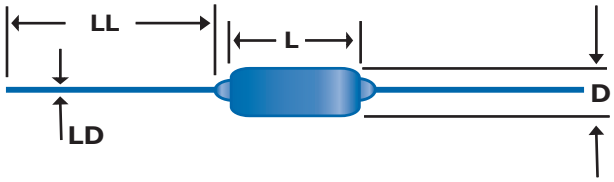


NOVACAP Axial Leaded Capacitors are available in COG, X7R and X8R characteristics. Conformal coating and lead mounting provide a rugged configuration for optimum performance, with high capacitance efficiency per KV rating. Units are designed for commercial/industrial use to 2 KV, with application in power supply and voltage multiplier circuits. High reliability versions with restricted capacitance ranges are also available. Please refer to other NOVACAP literature, or consult the factory.

CASE SIZE OPTIONS

SIZE	0805	1206
L MAX.	.150 (3.80)	.200 (5.10)
D MAX.	.100 (2.54)	.125 (3.20)
WD +/-.002	.020 (0.50)	.020 (0.50)
LL MIN.	1.00 (25.0)	1.00 (25.0)

Dimensions in inches; bracketed dimensions in millimeters.



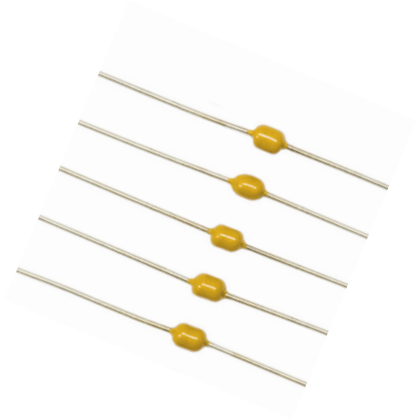
LEAD CONFIGURATION

CAPACITANCE & VOLTAGE

3 digit code: two significant digits, followed by number of zeros
eg: 183 = 18,000 pF. R denotes decimal, eg. 2R7 = 2.7 pF

MAX CAP & VOLTAGE

DIELECTRIC	NPO		X7R		X8R	
SIZE/VOLTAGE	0805	1206	0805	1206	0805	1206
50V	•	•	•	•	473	154
100V	•	•	•	•	333	104
250V	152	392	273	683	183	333
500V	821	182	123	223	562	153
1000V	471	102	272	682	•	•
2000V	•	391	•	102	•	•



COG DIELECTRIC CHARACTERISTICS

OPERATING TEMPERATURE RANGE:	-55°C to 125°C
TEMPERATURE COEFFICIENT:	0 +/- 30 ppm/°C
DISSIPATION FACTOR:	.001 (0.1%) max @ 25°C
INSULATION RESISTANCE, 25°C 125°C	>100GΩ or >1000ΩF >10GΩ or >100ΩF
DIELECTRIC WITHSTANDING VOLTAGE: *WHICHEVER IS GREATER	120% VDCW, or 750V*
AGING RATE:	0% per decade
TEST PARAMETERS:	1KHz, 1.0 +/- 0.2 VRMS, 25°C 1MHZ for Capacitance <100pF

X8R DIELECTRIC CHARACTERISTICS

OPERATING TEMPERATURE RANGE:	-55°C to 150°C
TEMPERATURE COEFFICIENT UP TO 150° C:	+/-15% ΔC Max
DISSIPATION FACTOR @ 25° C:	.025 (2.5%) max
INSULATION RESISTANCE AT 25°C AT 150°C	>100GΩ or >1000ΩF >10GΩ or >100ΩF
DIELECTRIC WITHSTANDING VOLTAGE: *WHICHEVER IS GREATER	< 200V, 250% 201-500V, 150% OR 500V* > 500V, 120% or 750V*
AGING RATE:	< 2.0% per decade
TEST PARAMETERS:	1KHz, 1.0 +/- 0.2 VRMS, 25°C

X7R DIELECTRIC CHARACTERISTICS

OPERATING TEMPERATURE RANGE:	-55°C to 125°C
TEMPERATURE COEFFICIENT:	+/-15% ΔC Max
DISSIPATION FACTOR @ 25° C:	.025 (2.5%) max @ 25°C
INSULATION RESISTANCE, 25°C 125°C	>100GΩ or >1000ΩF >10GΩ or >100ΩF
DIELECTRIC WITHSTANDING VOLTAGE: *WHICHEVER IS GREATER	120% VDCW, or 750V*
AGING RATE:	< 2.0% per decade
TEST PARAMETERS:	1KHz, 1.0 +/- 0.2 VRMS, 25°C

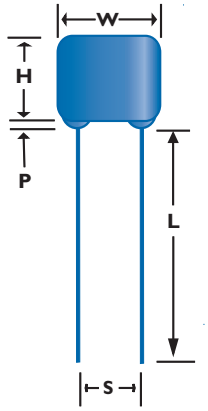
HOW TO ORDER

0805	B	123	K	501	LA	T	R
SIZE See Chart Above	**DIELECTRIC** N= C0G B = X7R S = X8R	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 123 = 12,000pF	**TOLERANCE** J = +/- 5 % K = +/- 10 % M = +/- 20 %	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 501 = 500V	**LEAD CONFIGURATIONS AVAILABLE** LA = 0805 & 1206	**PACKAGING** A = Ammo Pack 5K/Pack T = Tape & Reel 7.5K/Reel No suffix = Bulk	**RoHS** R = RoHS Compliant

RADIAL LEADED - COMMERCIAL

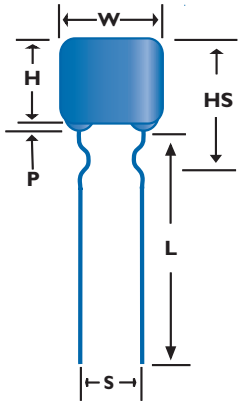
NOVACAP RoHS compliant small case Radial Leaded Capacitors are available in COG, X7R and X8R characteristics. Conformal coating and lead mounting provide a rugged configuration for optimum performance, with high capacitance efficiency per KV rating. Units are designed for commercial/industrial use to 5 KV, with application in power supply and voltage multiplier circuits. High reliability versions with restricted capacitance ranges are also available. Please refer to other NOVACAP literature, or consult the factory.

LEAD CONFIGURATION AND SIZE OPTIONS



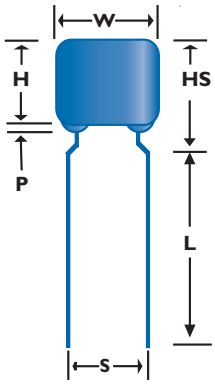
LEAD STYLE
LE

AVAILABLE IN SIZES
0805
1812



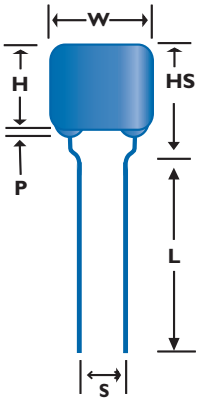
LEAD STYLE
LB

AVAILABLE IN SIZE
2225



LEAD STYLE
LD & LQ

LD AVAILABLE IN SIZES
0805
1206
1210
LQ -1206 only



LEAD STYLE
LR

AVAILABLE IN SIZE
1206

LEAD STYLE	LE	LD	LR	LD	LQ	LD	LE	LB
SIZE	0805	0805	1206	1206	1206	1210	1812	2225
W MAX.	.150 (3.81)	.150 (3.81)	.200 (5.08)	.200 (5.08)	.200 (5.08)	.200 (5.08)	.300 (7.62)	.350 (8.89)
H MAX.	.150 (3.81)	.150 (3.81)	.150 (3.81)	.150 (3.81)	.150 (3.81)	.200 (5.08)	.250 (6.35)	.350 (8.89)
T MAX.	.100 (2.54)	.100 (2.54)	.125 (3.18)	.125 (3.18)	.125 (3.18)	.175 (4.45)	.200 (5.08)	.200 (5.08)
HS MAX.	.200 (5.08)	.250 (6.35)	.250 (6.35)	.250 (6.35)	.250 (6.35)	.300 (7.62)	.350 (8.89)	.500 (12.70)
S +/- .020	.100 (2.54)	.200 (5.08)	.100 (2.54)	.200 (5.08)	.250 (6.35)	.200 (5.08)	.200 (5.08)	.200 (5.08)
WD +/- .002	.020 (0.51)	.020 (0.51)	.020 (0.51)	.020 (0.51)	.020 (0.51)	.020 (0.51)	.025 (0.635)	.025 (0.635)
L MIN.	1.00 (25.4)	1.00 (25.4)	1.00 (25.4)	1.00 (25.4)	1.00 (25.4)	1.00 (25.4)	1.00 (25.4)	1.00 (25.4)
P MAX.	.060 (1.50)	.060 (1.50)	.060 (1.50)	.060 (1.50)	.060 (1.50)	.060 (1.50)	.060 (1.50)	.060 (1.50)

Dimensions in inches; bracketed dimensions in millimeters.

NOVACAP RoHS compliant Conformal Coated Radial Leaded parts in small case sizes 0805, 1206, 1210, 1812 and 2225 are offered with bulk pack or Taped form Ref EIA-RS468 suitable for automatic insertion. For further explanation of the C0G and X7R Dielectric Characteristics please refer to page 8-9 of the catalog. X8R Dielectric characteristics can be found on page 31. Additional commercial and high reliability versions in larger case sizes are also available, please refer to pages 46-50 or consult the factory.

CAPACITANCE & VOLTAGE SELECTION

3 digit code: two significant digits, followed by number of zeros eg: 183 = 18,000 pF. R denotes decimal, eg. 2R7 = 2.7 pF

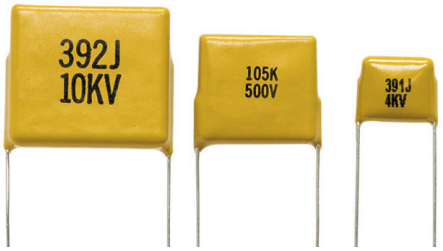
MAX CAP@ VOLTAGE

SIZE	0805			1206			1210			1812			2225		
Min Cap	100	121	121	100	121	221	100	121	331	101	151	221	101	471	102
	C0G	X7R	X8R	C0G	X7R	X8R	C0G	X7R	X8R	C0G	X7R	X8R	C0G	X7R	X8R
50V	•	•	473	•	•	154	•	•	274	•	•	564	•	•	125
100V	•	•	333	•	•	104	•	•	184	•	•	394	•	•	105
250V	152	273	183	392	683	333	822	124	823	223	394	154	473	824	564
500V	821	123	562	182	223	153	472	563	393	123	154	563	273	334	154
1000V	471	272	•	102	682	•	222	153	•	822	473	•	153	104	•
2000V	•	•	•	391	102	•	821	222	•	272	682	•	392	153	•
3000V	•	•	•	•	•	•	•	•	•	122	272	•	182	562	•
4000V	•	•	•	•	•	•	•	•	•	821	122	•	102	152	•
5000V	•	•	•	•	•	•	•	•	•	•	•	•	561	102	•

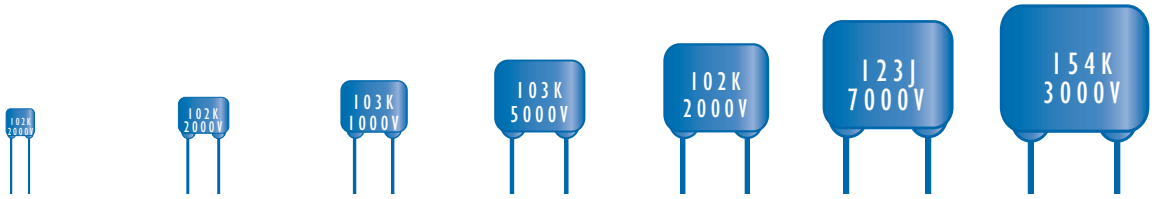
HOW TO ORDER

0805	B	123	K	501	LD	T	R
SIZE See Chart Above	**DIELECTRIC** N = C0G B = X7R S = X8R	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 123 = 12,000pF	**TOLERANCE** J = +/- 5 % K = +/- 10 % M = +/- 20 %	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 501 = 500V	**LEAD CONFIGURATIONS AVAILABLE (See Page 46)** LE = 0805 &1812 LB = 2225 only LD = 0805, 1206, 1210 LR = 1206 only LQ = 1206 only	**PACKAGING** T = Tape & Reel A = Ammo Pack No suffix = Bulk	**RoHS** R = RoHS Compliant

RADIAL LEADED HV - COMMERCIAL



NOVACAP High Voltage Leaded Capacitors are available in COG and X7R characteristics. Conformal coating and lead mounting provide a rugged configuration for optimum performance, with high capacitance efficiency per KV rating. Units are designed for commercial/industrial use to 10 KV, with application in power supply and voltage multiplier circuits. Minimum voltage is 500 Vdc. Higher voltage ratings are available, as well as high reliability versions, with restricted capacitance ranges. Please refer to other NOVACAP literature, or consult the factory.



SIZE	1515	2520	3530	4540	5550	6560	7565
Min Cap(C0G/X7R)	3R0/151	390/102	390/102	390/102	390/102	560/222	101/222
W MAX.	.250 (6.35)	.400 (10.2)	.500 (12.7)	.600 (15.2)	.700 (17.8)	.800 (20.3)	.900 (22.8)
H MAX.	.250 (6.35)	.350 (8.89)	.450 (11.4)	.550 (11.4)	.650 (16.5)	.750 (19.0)	.850 (21.6)
T MAX.	.200 (5.08)	.250 (6.35)	.350 (8.89)	.400 (10.2)	.400 (10.2)	.400 (10.2)	.400 (10.2)
S +/- .030	.170 (4.32)	.280 (7.10)	.380 (9.65)	.480 (12.2)	.580 (14.7)	.680 (17.3)	.780 (19.8)

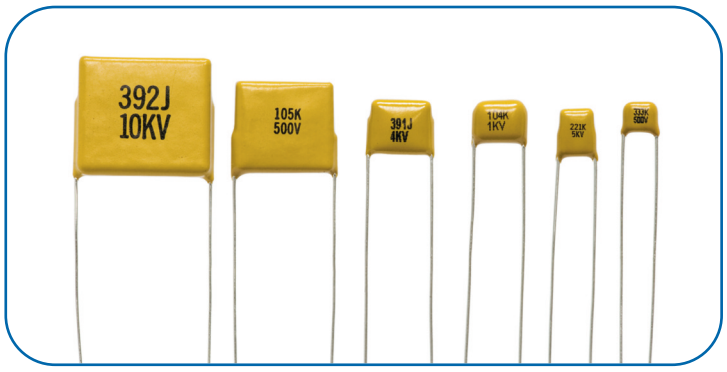
CAPACITANCE & VOLTAGE

3 digit code: two significant digits, followed by number of zeros eg: 183 = 18,000 pF. R denotes decimal, eg. 2R7 = 2.7 pF

MAX CAP@ VOLTAGE

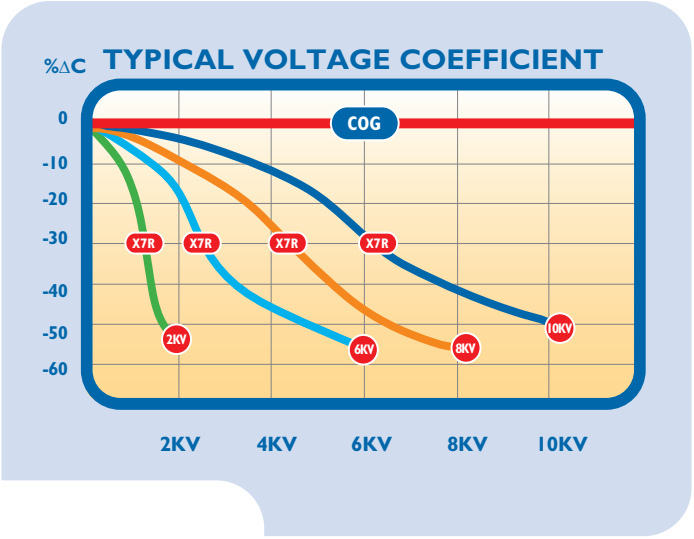
	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R
500V	822	154	393	684	683	105	124	185	184	225	274	335	334	475
600V	682	124	223	394	393	684	823	155	154	225	224	275	274	395
800V	682	823	183	274	333	394	683	824	124	155	184	225	224	275
1000V	562	563	123	184	273	334	563	684	104	105	154	155	184	225
2000V	272	822	562	273	153	683	333	184	473	274	683	394	104	474
3000V	122	332	272	123	103	273	223	683	333	124	473	184	563	224
4000V	681	122	152	472	562	153	123	333	183	473	273	823	393	104
5000V	•	•	102	272	332	103	822	183	123	333	183	473	223	563
6000V	•	•	•	•	182	562	392	123	562	223	103	333	123	393
7000V	•	•	•	•	122	472	272	822	472	153	682	223	822	273
8000V	•	•	•	•	102	332	222	682	332	123	562	153	682	223
9000V	•	•	•	•	•	272	182	472	272	103	392	123	472	183
10000	•	•	•	•	•	182	152	392	222	682	332	103	392	123

Dimensions in inches; bracketed dimensions in millimeters.



COG DIELECTRIC CHARACTERISTICS

OPERATING TEMPERATURE RANGE:	-55°C to 125°C
TEMPERATURE COEFFICIENT:	0 +/- 30 ppm/°C
DISSIPATION FACTOR:	.001 (0.1%) max @ 25°C
INSULATION RESISTANCE, 25°C 125°C	>100GΩ or >1000ΩF >10GΩ or >100 ΩF
DIELECTRIC WITHSTANDING VOLTAGE: *WHICHEVER IS GREATER	120% VDCW, or 750V*
AGING RATE:	0% per decade
TEST PARAMETERS:	1KHz, 1.0 +/- 0.2 VRMS, 25°C 1MHZ for Capacitance <100pF

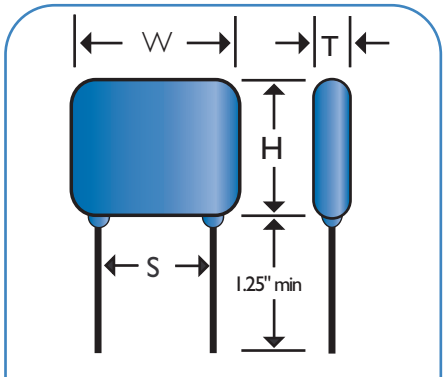


X7R DIELECTRIC CHARACTERISTICS

OPERATING TEMPERATURE RANGE:	-55°C to 125°C
TEMPERATURE COEFFICIENT:	+/-15% ³C Max.
DISSIPATION FACTOR @ 25° C:	.025 (2.5%) max @ 25°C
INSULATION RESISTANCE, 25°C 125°C	>100GΩ or >1000 ΩF >10GΩ or >100 ΩF
DIELECTRIC WITHSTANDING VOLTAGE: *WHICHEVER IS GREATER	120% VDCW, or 750V*
AGING RATE:	< 2.0% per decade
TEST PARAMETERS:	1KHz, 1.0 +/- 0.2 VRMS, 25°C

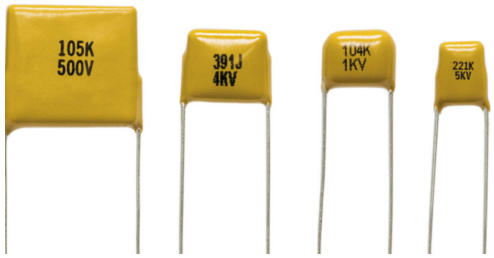
HOW TO ORDER

4540	B	103	K	302	LE	R
SIZE See Chart	**DIELECTRIC** N = COG B = X7R	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 103 = 10,000pF	**TOLERANCE** J = +/- 5 % K = +/- 10 % M = +/- 20 %	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 302 = 3000V	**TERMINALS** LE = Radial Lead with Conformal Coat on chip LO = Radial Lead without Conformal Coat on chip	**ROHS** R = RoHS Compliant

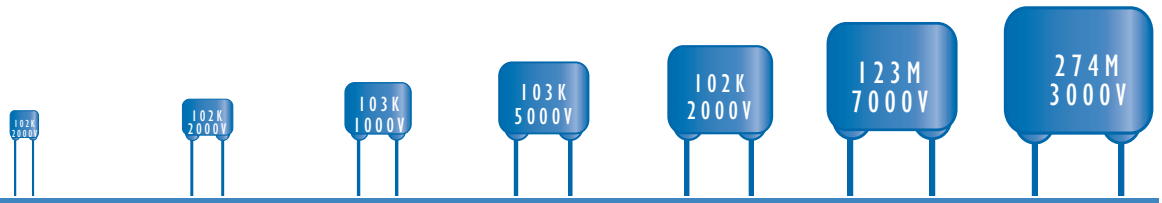


22AWG (.025" Diam)

RADIAL LEADED HV - HIGH RELIABILITY



NOVACAP High Voltage Leaded Capacitors with optimum design and special testing for long term reliability are available in COG and X7R characteristics. Conformal coating and lead mounting provide a rugged configuration for optimum performance. Units may be tested to MIL-PRF-49467 and/or MIL-PRF-39014. Applications include aerospace, airborne and military use for radar, power supplies and voltage multiplier circuits. Higher than cataloged voltage ratings are available. Commercial versions with higher capacitance efficiency per KV are offered, please refer to other NOVACAP literature, or consult the factory.



SIZE	1515	2520	3530	4540	5550	6560	7565
Min Cap(C0G/X7R)	3R0/151	390/102	390/102	390/102	390/102	560/222	101/222
W MAX.	.250 (6.35)	.400 (10.2)	.500 (12.7)	.600 (15.2)	.700 (17.8)	.800 (20.3)	.900 (22.8)
H MAX.	.250 (6.35)	.350 (8.89)	.450 (11.4)	.550 (14.0)	.650 (16.5)	.750 (19.0)	.850 (21.6)
T MAX.	.200 (5.08)	.250 (6.35)	.350 (8.89)	.400 (10.2)	.400 (10.2)	.400 (10.2)	.400 (10.2)
S +/- .030	.170 (4.32)	.280 (7.10)	.380 (9.65)	.480 (12.2)	.580 (14.7)	.680 (17.3)	.780 (19.8)

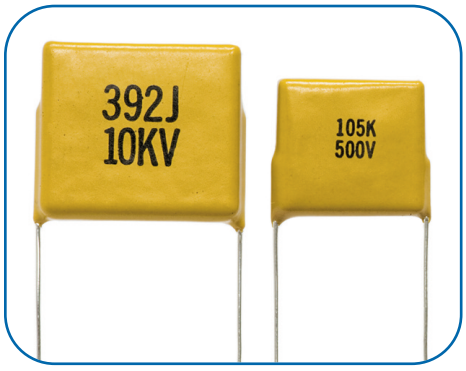
CAPACITANCE & VOLTAGE

3 digit code: two significant digits, followed by number of zeros eg: 183 = 18,000 pF. R denotes decimal, eg. 2R7 = 2.7 pF

MAX CAP® VOLTAGE

	C0G	X7R	C0G	X7R	C0G	X7R	C0G	X7R	C0G	X7R	C0G	X7R	C0G	X7R
500V	682	823	183	274	473	684	823	155	124	185	224	275	274	395
600V	682	563	183	184	393	474	823	824	124	155	184	225	274	275
800V	472	333	123	124	333	334	683	684	104	125	154	185	184	225
1000V	392	183	123	683	273	184	563	474	823	684	124	105	184	125
2000V	122	392	472	153	153	473	273	104	473	184	683	224	823	334
3000V	561	152	222	562	682	223	183	473	273	683	393	104	473	154
4000V	•	•	102	272	272	123	682	223	103	393	153	563	223	823
5000V	•	•	561	182	182	822	472	153	682	273	103	393	123	473
6000V	•	•	•	•	152	562	332	103	472	183	822	273	822	333
7000V	•	•	•	•	821	392	182	682	272	123	392	183	472	273
8000V	•	•	•	•	•	272	122	562	182	103	272	153	392	183
9000V	•	•	•	•	•	•	821	392	122	682	222	123	272	153
10000V	•	•	•	•	•	•	681	332	122	562	182	822	222	123

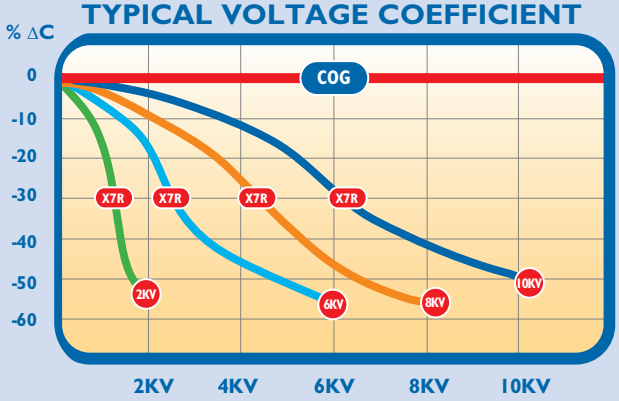
Dimensions in inches; bracketed dimensions in millimeters.



COG DIELECTRIC CHARACTERISTICS

OPERATING TEMPERATURE RANGE:	-55°C to 125°C
TEMPERATURE COEFFICIENT:	0 +/- 30 ppm/°C
DISSIPATION FACTOR:	.001 (0.1%) max @ 25°C
INSULATION RESISTANCE, 25°C 125°C	>100GΩ or >1000ΩF >10GΩ or >100ΩF
DIELECTRIC WITHSTANDING VOLTAGE: *WHICHEVER IS GREATER	120% VDCW, or 750V*
AGING RATE:	0% per decade
TEST PARAMETERS:	1KHz, 1.0 +/- 0.2 VRMS, 25°C 1MHZ for Capacitance < 100pF

TYPICAL VOLTAGE COEFFICIENT

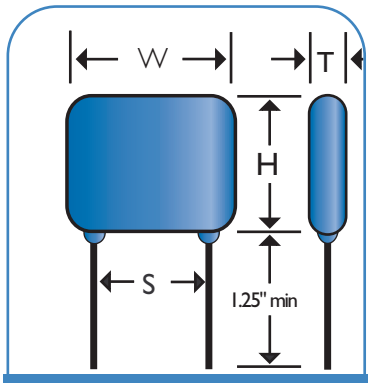


X7R DIELECTRIC CHARACTERISTICS

OPERATING TEMPERATURE RANGE:	-55°C to 125°C
TEMPERATURE COEFFICIENT:	+/-15% ΔC Max.
DISSIPATION FACTOR @ 25° C:	.025 (2.5%) max @ 25°C
INSULATION RESISTANCE, 25°C 125°C	>100GΩ or >1000 ΩF >10GΩ or >100 ΩF
DIELECTRIC WITHSTANDING VOLTAGE: *WHICHEVER IS GREATER	120% VDCW, or 750V*
AGING RATE:	< 2.0% per decade
TEST PARAMETERS:	1KHz, 1.0 +/- 0.2 VRMS, 25°C

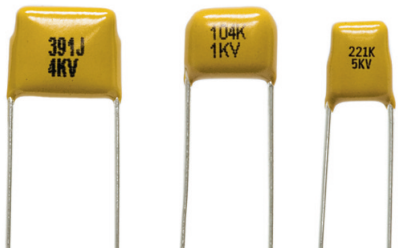
HOW TO ORDER

4540	B	103	K	302	LE	H	R
SIZE See Chart	**DIELECTRIC** N = COG B = X7R	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 103 = 10,000pF	**TOLERANCE** J = +/- 5 % K = +/- 10 % M = +/- 20 %	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 302 = 3000V	**TERMINALS** LE = Radial Lead with Conformal Coat on chip LO = Radial Lead without Conformal Coat on chip	**HIGH RELIABILITY** Specify Testing	**RoHS** R = RoHS Compliant



22AWG (.025" Diam)

DSCC APPROVED - RADIAL LEADED HV



NOVACAP High Voltage leaded capacitors are available in ten DSCC approved specifications. The below referenced DSCC drawing numbers cover the NPO and X7R dielectrics with a voltage rating from 1,000 to 10,000 VDC. Novacap Cage number is 65238. Please refer to our other catalog pages for information about DSCC 87106 stacked capacitor assemblies.

SIZE	1515	2020	2520	3015	3530	4020	4540	5550	6560	9040	11050	13060
W Max	0.250	0.320	0.370	0.450	0.470	0.550	0.570	0.670	0.770	1.050	1.250	1.450
H Max	0.220	0.280	0.300	0.220	0.400	0.280	0.500	0.600	0.720	0.500	0.600	0.720
T Max	0.200	0.250	0.250	0.270*	0.270	0.250	0.270	0.270	0.270	0.270	0.270	0.270
S ± .030"	0.170	0.220	0.275	0.300	0.375	0.400	0.475	0.575	0.675	0.900	1.100	1.300

*Max thickness for 87076 is .200"

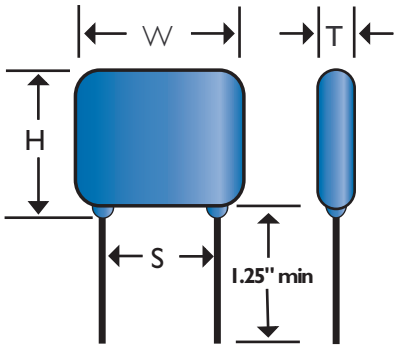
DASH NUMBERS

DSCC#	VOLT	1515	2020	2520	3015	3530	4020	4540	5550	6560	9040	11050	13060
87043	1000	01-50	51-58	59-60		61-70		71-78	79-84	85-90			
87046	1000	01-50	51-56	57-58		59-66		67-74	75-80	81-84			
87040	2000	01-40	41-46	47-50		51-60		61-66	67-70	71-74		75-78	79-82
87047	3000		01-38	39-42		43-54		55-62	63-64	65-68		69-70	71-75
87114	3000		01-44	45-46		47-54		55-64	65-68	69-72			
87076	4000				01-24	25-50		51-58	59-62	63-64			65-70
89044	4000				01-24	25-46		47-50	51-54	55-60		61-62	63-68
87070	5000						01-24	25-46	47-50	51-54	55-58	59-60	61-62
87077	5000						01-40		41-58	59-60			61-68
87081	10000										01-22	23-26	27-34

ORDERING INFORMATION

The purchase order or contract must specify the following:

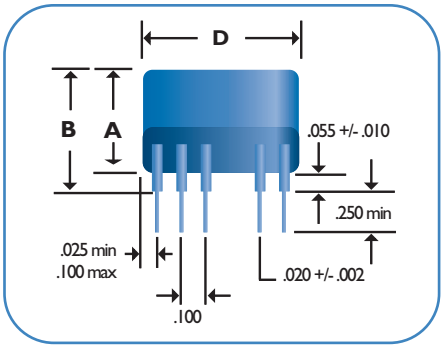
1) The Complete DSCC part number
   Drawing Number - Dash Number
   8XXXX - XX
   Example: 87043-47
2) Whether you want Novacap to perform the Group B Test, or provide a certification of compliance for Group B requirements.
3) Specify requirements for packaging.

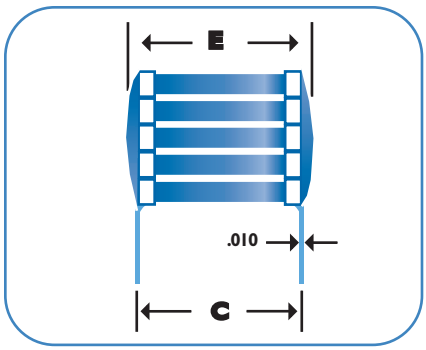


DSCC 87106 - CAPACITOR ASSEMBLIES

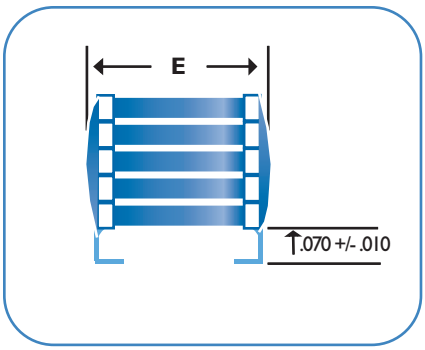
NOVACAP "SWITCH'M" leaded capacitors are available in three approved DSCC 87106 case codes sizes. The below referenced DSCC dash numbers show Novacap's approved range. Please refer to the previous catalog page for information about the DSCC high voltage radial leaded product. Novacap Vendor CAGE Number is 65238.

LEAD CONFIGURATION AND ASSEMBLY OPTIONS





LEAD STYLE N



LEAD STYLE J

87106 Dash #	Voltage	Lead Type	Dash # by Case Code			Cap Value by Case Code		
			5	4	3	5	4	3
001-040	50	N	001-020	021-028	029-040	105-565	825-156	186-476
055-092	100	N	055-072	073-082	083-092	684-335	395-825	126-276
113-148	200	N	113-126	127-136	137-148	474-155	185-395	475-126
173-208	500	N	173-190	191-198	199-208	154-684	105-185	275-565
222-223	50	N		222-223			685	
229-230	100	N			229-230			106
231-232	500	N		231-232			824	
233-234	500	N			233-234			225
241-282	50	J	241-260	261-270	271-282	105-565	685-156	186-476
301-340	100	J	301-318	319-328	329-340	684-335	395-825	106-276
361-396	200	J	361-374	375-384	385-396	474-155	185-395	475-126
421-460	500	J	421-438	439-448	449-460	154-684	824-185	225-565

ORDERING INFORMATION

The purchase order or contract must specify the following:

1) The Complete DSCC part number
Drawing Number - Dash Number
87106 - XXX
Example: 87106-222

2) Whether you want Novacap to perform the Group B test, or provide a certification of compliance for Group B requirements.

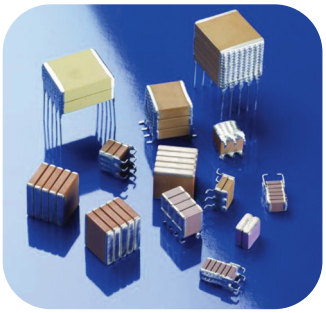
3) Specify requirements for packaging.

DIMENSIONS - INCHES

CASE CODE			
Dimension	3	4	5
C +/- .025	0.450	0.400	0.250
D (Min.)	0.950	0.350	0.224
D (Max.)	1.075	0.425	0.275
E (Max.)	0.500	0.440	0.300
Leads/side	10	4	3

See DSCC 87106 for A and B dimensions

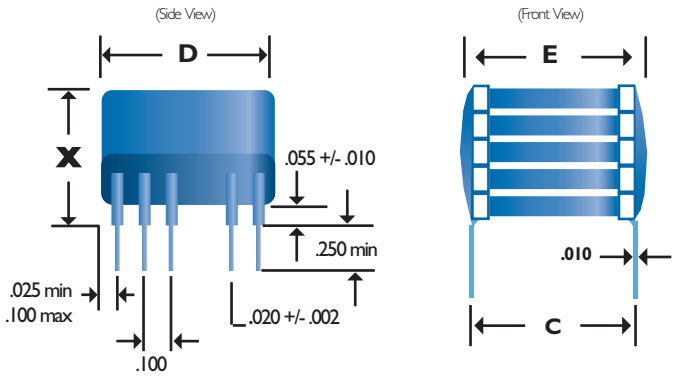
ST AND SM - CAPACITOR ASSEMBLIES



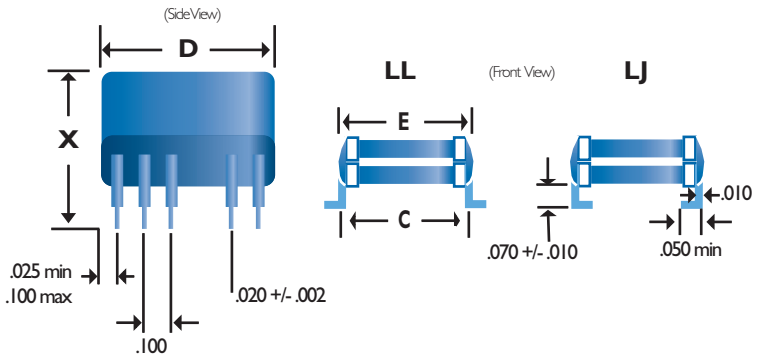
NOVACAP capacitor assemblies with low equivalent series resistance (ESR) and low equivalent series inductance (ESL) are available in dielectric characteristics COG and X7R available for use in high power or high frequency applications, as replacement for tantalums and aluminum electrolytics. The leaded configurations safeguard the device against thermal and mechanical stresses, and include thru-hole and surface mount J and L style leads, bonded with high temperature solder. Applications include input and output filters in switch mode power supplies, high capacitance discharge circuits, and high temperature filtering/decoupling. Other sizes and voltage ratings than indicated in the tables are available, consult NOVACAP.

LEAD CONFIGURATION AND ASSEMBLY OPTIONS

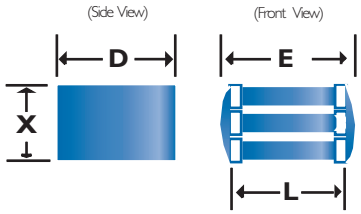
LN (straight wire leads)



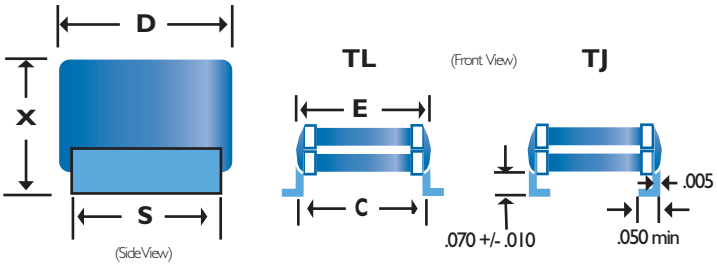
LJ & LL (bent wire leads)



NN or NP (no leads)



TJ & TL (tab leads)



DIMENSIONS

SIZE	1812	1825	2225	3640	4540	5550	7565
C +/- .025	.210 (5.33)	.210 (5.33)	.250 (6.35)	.400 (10.2)	.480 (12.2)	.580 (14.7)	.780 (19.8)
D +/- .025	.125 (3.18)	.250 (6.35)	.250 (6.35)	.400 (10.2)	.400 (10.2)	.500 (12.7)	.650* (16.5)
E (MAXIMUM)	.260 (6.60)	.260 (6.60)	.300 (7.62)	.430 (10.9)	.530 (13.5)	.630 (16.0)	.830 (21.1)
X (MAXIMUM)	.600 (15.2)	.600 (15.2)	.715 (18.2)	.715 (18.2)	.715 (18.2)	.715 (18.2)	.715 (18.2)
L (NOMINAL)	.180 (4.57)	.180 (4.57)	.220 (5.59)	.360 (9.14)	.450 (11.4)	.550 (14.0)	.750 (19.1)
LEADS/SIDE	N/A	3	3	4	4	5	6

Dimensions in inches; bracketed dimensions in millimeters

* +/- .035". Contact the factory for RoHS compliant product.

ST AND SM - CAPACITOR ASSEMBLIES

The ST series provide the highest capacitance available, based on chip designs for general purpose use. The assemblies are 100% tested for Dielectric Withstanding Voltage, Insulation Resistance, Capacitance, and Dissipation Factor.

The SM series are designed and tested for high reliability military and industrial applications. The parts are tested per Group A of MIL-PRF-49470 (DSCC 87106). NOVACAP has a complete testing facility. Please contact the factory for any additional military testing requirements.

"ST" SERIES (GENERAL PURPOSE)

MAXIMUM CAPACITANCE (FULL STACK OF 5 CHIPS) & VOLTAGE SELECTION

3 digit code: two significant digits, followed by number of zeros eg: 273 = 27,000 pF

SIZE	1812		1825		2225		3640		4540		5550		7565	
	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R
50V	154	395	334	685	394	825	105	226	125	276	185	396	275	686
100V	124	335	274	565	334	685	824	156	105	186	125	226	225	396
200V	104	225	224	395	274	475	564	825	684	106	824	156	155	276
500V	393	474	823	105	104	155	224	225	224	275	334	335	684	565

"SM" SERIES (HIGH RELIABILITY)

MAXIMUM CAPACITANCE (FULL STACK OF 5 CHIPS) & VOLTAGE SELECTION

3 digit code: two significant digits, followed by number of zeros eg: 273 = 27,000 pF

SIZE	1812		1825		2225		3640		4540		5550		7565	
	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R
50V	154	335	334	565	394	825	105	186	105	226	125	336	275	566
100V	124	275	274	475	334	685	824	126	824	126	105	186	225	336
200V	104	155	224	275	274	395	474	685	564	825	684	126	155	226
500V	223	274	473	564	563	824	154	185	184	225	224	275	474	475

HOW TO ORDER

ST	3640	B	156	K	101	LJ	X	W	5
STYLE ST = General Purpose SM = High Reliability	**SIZE** See Chart	**DIELECTRIC** N = COG B = X7R	**CAPACITANCE** Value in Picofarads Two significant figures, followed by number of zeros: 825=8,200,000 pF (8.2mF)	**TOLERANCE** F = +/- 1.0 % G = +/- 2.0 % H = +/- 3.0 % COG J = +/- 5.0 % K = +/- 10 % M= +/- 20 % Z = +80% -20% P = +100% -0%	**VOLTAGE-VDCW** Two significant figures, followed by number of zeros: 101 = 100V	**LEAD STYLE** LN = Straight LL = L Lead LJ = J Lead TL = L Tab TJ = J Tab NN = Nickel NP = Pd/Ag (1812: no LN LJ or LL)	**THICKNESS OPTION** Specify Standoff dimension (X) if less than max.	**PACKING OPTION** W=Waffle T=Reeled * * Consult Factory for Availability	**NUMBER OF CHIPS**

For complete detail of stacked parts refer to Novacap ST and SM Capacitor Assembly Catalog at www.novacap.com/capassemblies.php

APPLICATION SPECIFIC

NOVACAP excels at application specific ceramic capacitor solutions for unique applications. We possess a full machine shop that affords the customer with quick development times and lower NRE charges. We have extensive tooling and screens for a wide variety of sizes other than EIA and what is listed in this catalog. NOVACAP's R&D and Engineering Departments have extensive industry experience to provide a solution for your application. Please consult the factory with your specific requirements.

ARC PREVENTION CAPACITORS

NOVACAP has a proprietary coating process that can be applied to eliminate arcing in High Voltage capacitors in smaller case sizes.

(Patent # 6,627,509)

LOW ESL & ESR CAPACITORS

ESL & ESR capacitors (sizes 0612, 0810 and 1214) reduce current paths and resistance which lower ESR and ESL for improved performance in high speed de-coupling.

SPECIALTY FEED THRU CAPACITORS

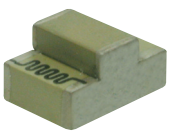
Feed Thru/High Current units for pacemaker/defibrillator applications. These units provide signal conduits through openings while suppressing EMI and RFI interference. Manufactured to customer SCD.

(Patent #'s 5,825,608 & 6,058,004)

MULTIPLE COMPONENT MODULES

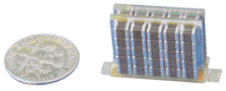
NOVACAP can design and integrate various components to create a single unique multiple component module.

INTEGRATED BLEED RESISTOR ASSEMBLY



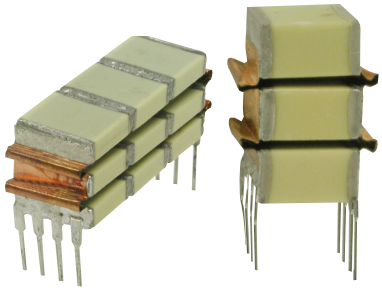
Screen-printing of bleed resistors on capacitors is available for safety in detonation circuits.

HIGH CAPACITANCE CAPACITOR ARRAY



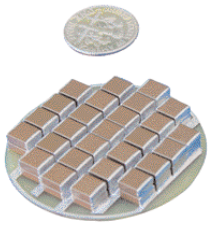
Designed to maximize board space in building block modular form. Ideal for high capacitance energy storage and filtering.

STRESS RELIEF CAPACITOR ASSEMBLIES



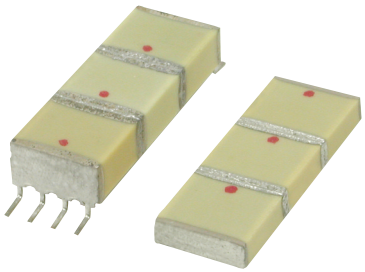
A flexible copper ribbon specially designed for stress relief in high current discharge circuits.

LOW PROFILE CAPACITOR ARRAY



Specifically designed to offer high capacitance value in modular form for single component installation.

CAPACITOR ASSEMBLIES



NOVACAP is capable of soldering capacitors in series, parallel, or series-parallel arrangements for custom capacitor applications.

FREE FORM CAPACITORS

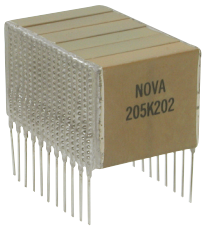
The Free Form capacitor allows any size geometry and shape for utilization in custom fit applications.

(Patent # 6,453,527)

VERTICAL MOUNT CAPACITOR

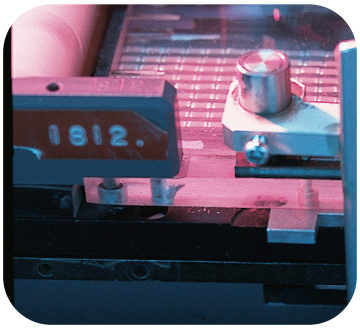
A vertical surface mount of a single large capacitor using specially designed and developed leads to allow for board space savings.

VERTICAL CAPACITOR ASSEMBLIES



NOVACAP is capable of stacking capacitors on the side for applications of limited height.

CHIP MARKING SYSTEM



NOVACAP chip identification marking is accomplished using an excimer laser which does not degrade the ceramic surface or induce microcracks. The marking code is based on EIA 198 two digit code which determines capacitance value. Laser marking is available for chip sizes 0805 through 2628. Other sizes require special request to determine if applicable. Ink marking is available for chips larger than 2628, or for leaded encapsulated devices. Marking is an option, specify using the letter M in the part number code, as shown below.

MARKING CODE

Value in picofarads for alpha-numeric code

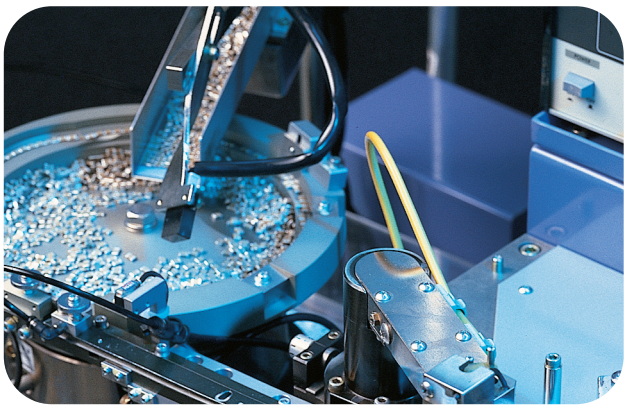
LETTER	0	1	2	3	4	5	6	7
A	1.0	10	100	1,000	10,000	100,000	1,000,000	10,000,000
B	1.1	11	110	1,100	11,000	110,000	1,100,000	11,000,000
C	1.2	12	120	1,200	12,000	120,000	1,200,000	12,000,000
D	1.3	13	130	1,300	13,000	130,000	1,300,000	13,000,000
E	1.5	15	150	1,500	15,000	150,000	1,500,000	15,000,000
F	1.6	16	160	1,600	16,000	160,000	1,600,000	16,000,000
G	1.8	18	180	1,800	18,000	180,000	1,800,000	18,000,000
H	2.0	20	200	2,000	20,000	200,000	2,000,000	20,000,000
J	2.2	22	220	2,200	22,000	220,000	2,200,000	22,000,000
K	2.4	24	240	2,400	24,000	240,000	2,400,000	24,000,000
L	2.7	27	270	2,700	27,000	270,000	2,700,000	27,000,000
M	3.0	30	300	3,000	30,000	300,000	3,000,000	30,000,000
N	3.3	33	330	3,300	33,000	330,000	3,300,000	33,000,000
P	3.6	36	360	3,600	36,000	360,000	3,600,000	36,000,000
Q	3.9	39	390	3,900	39,000	390,000	3,900,000	39,000,000
R	4.3	43	430	4,300	43,000	430,000	4,300,000	43,000,000
S	4.7	47	470	4,700	47,000	470,000	4,700,000	47,000,000
T	5.1	51	510	5,100	51,000	510,000	5,100,000	51,000,000
U	5.6	56	560	5,600	56,000	560,000	5,600,000	56,000,000
V	6.2	62	620	6,200	62,000	620,000	6,200,000	62,000,000
W	6.8	68	680	6,800	68,000	680,000	6,800,000	68,000,000
X	7.5	75	750	7,500	75,000	750,000	7,500,000	75,000,000
Y	8.2	82	820	8,200	82,000	820,000	8,200,000	82,000,000
Z	9.1	91	910	9,100	91,000	910,000	9,100,000	91,000,000
a	2.5	25	250	2,500	25,000	250,000	2,500,000	25,000,000
b	3.5	35	350	3,500	35,000	350,000	3,500,000	35,000,000
d	4.0	40	400	4,000	40,000	400,000	4,000,000	40,000,000
e	4.5	45	450	4,500	45,000	450,000	4,500,000	45,000,000
f	5.0	50	500	5,000	50,000	500,000	5,000,000	50,000,000
m	6.0	60	600	6,000	60,000	600,000	6,000,000	60,000,000
n	7.0	70	700	7,000	70,000	700,000	7,000,000	70,000,000
t	8.0	80	800	8,000	80,000	800,000	8,000,000	80,000,000
y	9.0	90	900	9,000	90,000	900,000	9,000,000	90,000,000

A5

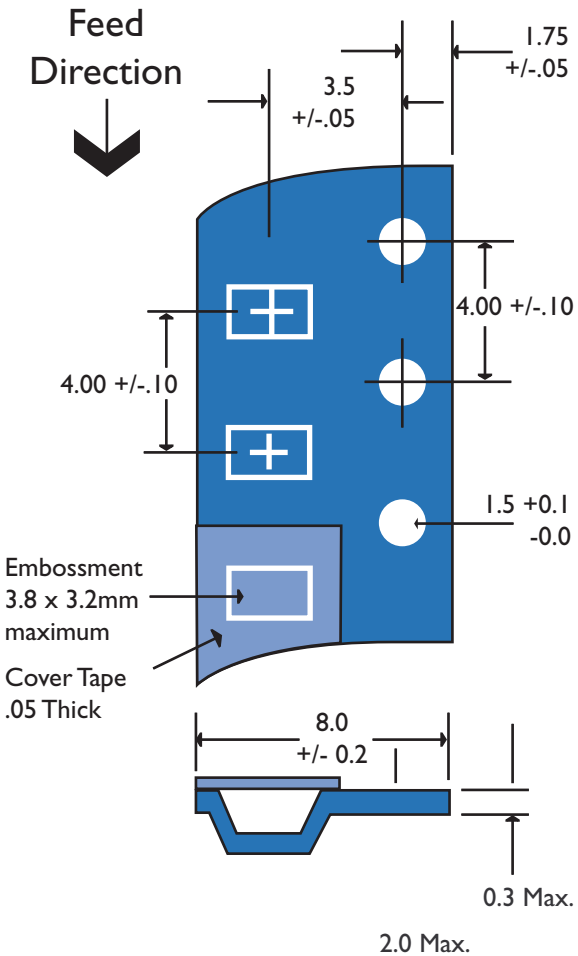
Two position alpha numeric marking is available on chip sizes 0805 through 2628. The marking denotes retma value and significant figures of capacitance (see table) eg: A5 = 100,000 pF

NA5

Three position alpha numeric marking is available on chip sizes 1206 and larger, denoting NOVACAP as vendor (N), followed by the standard two digit alpha numeric identification.



NOVACAP chip capacitors are available packaged in 8mm to 24mm embossed carrier, per EIA RS 481. Specify the reeled option (T) in the NOVACAP part number code. Chips are also supplied in bulk or waffle pack.



Dimensions for 8mm tape. Dimensions with max. tolorance are dependent on component size.

UNITS PER REEL (TYPICAL)

CHIP SIZE	TAPE WIDTH	UNITS PER REEL* 7" Diam.	13" Diam.
0402	8 mm	10000	•
0504	8 mm	3000-4000	15000
0603	8 mm	3000-4000	15000
0805	8 mm	3000-4000	15000
1005	8 mm	2000-4000	15000
1206	8 mm	2000-4000	15000
1210	8 mm	2000-3000	10000
1505	12 mm	2000-3000	10000
1808	12 mm	2000-3000	10000
1812	12 mm	1000	10000
1825	12 mm	1000	5000
2221	12 mm	1000	5000
2225	12 mm	1000	5000
2628	16 mm	•	1000
3333	16 mm	•	1000
3530	16 mm	•	1000
4040	16 mm	•	1000

Quantity per reel varies with chip thickness. Thicker chips (typically higher capacitance values) will result in lesser quantities.

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