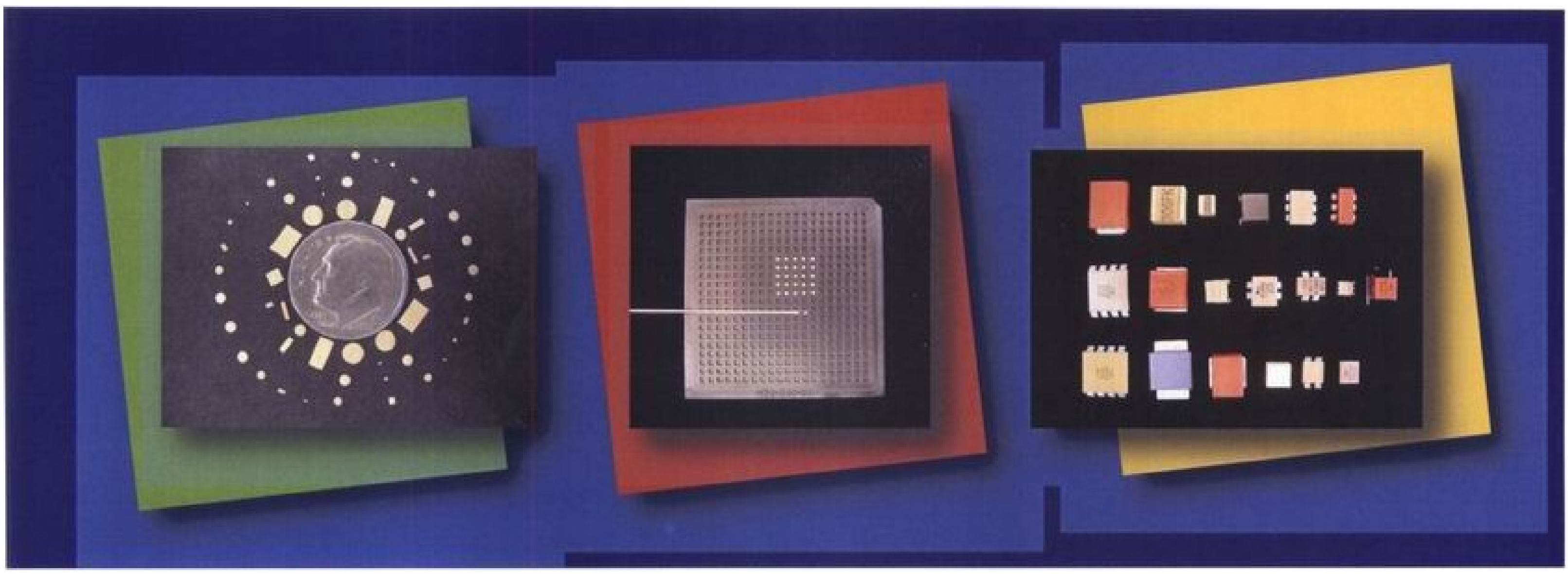
Wright Capacitors, Inc.

Excellence...



Personified

ISO 9001
10000569

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Our People...

Our Policy...

WRIGHT CAPACITORS, INC. endlessly strives to meet or exceed customer requirements through continual improvement of our quality management system and application of our philosophy of building quality into our products.

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Our Purpose...

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HISTORY

Wright Capacitors, Inc. an ISO 9001 registered firm, was founded in 1977 by Curtiss C. Wright. The establishment of Wright Capacitors is attributed to the prodding by several companies frustrated in finding a source for high voltage and custom ceramic capacitors, an area of expertise for Mr. Wright. In 1982 Casey Crandall was enlisted by Curtiss Wright to join the company. Crandall's vision and ingenuity flourished and a buy-sell agreement was penned in 1984.

Since the beginning, ***WCI*** has been a small “hand” operation servicing a limited niche market for custom designed ceramic capacitors. Business has continued to expand and service over 100 accounts including most major OEM's, US Government, Military and NASA. You will find WCI parts in the Hubble, Shuttle, Space Station and many satellites including Voyager I. Voyager I is now beyond our Solar system and still transmitting data!

With over three and a half decades of service, our strong military, space, commercial and High Temperature 200°C down-hole logging business gives testimony to our long term investment in emerging fields. WCI emphasis and expertise in R&D and small quantity prototyping continues to lead to large volume and long term programs.

PRODUCT SUMMARY

Wright Capacitors, Inc. is a small (e<20) manufacturer of specialized multi-layer and single-layer ceramic capacitors and capacitor assemblies. Capacitors are electronic components that store, filter, and regulate electrical energy and current flow, and are one of the essential passive components used on circuit boards. These products are used in diversified markets within the electronics industry. Virtually all electronic applications and products contain capacitors; including communication systems, data processing equipment, personal computers, cellular phones, military and aerospace systems, and consumer electronics. WCI products are used in telecommunications, test and measurement, industrial controls; and, most heavily in power supplies and detonation fuzing for military, Hi-Rel space, and high temperature oil exploration.

Our hand oriented, custom build-to-order capabilities, along with our personal attention, fast responses, quality, reputation, unparalleled technical expertise and willingness to “do anything that can be done” fills a need for prototype and small quantities that can not be fulfilled by high volume commodity manufacturers. This is “***Excellence Personified”!*** Product lines include the microwave industry where we manufacture single-layer capacitors as small as .010” square. Custom designed high voltage capacitor assemblies represent the majority of sales, with new products constantly being developed to suit customer requirements.

MATERIAL SPECIFICATIONS

All products meet or exceed the following:

MECHANICAL

Dimensions and Configurations: As shown on product sheet.

Case: "C" P/N Conformal Epoxy Coating, "P" P/N RTV or Epoxy potted in a Diallyl Phthalate fiberglass, or vectra shells.

Lead Material: Ni or Sn plated copper. Dimensions as specified; 22 or 24 AWG Standard.

ELECTRICAL

Voltage Rating: as shown on product sheet.
Operating Temperature Range: Class I and II: -55° to +125°C (higher temperature to 300°C available)
Class III: Z5U +10° to 85°C.

Temperature Characteristics: Method 302

NPO: +30ppm/°C
N2200: 2200ppm/°C
X7R: ±15%
Z5U: +22%, -56%
Y5V: +22%, -82%

Voltage Characteristics:

Class I: 0%

Class II: BR= +15%, -40% with rated voltage

BZ= +15%, -45% at 60% rated voltage.

Class III: see performance curves.

Capacitance: Per MIL-STD-202, Method 305 @ 25° NPO>100pF @1MHz, 1.2 VRMS Max

NPO<100pF & X7R @ 1 KHz, 1.0 + .2 VRMS Class III @ 1 KHz and .5 VRMS

ENVIRONMENTAL (Non-Standard Testing)

Thermal Shock: Method 107 of MIL-STD-202 and MI L-PRF-49467

Voltage Conditioning: 96 Hours minimum at 125°C per MIL- PRF-49467

Low Temperature Storage: 8 hours at -65°C

Solderability: MIL-STD-202, Method 208 except Sn 62 for chips

Voltage Temperature Characteristic: Per para 4.8.10, MIL- PRF-49467

Vibration (High Frequency): Method 204 of MIL-STD202, Condition D (20 G's)

Immersion Cycling: Method 104 of MIL-STD-202, Test Condition B

Shock: Method 213 of MIL-STD-202, Test Condition 1 (100 G's)

Terminal Strength: Method 211 per MIL-STD-202, Test Condition A (5 lbs.)

Resistance to Solder Heat: Method 210 of MIL-STD-202, Test Condition C and MIL-PRF-49467

Moisture Resistance: Method 106 of MIL-STD-202 and MIL-PRF-49467

Terminal Strength: Per MIL-STD-202, Method 211, Test Condition A.

Marking: Per MIL-STD-1 285, depending on space available in the following order of preference: manufacturer I.D. (WCI), capacitance and tolerance, voltage, lot number, size or part number.

Dissipation Factor: @ 25°C

Class I: .15% max

Class II: 2.5% max

Class III: 3.0% max

Insulation Resistance: Per MIL-STD-202

Class I & II lesser of 100KmΩ /1000mΩ-μF @125°C, lesser of 10KmΩ /100mΩ-μF

Class III: lesser of 10KmΩ /100mΩ-μF@125°C, lesser of 1KmΩ / 10mΩ-μF

Dielectric Withstanding Voltage (Flash Test): Per

MIL-STD-202, Method 301, 5sec, <10mA

<500 VDC: 250% rated voltage

500 VDC to 1KV: 150% rated voltage

> 1KV: 120% rated voltage- to be tested in

a non-corrosive fluid.

Body Insulation: 1000VDC per MIL-PRF-49467

Fungus: Method 508 of MIL-STD-202

Resistance to Solvents: Method 215 of MIL-STD-202

Life Test: Class I and II @ 125°C, Class III @ 85°C per MIL-PRF-49467 Para 4.8.18

Group A: As required by contract or specification (MIL-PRF-49467 STD)
Group B: As required by contract or specification (MIL-PRF-49467 STD)
Barometric Pressure: MIL-STD-202, Method 106, Condition E. Other testing available, consult factory.

Partial Discharge (if required): (Corona) per MIL-PRF-49467

Reference Documents: MIL-PRF-49467 -Leaded

MIL-PRF-55681 -Chips

MIL-STD-202 -Testing

EIA RS469 - Ceramic Capacitor.

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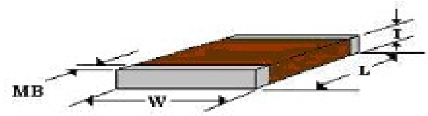
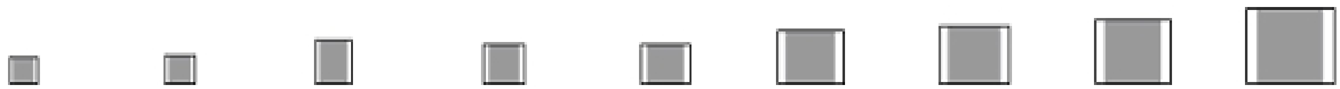
CLASS I DIELECTRIC (NPO & N2200)





SIZE	1210	1515	1825	2020	2520	2725	3530	3735	4540
LENGTH-NOM	0.120	0.150	0.180	0.200	0.250	0.270	0.360	0.370	0.450
WIDTH-NOM	0.100	0.150	0.250	0.200	0.200	0.250	0.310	0.350	0.400
THICK-MAX	0.150	0.150	0.200	0.200	0.250	0.250	0.250	0.250	0.250

Dimensions are +/- 5% length and width or .015", whichever is greater. **MB= .005"/.040"**

SIZE	1210C	1515C	1825C	2020C	2520C	2725C	3530C	3735C	4540C
LENGTH-NOM	0.200	0.270	0.300	0.320	0.400	0.400	0.470	0.500	0.570
WIDTH-NOM	0.200	0.250	0.350	0.300	0.300	0.330	0.400	0.420	0.500
THICK-MAX	0.250	0.250	0.300	0.350	0.350	0.350	0.350	0.350	0.350
LEAD SPACING	0.100	0.170	0.200	0.220	0.275	0.300	0.375	0.400	0.475

Dimensions are +/- 5% length and width or .015", whichever is greater.
Lead Spacing +/- .030"

SIZE	1210		1515		1825		2020		2520		2725		3530		3735		4540	
WVDC	NPO	R	NPO	R	NPO	R	NPO	R	NPO	R	NPO	R	NPO	R	NPO	R	NPO	R
500V	222	682	392	123	103	333	822	273	682	223	822	273	183	563	273	823	393	124
1000V	102	332	222	682	472	153	392	123	332	103	392	123	103	333	123	393	223	683
2000V	681	222	102	332	272	103	222	682	182	562	222	682	562	183	822	273	123	393
3000V			331	102	102	332	821	272	681	222	821	272	222	682	332	103	562	183
4000V							561	182	471	152	561	182	152	472	222	682	332	103
5000V							391	122	271	102	391	122	102	332	122	392	222	682
7000V													561	182	681	222	152	472
10000V													331	102	471	152	821	272

Notes:
1) Class I Dielectrics are stable, non-ferroelectric materials. See performance specification.
2) WCI offers Industry, Space, and Military standard package series for the 2520 (2725) through 6560 (6864) devices. The major difference is the nominal lead spacing with the military based on .X75" nominal and the industry on .X00" nominal (i.e. .275"vs .300").
3) Chips larger than 2520 are extremely susceptible to thermal shock and expansion mismatch cracking. They are not recommended for any direct surface mount applications without tabs or leads for stress relief. See Surface Mount section.
4) Voltage ratings are based on .1 minimum lead spacing per 1KV of voltage. Capacitance values listed for voltage ratings higher than this are intended for use in circuits that are potted, run in a dielectric fluid, or otherwise protected from the atmosphere.
5) Higher voltages, capacitances, dielectric types, and chip sizes or lead configurations are available; please consult the factory.

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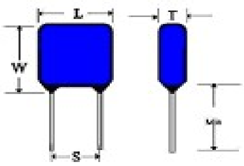
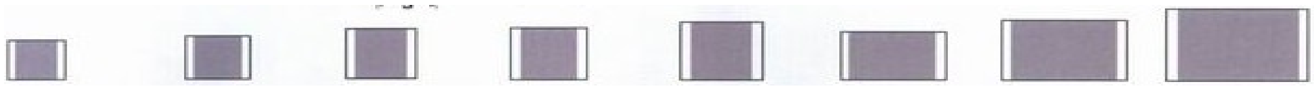
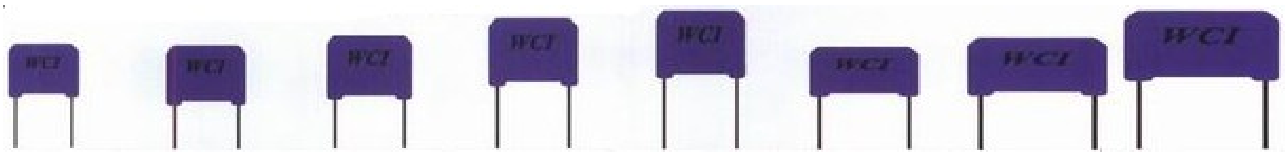
CLASS I DIELECTRIC (NPO & N2200)





SIZE	4745	5550	5755	6560	6864	8840	11050	13060
LENGTH-NOM	0.470	0.560	0.570	0.660	0.680	0.880	1.100	1.300
WIDTH-NOM	0.450	0.520	0.540	0.620	0.640	0.400	0.510	0.630
THICK-MAX	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250

Dimensions are +/- 5% length and width or .015", whichever is greater. **MB= .005"/.040"**



SIZE	4745C	5550C	5755C	6560C	6864C	8840C	11050C	13060C
LENGTH-NOM	0.570	0.670	0.700	0.770	0.770	1.000	1.220	1.420
WIDTH-NOM	0.550	0.600	0.650	0.720	0.750	0.500	0.600	0.720
THICK-MAX	0.350	0.350	0.350	0.350	0.350	0.350	0.350	0.350
LEAD SPACING	0.500	0.575	0.600	0.675	0.700	0.900	1.100	1.300

Dimensions are +/- 5% length and width or .015", whichever is greater.
Lead Spacing +/- .030"

SIZE	4745		5550		5755		6560		6864		8840		11050		13060	
WVDC	NPO	R	NPO	R	NPO	R	NPO	R	NPO	R	NPO	R	NPO	R	NPO	R
500V	473	154	563	184	683	224	823	274	104	334						
1000V	273	823	333	124	393	154	473	154	563	184						
2000V	153	473	223	683	273	823	333	104	393	124						
3000V	682	273	822	273	103	333	123	393	153	473						
4000V	472	153	562	183	682	183	882	223	103	273	392	123	822	273	123	393
5000V	272	822	332	103	392	123	472	153	562	183	272	103	562	223	682	273
7000V	182	472	222	562	272	682	332	822	392	103	152	562	332	123	472	183
10000V	821	272	102	332	102	332	122	392	122	392	681	272	152	562	182	682

Ordering Information:	WC	(N)	2725	C*	X	102	M	D	501
*** All "C" conformal coated devices can be ordered with High Temperature 200°C by specifying HiTemp for the N-non standard.** Contact office.	Wright Cap MLC's	(Optional) Insert **N** for Non-Standard Requirements, Processing, or Group A or B Screening	Chip Size	**C**=Conformal coat with radial lead **L**=Leaded only **P**=Potted Case **DELETE FOR CHIP CAP**	Dielectric Material **N**=NPO **R**=N2200	Capacitance Value Code In cap. Code i.e. 102=1000pF	Tolerance J=±5% K=±10% M=±20% Z=+80% -20% V=+100% A=±.5% B=±.1pF F=±.1% G=±2%	Termination Type A=Ag D=PdAg N=Ni	Voltage i.e.501=500V

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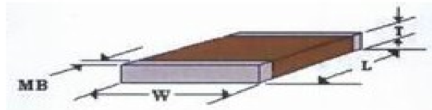
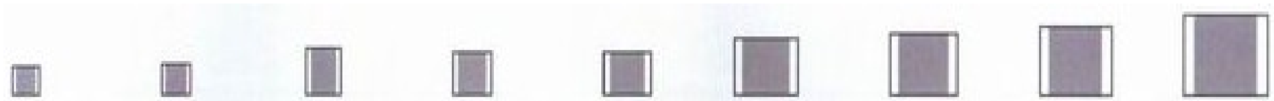
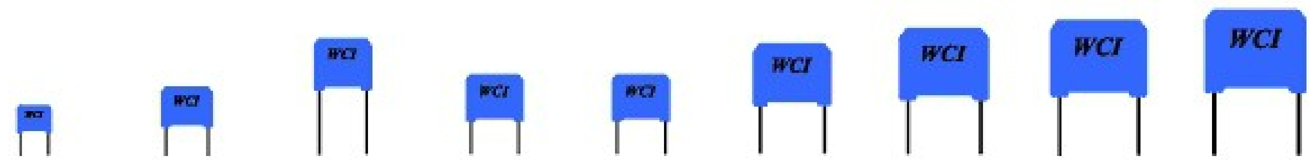
CLASS II DIELECTRIC (BR & BZ)





SIZE	1210	1515	1825	2020	2520	2725	3530	3735	4540
LENGTH-NOM	0.120	0.150	0.180	0.200	0.250	0.270	0.360	0.370	0.450
WIDTH-NOM	0.100	0.150	0.250	0.200	0.200	0.250	0.310	0.350	0.400
THICK-MAX	0.150	0.150	0.200	0.200	0.250	0.250	0.250	0.250	0.250

Dimensions are +/- 5% length and width or .015", whichever is greater. **MB= .005"/.040"**



SIZE	1210C	1515C	1825C	2020C	2520C	2725C	3530C	3725C	4540C
LENGTH-NOM	0.200	0.270	0.300	0.320	0.400	0.400	0.470	0.500	0.570
WIDTH-NOM	0.200	0.250	0.350	0.300	0.300	0.330	0.400	0.420	0.500
THICK-MAX	0.250	0.250	0.300	0.350	0.350	0.350	0.350	0.350	0.350
LEAD SPACING	0.100	0.170	0.200	0.220	0.275	0.300	0.375	0.400	0.475

Dimensions are +/- 5% length and width or .015", whichever is greater.
Lead Spacing +/- .030"

SIZE	1210		1515		1825		2020		2520		2725		3530		3735		4540	
WVDC	BR	BZ	BR	BZ	BR	BZ	BR	BZ	BR	BZ	BR	BZ	BR	BZ	BR	BZ	BR	BZ
500V	273	473	473	154	154	474	823	224	683	564	104		224	824	274		564	155
1000V	562	153	153	333	683	154	473	124	393	104	563		124	224	184		254	564
2000V	102	272	472	562	223	273	153	223	123	223	183		393	563	473		683	154
3000V			122	182	822	103	562	822	472	103	682		153	223	183		273	563
4000V							152	222	122	392	182		562	123	682		153	273
5000V							122	152	102	222	152		472	822	562		103	153
7000V													222	392	272		392	682
10000V													821	152	122		182	332

Notes:

1) Class II Dielectrics differ in voltage coefficient as defined in MIL-PRF-49467. See performance specification.
2) WCI offers Industry, Space, and Military standard package series for the 2520 (2725) through 6560 (6864) devices. The major difference is the nominal lead spacing with the military based on .X75" nominal and the industry on .X00" nominal (i.e. .275"vs .300").
3) Chips larger than 2520 are extremely susceptible to thermal shock and expansion mismatch cracking. They are not recommended for any direct surface mount applications without tabs or leads for stress relief. See Surface Mount section.
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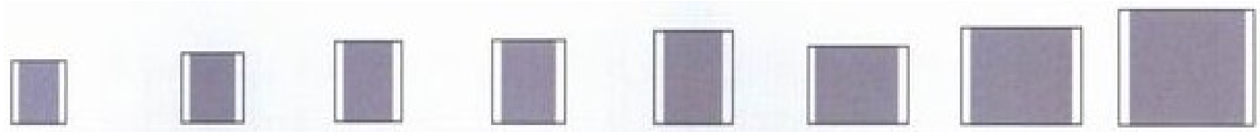
CLASS II DIELECTRIC (BR & BZ)



SIZE	4745	5550	5755	6560	6864	8840	11050	13060
LENGTH-NOM	0.470	0.560	0.570	0.660	0.680	0.880	1.100	1.300
WIDTH-NOM	0.450	0.520	0.540	0.620	0.640	0.400	0.510	0.630
THICK-MAX	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250

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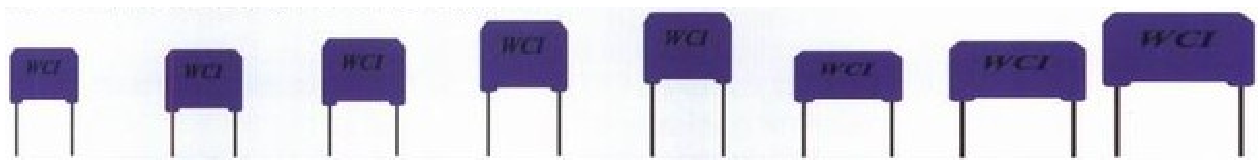


SIZE	4745C	5550C	5755C	6560C	6864C	8840C	11050C	13060C
LENGTH-NOM	0.570	0.670	0.700	0.770	0.770	1.000	1.220	1.420
WIDTH-NOM	0.550	0.600	0.650	0.720	0.750	0.500	0.600	0.720
THICK-MAX	0.350	0.350	0.350	0.350	0.350	0.350	0.350	0.350
LEAD SPACING	0.500	0.575	0.600	0.675	0.700	0.900	1.100	1.300

Dimensions are +/- 5% length and width or .015", whichever is greater.
Lead Spacing +/- .030"

SIZE	4745		5550		5755		6560		6864		8840		11050		13060	
WVDC	BR	BZ	BR	BZ	BR	BZ	BR	BZ	BR	BZ	BR	BZ	BR	BZ	BR	BZ
500V	684		824	185	824			275								
1000V	334		394	824	474		564	125	684							
2000V	823		124	224	154		184	334	224							
3000V	333		473	823	563		683	154	823		473		104		124	
4000V	183		223	393	273		393	563	473		223		563		823	
5000V	472		153	273	183		223	393	273		153		333		473	
7000V	392		562	103	682		822	183	103		682		153		223	
10000V	152		272	472	332		392	822	472		222		562		822	

Ordering Information:	WC	(N)	2725	C*	X	102	M	D	501
*** All "C" conformal coated devices can be ordered with High Temperature 200°C by specifying HiTemp for the N-non standard.** Contact office.	Wright Cap MLC's	(Optional) Insert **N** for Non-Standard Requirements, Processing, or Group A or B Screening	Chip Size	**C**=Conformal coat with radial lead **L**=Leaded only **P**=Potted Case **DELETE FOR CHIP CAP**	Dielectric Material **X**=X7R (BR) **B**=X7R (BZ)	Capacitance Value Code In cap. Code i.e. 102=1000pF	Tolerance J=±5% K=±10% M=±20% Z=+80% -20% V=+100%	Termination Type A=Ag D=PdAg N=Ni	Voltage i.e.501=500V

Surface Mount Lead Options

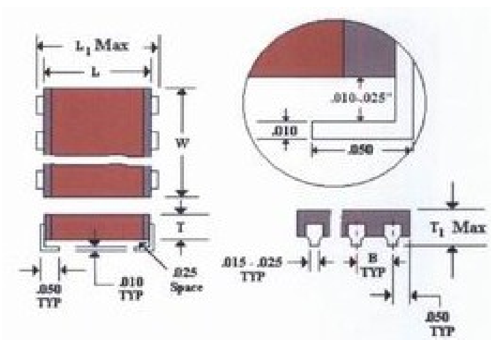
Ceramic capacitors larger than 2520 or thicker than .125” are extremely susceptible to thermal shock and thermal cycle TCE mismatch. This is especially true when mounting to FR4 or similar type epoxy boards where the thermal expansion mismatch is extreme from the ceramic to “plastic” board.

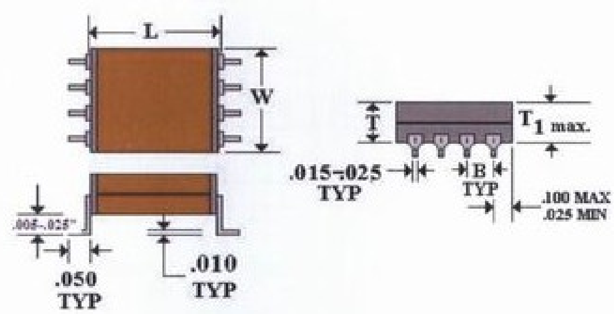
It is of utmost importance to take precautions when preheating the parts prior to any solder attachment operation to verify that no damage (micro-cracking) has been caused during the solder cycle. A visual inspection as well as DWV (HiPot) test is highly recommended to assure no damage has occurred. Otherwise, micro cracking typically could not show up until later in initial power up.

For surface mount we offer a variety of “Tab” leads for various requirements and sizes. For smaller parts, the “J” or “L” Dual Inline package is typically used to allow designers to minimize the land area required. Generally the “J” leads add .100” (.050”/side) to package length. The “L” leads add .025”- .050” to the height by wrapping under the chip.

We also have variety of custom leads, most Cu/Sn/Pb tabs. Some with “flex” bends for larger, higher reliability stress conditions. Our “E” lead and Gull-wing are examples with the gull wing taking up the most real estate, but with extreme reliability, and multiple configurations at .200” center spacing. We can also custom design an attachment method to meet your special requirements.

J & L Leaded Components





J-Lead

L-Lead

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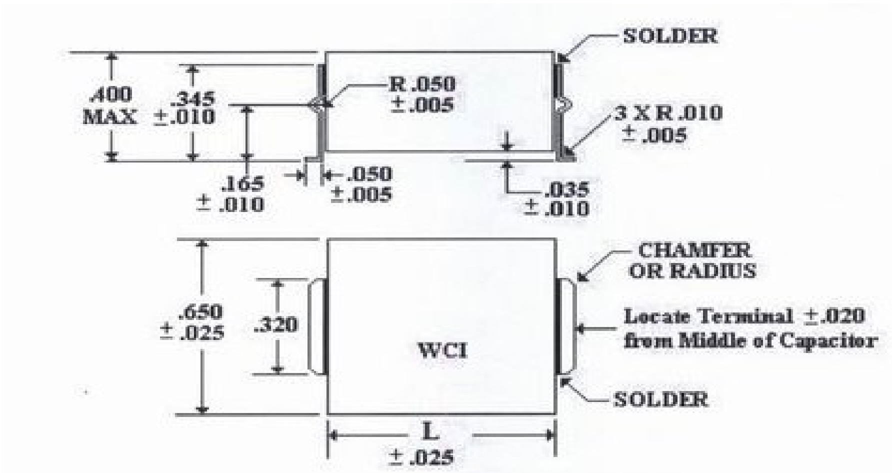
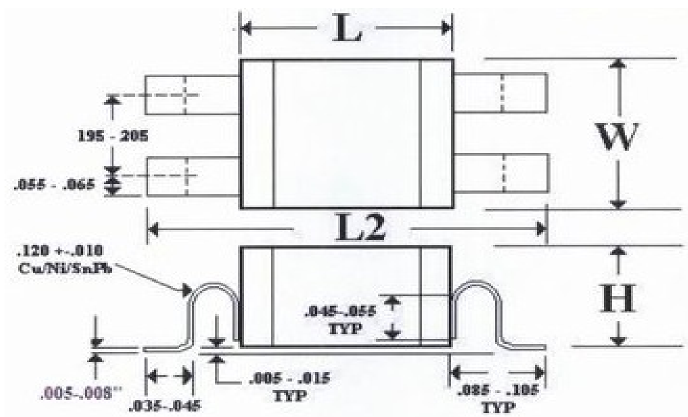
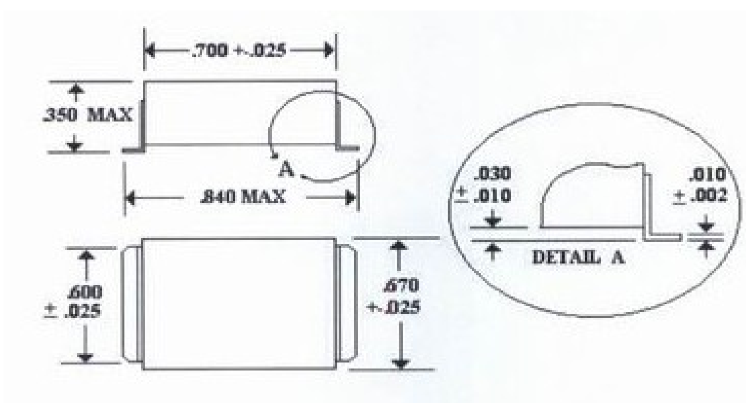
E-Lead

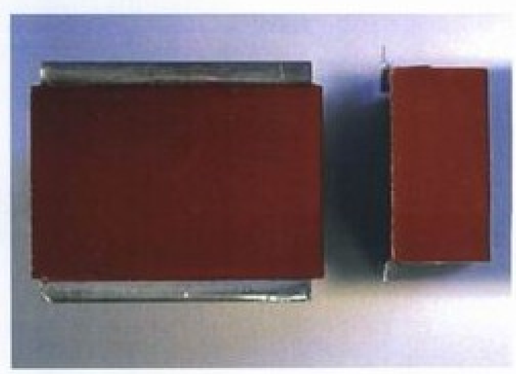


Gull-Lead



Tab-Lead





Ordering Information:	SM	(N)	3840	(T)	X	102	K	D	102
	Surface Mount Series	(Optional) Insert **N** for Non-Standard Requirements, Processing, or Group A or B Screening	Chip Size	**T**=Tab **J** or **L** =DIP Leads **E** and **G**= Flex tabs **DELETE FOR CHIP CAP**	Dielectric Material **X**=X7R (BR) **B**=X7R (BZ) **N**=NPO **R**=N2200	Capacitance Value Code In cap. Code i.e. 102=1000pF	Tolerance J=±5% K=±10% M=±20% Z=+80% -20% V=+100%	Termination Type A=Ag D=PdAg N=Ni	Voltage i.e.102=1000V

10000569 ISO 9001 WCI Wright Capacitors, Inc.

High Temperature Line

"P" Square- Potted Case - Radial Lead
"B" with solder Standoffs

Shell Material

"B" Off White Vectra Per MIL-M-24519C
"P" Black Epoxy Per MIL-M-24325MEC
Leads - 22 AWG Cu/Ni/SnPb Sn96
Hot Solder Dipped
Voltage - As specified, rated to 200°C
Tcc – X7R= -45% max at 200°C
-30% max at 175°C
NPO= 30 ppm/°C max
IR = 25°C = 1000mΩ-µFmin
125°C = 100mΩ-µFmin
150°C = 10mΩ-µFmin
200°C = 1mΩ-µFmin

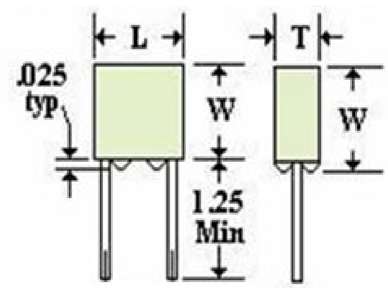
Case	L ±.005	W ±.005	W/B (Incl. Bump)	L.S. ±.015	Bump Space
HT2020P	.200	.200		.200	
HT3030P	.300	.300		.200	
HT3030B	.300	.300	.330	.200	.100
HT4040P	.400	.400		.300	
HT4040B	.400	.400	.430	.300	.200
HT5050P	.500	.500		.400	
HT5050B	.500	.500	.530	.400	300

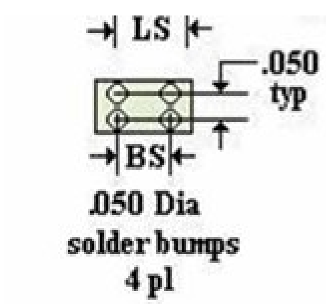
All dimensions in mils.
HT2020 - No solder bumps available. Lead form gives .025" typical offset.
HT3030, 4040, and 5050 - available with .025" solder standoff bumps (B Option) for cleaning and inspection of solder joints.

Table of Maximum Capacitance Values for High Temperature Line Potted Shells @ thickness .100" and .150".
*Note: Shells do come in thickness > .150" for higher values. Please consult factory.

		500 Volts		1KV		2KV	
Thick Max	**Material**	**.100"**	**.150"**	**.100"**	**.150"**	**.100"**	**.150"**
2020	NPO	152		681		271	
	N2200	392				821	
	BR	103		472		222	
3030	NPO	472	562	222	272	102	152
	N2200	123	153	562	682	332	472
	BR	333	473	153	183	822	103
4040	NPO	123	153	682	822	222	272
	N2200	393	473	183	223	682	822
	BR	104	154	473	683	223	273
5050	NPO	223	273	103	123	472	562
	N2200	563	683	273	333	103	123
	BR	154	184	683	823	333	393

Note: Class I and Class II BR materials can meet 200 C or greater requirements. Please consult factory.





Ordering Information:	HT	2020	B	X	121	J	D	501
	Wright Cap MLC's	Chip Size	**P**=Square Case **B**= Solder bumps **C**= Radial Leaded	Dielectric Material **X**=X7R (BR) **B**=X7R (BZ) **N**=NPO **R**=N2200	Capacitance Value Code In cap. Code i.e. 121=120pF	Tolerance J=±5% K=±10% M=±20% Z=+80% -20% V=+100% A=±.5% B=±.1pF F=±.1% G=±2%	Termination Type A=Ag D=PdAg N=Ni C= Leads w/ SnPb coating	Voltage i.e.501=500V

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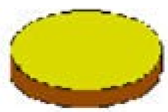
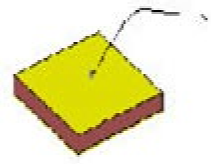
Single Layer Microwaves

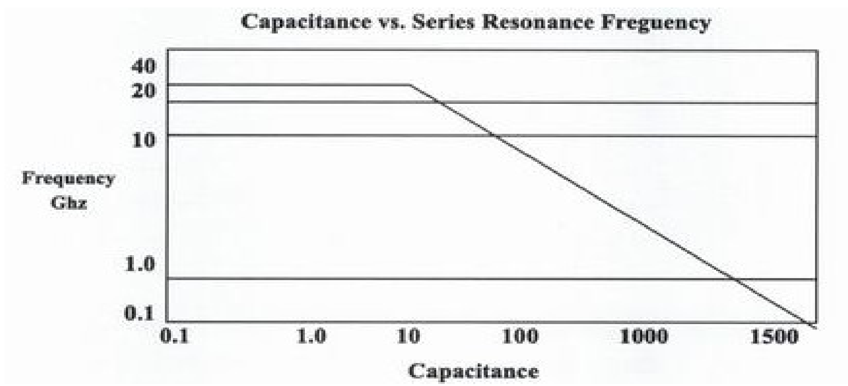
WCI's single sheet (SS) ceramic chip capacitors are intended for hybrid applications from direct current through gigahertz frequencies. Their dual plate construction and low profile make them ideally suited for microwave stripline applications. They display ultra-low series resistance and inductance with high series resonance frequencies. (See graph)





WCI's capacitors use the finest ceramic and electrode materials resulting in a high quality, stable, hermetic device which is unaffected by static discharges.

Terminations are high quality vapor deposited gold, suitable for thermo compressions or ultrasonic wire bonding, soldering, or epoxy mounting. PdAg terminations are also available.



Microwave capacitors are available in all three dielectric classes, as well as temperature compensating dielectrics. This fact, coupled with variation in geometries, make a wide range of capacitance values available through 50,000pF in an area as small as one-quarter inch square.

At microwave frequencies, the physical dimensions of the chip should be equal to the stripline width for greatest efficiency. To accomplish this, configurations can be square or rectangular - as long as the total area is sufficient for the capacitance desired. (See figure 2)

Axial-beam leaded, leaded and coated, circular discs, cap arrays and tight tolerances are also available. Standard disc sizes are 0.45", .050", .060", .080" and .120" O.D. (all =/-.005"). High voltage single layer (SL's) up to 20KV are also available. Please consult the factory for any special requirements.

Ordering Information:	**SS**	**0502**	**X**	**121**	**J**	**G**	**501**
	SS= Microwave "single sheets" **SD**= Microwave "single-discs" **SL**= High Voltage	Part Size i.e.. 0502=.050"x.020" Two or three digits only for squares and discs. Six digits for Sl's > 1.0" rectangular.	Dielectric Material **X**=X7R **N**=NPO **Z**=Z5U **Y**=Y5V	Capacitance Value Code In cap. Code i.e. 121=120pF	Tolerance J=±5% K=±10% M=±20% Z=+80% -20% V=+100%	Termination Type A=Ag D=PdAg G=Au	Voltage i.e.501=500V

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Table of Maximum Capacitance Values for custom chips

Class I - N2200 (R) Dielectric
Max Tcc = + 25% @ -55 C,
-20% @ 125 C
DF= .15 Max

N2200 Fuze Capacitors

(Also see Class I Dielectric charts, "R" material, for other maximum capacitance values.)

SIZE	2832	3840	4565	6964	13060
LENGTH-NOM	0.280	0.380	0.450	0.690	1.600
WIDTH-NOM	0.380	0.400	0.650	0.650	0.600
THICK-MAX	0.250	0.250	0.250	0.350	0.250

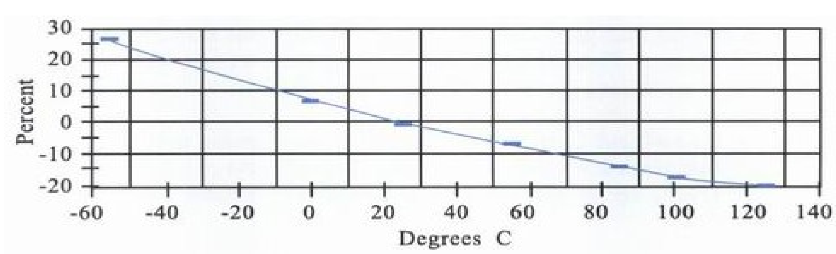
Dimensions are +/-5% length and width or .015"; whichever is greater.
MB = .005" / .030"

SIZE / VOLTAGE	2838	3840	4565	6964	13060
500V	0.12µF	0.15µF	0.27µF	0.33µF	0.68µF
1000V	0.068µF	0.10µF	0.18µF	0.22µF	0.47µF
2000V	0.039µF	0.056µF	0.10µF	0.18µF	0.27µF
3000V	0.033µF	0.039µF	0.033µF	0.12µF	0.154µF
4000V	0.022µF	0.027µF	4700pF	0.082µF	0.047µF
5000V	0.012µF	0.015µF	3900pF	0.068µF	0.027µF
7000V			2700pF	0.047µF	0.01µF
10000V			1500pF	0.027µF	6800pF

Higher voltages and capacitance values are available with "stacked chip" configurations and thickness maximums greater than .3 50".
Other chip sizes also available. Please consult the factory.

TEMPERATURE COEFFICIENT

N2200 (R) DIELECTRIC



This is the Class I temperature compensating dielectric. N2200 is non-piezoelectric and particularly well suited for repetitive high current pulse type applications (where long charge/discharge life is required). N2200 also has no voltage coefficient, which makes it more volumetric efficient than X7R at higher voltages. Also, the lower ESR (DF=.1% typical, X7R=1.8% to 2.5% typical) as well as increased capacitance at lower temperatures is an additional benefit in many applications.

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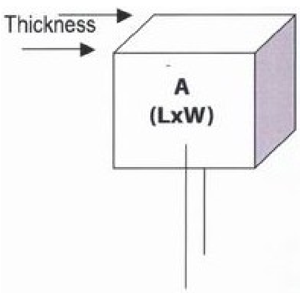
WCI Ceramic Capacitors

Our ceramic capacitors are composed of conducting plates (electrodes) separated by an insulating material (dielectric) that is polarizable. They are manufactured in a wide variety of sizes and shapes determined by use requirements. Barium Titanate has excellent Ferro electric proper ties and is the basic material used by WCI in the manufacture of dielectrics. Basically, increasing the amount of Barium Titanate in the composition will result in a higher dielectric constant. The practical formula for determining capacitance is:

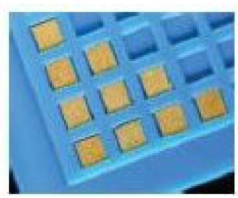


$$C = \frac{NKA}{t}$$ (t = thickness)

C = Capacitance expressed in picofarads
N = Number of dielectric layers Between opposing conductors
K = Dielectric Constant
A = Area of the opposing electrodes
t = Thickness

Types of Ceramic

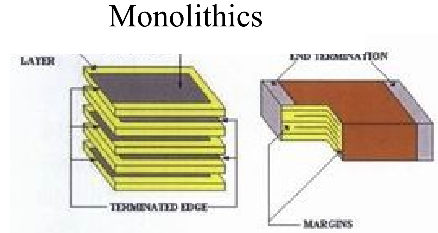
Microwave SS



High Voltage SL

SINGLE LAYER–A single layer ceramic capacitor is formed by a dielectric block with an opposing electrode on each side. The ceramic has a higher dielectric constant than thick film and a reasonable capacitance can be achieved since glass is not required for bonding. This type is primarily used in Monolithics, high voltage, or high frequency applications.

Monolithics



MONOLITHIC – A multilayer ceramic capacitor is formed by the parallel assembly of single layer ceramic capacitors. The unique manufacturing process hermetically seals the opposed electrodes inside the dielectric so thinner dielectrics can be used to increase the capacitance per unit volume. Due to the high volumetric efficiency achieved, they are ideal for applications where higher capacitance than single layers are required.

These descriptions of the types of ceramic capacitors, treat a complex subject in an elementary fashion. To avoid misapplication, further information should be obtained from WCI.

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Classes of Ceramic Dielectrics

Ceramic dielectric materials fall into three classes as defined by industry/military standards. These materials are manufactured to perform within specified limits. WCI has proprietary formulations with particular emphasis placed upon high voltage performance designed to meet and exceed specified requirements.

CLASS I NPO/N2200

These materials have extremely stable characteristics over varied temperature, voltage and frequency ranges; however, the low percentage of barium titanate restricts dielectric constants (K) to a range of 10-100. Being non-ferro electric they show little aging or voltage coefficient. Modification of these materials can result in temperature compensating dielectrics with constants in a range of 100-300. This will also increase the temperature effect of capacitance change from 30 ppm/°C to the 1000-3300 ppm/°C.

CLASS II BR/BZ

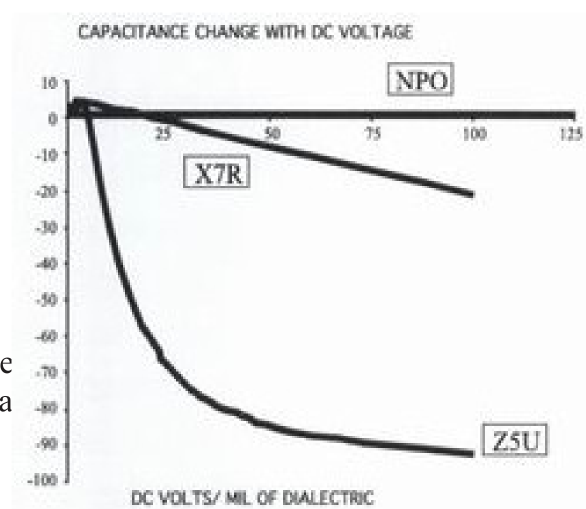
This class of mid-K dielectrics has a broader tolerance over temperature, voltage, and frequency than does NPO; however the dielectric constants fall in a much higher range of 1000-2500. Selection of the dielectric used for any given application to achieve the capacitance required at any given temperature, voltage, or frequency is critical.

CLASS III Z5U/Y5V

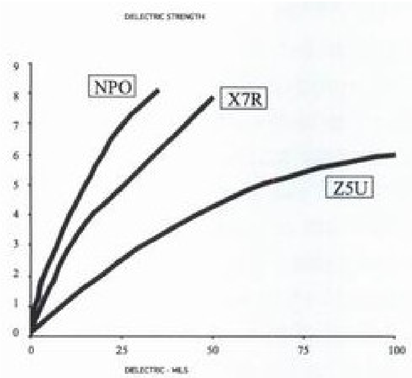
This class represents the highest dielectric constants with a range of 3500-12,500. The temperature, voltage, and frequency are effected very severely by a deviation from 25°C and 1 Vrms. Increased capacitance can generally be achieved by proper selection of a lower class dielectric if higher temperatures or voltages are to be used.

Voltage Effects

All ceramic capacitor values are stated at a rating of 25°C and 1Vrms. The application of voltage to a capacitor causes a change in the capacitance and volume efficiency as illustrated to the right.



Another important consideration in capacitor design is the break down or failure voltage of a capacitor body. This phenomenon takes place when the applied voltage causes permanent failure through a given thickness of ceramic. The dielectric strength of all insulating materials varies inversely with the square root of the thickness. The probability of a flaw increases as the thickness of a fixed area increases. Flaw rates will vary depending upon the process and the raw material selection.



Dielectric strength versus thickness is shown in the figure to the left and illustrates that making a part thicker to increase the voltage rating does not necessarily obtain the desired result in total. The flash voltage or over-rated test voltage had a limiting effect on how much capacitance can be achieved in a given area. The dielectric strength is not directly proportional to thickness and voltage strength falls off quite rapidly at greater thicknesses. Having a flash test requirement of 2X could require the dielectric thickness to be increased to 4X to ensure the same degree of reliability. For these reasons, flash voltages of 1.5X for 500V to 1KVDC and 1.2X for higher voltages have been set as industry standards and have proven by experience to be the best balance between reliability and volumetric efficiency.

Surge Current

High surge currents can have damaging effects on ceramic capacitors and electrodes. Barium Titanate can be ferroelectric or piezoelectric, depending on how it is doped. The higher “K” dielectrics appear to retain a slight piezoelectric tendency; therefore a high current surge could cause mechanical damage to a capacitor. This could show as cracking thereby creating a short circuit failure, or the burn-out of internal electrodes; thus causing a permanent reduction in capacitance. By controlling the design parameters and utilizing low ESR precious metal electrode systems, surge currents greater than 10 amps are obtainable without sacrificing quality and reliability.

Energy Density

The amount of energy stored in a capacitor is defined as $1/2CV^2$. The energy density, or joules/in^3, coupled with shape and dielectric material considerations are important factors in designing a capacitor. It is practical for high capacitance and high voltage to achieve energy densities of 6 to 10 joules/in^3. WCI has extensive experience with high capacitance at high voltage and employs original designs to avoid piezoelectric effects and other potential problem areas.

Corona

Corona is the ionization of a gas by applied voltage. The ions are accelerated by voltage stress and discharge their energy upon impact with a solid. Effects of corona are dependent on the frequency of generation and energy dissipated on impact. Corona inception occurs when voltage is applied across a void or other imperfection in the structure of the ceramic dielectric. Ceramics are made of hard materials with high melting points and would require extended exposure to corona to sustain critical damage.

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Capacitor Mounting

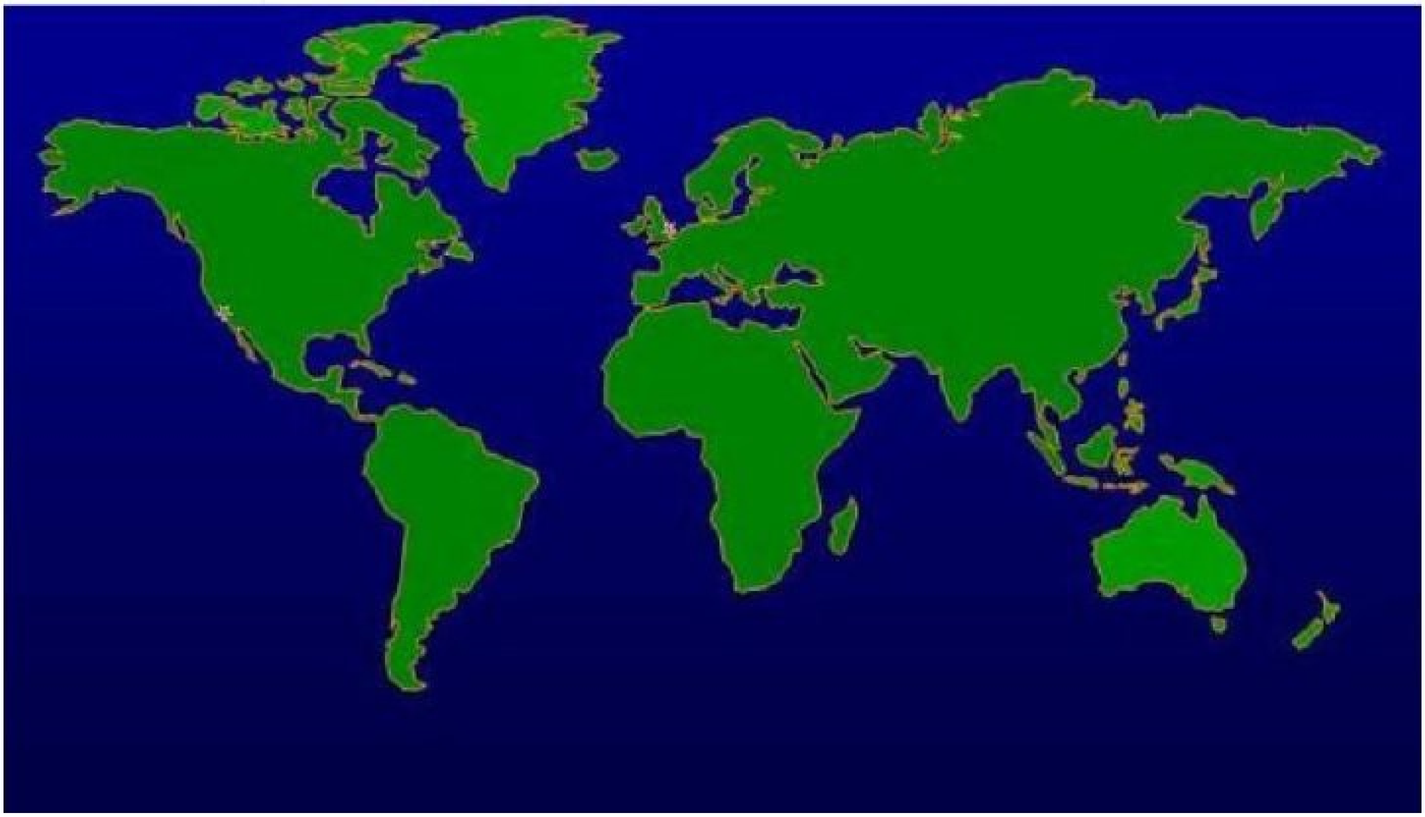
After acquiring a high quality ceramic capacitor it is extremely important that it is installed in your circuit without damage. The two most common methods of affixing are conductive epoxy and soldering. Conductive epoxy is popular due to the ease of application. This type of adhesive contains metal particles for electrical contact and a degree of mechanical strength; however it is of lesser strength than solder and the D.F. can increase due to lower conductivity. This attachment technique is only good in circuits not exposed to atmosphere. Solders come in many melting point compositions and must be applied very carefully. If capacitor chips are being used, the chip should be cautiously preheated to just below the liquidous temperature of the solder and then the solder should be applied quickly to avoid thermal shock or leaching of the termination. Leaded devices are not as sensitive, but care must still be taken to prevent thermal shock and reflow of solder onto the capacitor. Chips larger than 2725 or thicker than .100" are not recommended for solder mounting, particularly on epoxy boards. They can be used with some success on hybrid boards with carefully controlled preheating. Conductive epoxy or the use of leaded components are recommended for any solder attachment of these large devices. Gold, silver, palladium-silver, or nickel barrier terminations are available. Consult the factory. WCI's technical service group is available to help with any mounting problems you may encounter.

Temperature Effect

Class II and III dielectrics contain substantial amounts of the ferroelectric material Barium Titanate. Barium Titanate undergoes a crystalline change at approximately 125°C. This is called the curie point. After this transition occurs the ability to become polarized is drastically reduced and the "K" is diminished. The X7R dielectrics are blended to broaden this precipitous change in "K", resulting in a more moderate performance. The Z5U dielectrics, with the highest percentage of Barium Titanate, are formulated to shift this curie point closer to room temperature. This takes maximum advantage of Barium Titanate's high "K" and results in the most extreme performance.

Aging

An effect that is sometimes overlooked by capacitor users is aging. When the capacitor passes through the curie point of 125°C, a crystalline change occurs. As the capacitor cools to room temperature, the capacitance returns to its original 25°C value. The rate of capacitance decrease or "aging" varies with "K" and generally increases with higher dielectric constants. This rate of change is expressed in percent change per decade hour. For NPO the rate of change is zero; with X7R's varying between 0.5% to 2% per decade hour; and Z5U's varying as high as 4% to 5% per decade hour. As all ceramic capacitors go through temperature processing, it is important to understand how this could effect the value of a capacitor that has been sitting on a shelf for many decade hours. (General industry practice uses 1000 hours as the reference time for tolerance determination.)



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