PPI Passive Plus Inc.

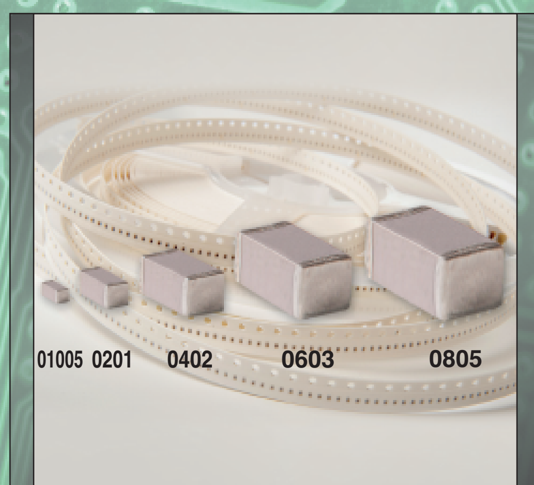
RF & Microwave Capacitors

High Q / Low ESR Ceramic Capacitors

RF & Microwave Capacitors

HF/UHF Power Applications

Custom Assemblies



Broadband Capacitors - Up to 110GHz

www.PassivePlus.com

- New State-of-the-Art Manufacturing Facility
    - over 130,000 square feet of NEW manufacturing area.
- Established 1988
- ISO-9001 Certified
- ISO-14001 Certified
- MRI-Non-Magnetic Components
- S-Level Reliability
- Our products have been widely used in various RF/Microwave Communication Systems, MRI Medical Systems, Broadcast Equipment and various Military Applications

PPI Passive Plus Inc.
RF & Microwave Capacitors

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Passive Plus Inc. RF & Microwave Capacitors

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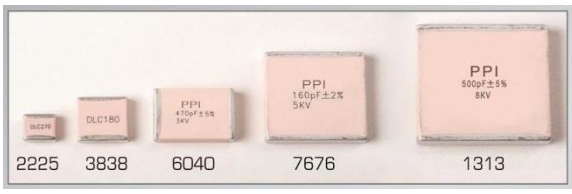
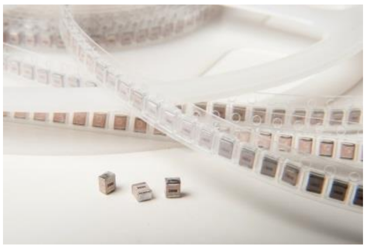
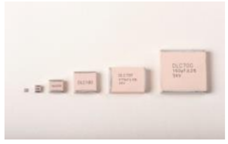

DLC180
PPI
470pF±5%
3KV
PPI
160pF±2%
5KV
PPI
500pF±5%
8KV
2225
3838
6040
7676
1313



Traditional High Q (> 10,000) Low ESR Capacitors
(NP0 & P90 TC)

Traditional High Q (>10,000) Low ESR Capacitors



◆ Product Features

High Q, High Power, Low ESR/ESL, Low Noise, High Self-Resonance, Ultra-Stable Performance

◆ Typical Applications Field

Wireless Broadcasting Equipment, Mobile Base Stations, GPS Portables, Medical (MRI coils), Radar

◆ Part Numbering Overview

0505	C	101	J	W	151	X	TV
❶	❷	❸	❹	❺	❻	❼	❽
Dimensions Code	Temperature Coefficient	Rated Capacitance	Tolerance	Termination Type	Rated Voltage	Laser Marking	Tape carrier packing Vertical Orientation

① Dimensions Code

unit: inch (millimeter)

	0505	1111	2225	3838
Length	0.055 +.015～-.010 (1.4 +0.38 ~ -0.25)	0.110 +.020 ~ -.010 (2.79 +0.51 ~ -0.25)	0.220 +.020 ~ -.010 (5.84 +0.51 ~ -0.25)	0.380 +.015 ~ -.010 (9.65 +0.38 ~ -0.25)
Width	.055±.010 (1.4±0.25)	.110±.010 (2.79±0.25)	.250±.015 (6.35±0.38)	.380±.010 (9.65±0.25)
Thickness	.057(1.45) max	.10(2.6) max	.165(4.19) max	.177(4.5) max

② Temperature Coefficient: C: 0±30ppm/℃, P: +90±20ppm/℃.

③ Rated Capacitance

Capacitance is less than 10pF; for example: 1R0=1.0pF, R denotes decimal point.

Capacitance greater than 10pF; for example: 101=100pF, the third number is the power of 10.

④ Tolerance

Code	A	B	C	D	F	G	J	K	M
Tolerance	±0.05pF	±0.1pF	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%	±20%

⑤ Termination Type

Code	W	P	L
Type	100% Sn Solder over Nickel Plating	100% Sn Solder over Copper Plating RoHS Compliant	90% Sn10%Pb Solder over Nickel Plating (Tin/Lead)

Code	MS	AR	RR	AW	RW
Type	Microstrip	Axial Ribbon	Radial Ribbon	Axial Wire	Radial Wire

Code	MN	AN	FN	BN	RN
Type	Non-Mag Microstrip	Non-Mag Axial Ribbon	Non-Mag Radial Ribbon	Non-Mag Axial Wire	Non-Mag Radial Wire

⑥ Rated Voltage

Code	Rated Voltage	Code	Rated Voltage
500	50V	152	1500V
101	100V	202	2000V
151	150V	252	2500V
201	200V	302	3000V
301	300V	362	3600V
501	500V	502	5000V
102	1000V	722	7200V

⑦ Laser Marking

X denotes Marking. Capacitance is less than 10pF; for example: the marking of 1.0pF is 1R0. Capacitance greater than 10pF; for example: the marking of 100pF is 101.

⑧ Packaging Orientation

TV: Tape carrier packaging Vertical Orientation. Vertical orientation means that if the part is lifted from the tape without any rotation and placed on a substrate, its electrodes will be perpendicular to the substrate plane. This impacts the frequency of First Parallel Resonance (suckout).

◆ Performance Requirements

Capacitors are designed and manufactured to meet the requirements of MIL-PRF-55681 and MIL-PRF-123.

◆ All Products are in Compliance with RoHS Instruction.

0505C/P (.055” x .055”)

◆ Product Features

High Q, High Power, Low ESR/ESL, Low Noise, High Self-Resonance, Ultra-Stable Performance.

◆ Product Application

Typical Functional Applications: Tuning, Bypass, Coupling, Feedback, D.C. Blocking and Impedance Matching.
Typical Circuit Applications: UHF/Microwave RF Power Amplifiers, Mixers, Oscillators, Low Noise Amplifiers, Filter Networks, Timing Circuits and Delay Lines.

◆ 0505C/P Capacitance Table NP0=C; P90=P **Max. capacitance: 0505P=100pF; 0505C=1000pF**

<table>
<tr><th>Cap. pF</th><th>Code</th><th>Tol.</th><th>Rated WVDC</th><th>Cap. pF</th><th>Code</th><th>Tol.</th><th>Rated WVDC</th><th>Cap. pF</th><th>Code</th><th>Tol.</th><th>Rated WVDC</th><th>Cap. pF</th><th>Code</th><th>Tol.</th><th>Rated WVDC</th></tr>
<tr><td>0.1</td><td>0R1</td><td rowspan="22">A,B,
C,D</td><td rowspan="22">150V
Code
151
or
300V
Code
301</td><td>2.4</td><td>2R4</td><td rowspan="11">A,B,
C,D</td><td rowspan="22">150V
Code
151
or
300V
Code
301</td><td>20</td><td>200</td><td rowspan="22">F,G,
J,K</td><td rowspan="10">150V
Code
151
or
300V
Code
301</td><td>160</td><td>161*</td><td rowspan="22">F,G,
J,K</td><td rowspan="7">150V
Code
151
or
200V
Code
201</td></tr>
<tr><td>0.2</td><td>0R2</td><td>2.7</td><td>2R7</td><td>22</td><td>220</td><td>180</td><td>181*</td></tr>
<tr><td>0.3</td><td>0R3</td><td>3.0</td><td>3R0</td><td>24</td><td>240</td><td>200</td><td>201*</td></tr>
<tr><td>0.4</td><td>0R4</td><td>3.3</td><td>3R3</td><td>27</td><td>270</td><td>220</td><td>221*</td></tr>
<tr><td>0.5</td><td>0R5</td><td>3.6</td><td>3R6</td><td>30</td><td>300</td><td>240</td><td>241*</td></tr>
<tr><td>0.6</td><td>0R6</td><td>3.9</td><td>3R9</td><td>33</td><td>330</td><td>270</td><td>271*</td></tr>
<tr><td>0.7</td><td>0R7</td><td>4.3</td><td>4R3</td><td>36</td><td>360</td><td>300</td><td>301*</td></tr>
<tr><td>0.8</td><td>0R8</td><td>4.7</td><td>4R7</td><td>39</td><td>390</td><td>330</td><td>331*</td><td rowspan="8">150V
Code
151</td></tr>
<tr><td>0.9</td><td>0R9</td><td>5.1</td><td>5R1</td><td>43</td><td>430</td><td>360</td><td>361*</td></tr>
<tr><td>1.0</td><td>1R0</td><td>5.6</td><td>5R6</td><td>47</td><td>470</td><td>390</td><td>391*</td></tr>
<tr><td>1.1</td><td>1R1</td><td>6.2</td><td>6R2</td><td>51</td><td>510</td><td rowspan="12">150V
Code
151
or
200V
Code
201</td><td>430</td><td>431*</td></tr>
<tr><td>1.2</td><td>1R2</td><td>6.8</td><td>6R8</td><td rowspan="4">B,C,
J,K</td><td>56</td><td>560</td><td>470</td><td>471*</td></tr>
<tr><td>1.3</td><td>1R3</td><td>7.5</td><td>7R5</td><td>62</td><td>620</td><td>510</td><td>511*</td></tr>
<tr><td>1.4</td><td>1R4</td><td>8.2</td><td>8R2</td><td>68</td><td>680</td><td>560</td><td>561*</td></tr>
<tr><td>1.5</td><td>1R5</td><td>9.1</td><td>9R1</td><td>75</td><td>750</td><td>620</td><td>621*</td></tr>
<tr><td>1.6</td><td>1R6</td><td>10</td><td>100</td><td rowspan="7">F,G,
J,K</td><td>82</td><td>820</td><td>680</td><td>681*</td><td rowspan="7">50V
Code
500
or
100V
Code
101</td></tr>
<tr><td>1.7</td><td>1R7</td><td>11</td><td>110</td><td>91</td><td>910</td><td>750</td><td>751*</td></tr>
<tr><td>1.8</td><td>1R8</td><td>12</td><td>120</td><td>100</td><td>101</td><td>820</td><td>821*</td></tr>
<tr><td>1.9</td><td>1R9</td><td>13</td><td>130</td><td>110</td><td>111*</td><td>910</td><td>911*</td></tr>
<tr><td>2.0</td><td>2R0</td><td>15</td><td>150</td><td>120</td><td>121*</td><td>1000</td><td>102*</td></tr>
<tr><td>2.1</td><td>2R1</td><td>16</td><td>160</td><td>130</td><td>131*</td><td></td><td></td></tr>
<tr><td>2.2</td><td>2R2</td><td>18</td><td>180</td><td>150</td><td>151*</td><td></td><td></td></tr>
</table>

Remark: special capacitance, tolerance and WVDC are available, consult with PASSIVE PLUS.
* - Available in NP0 only.

◆ Part Numbering

0505C 100 J W 151 X TV

- 0505C — C=NP0; P=P90
- 100 — Capacitor Code: 100=10x10^0=10pF; 1R0=1.0pF
- J — Capacitance Tolerance: See below list
- W — Termination Type
- 151 — Rated Voltage
- X — Laser Marking
- TV — Add TV for Vertical Orientation

Capacitance Tolerance								
Code	A	B	C	D	F	G	J	K
Tolerance	±0.05pF	±0.1pF	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%

◆0505C/P Magnetic and Non-Magnetic Dimensions

unit:inch(millimeter)

Series	Term. Code	Type/Outlines	Capacitor Dimensions				Plated Material
			Length Lc	Width Wc	Thickness Tc	Overlap B	
0505C 0505P	W	 Chip	.055 +.015 to -.010 (1.40 +0.38 to -0.25)	.055±.010 (1.40±0.25)	.057 (1.45max)	.020 (0.51max)	100%Sn Solder over Nickel Plating RoHS Compliant
0505C 0505P	L						90%Sn10%Pb Tin/Lead Solder over Nickel Plating
0505C 0505P	P (Non-Mag)	 Chip (Non-Mag)					100%Sn Solder over Copper Plating RoHS Compliant

Note: “Non-Mag” means no magnetic materials.

◆ Performance

Item	Specifications
Quality Factor (Q)	greater than 10,000 at 1MHz.
Insulation Resistance (IR)	10^5 Megohms min. @ +25 ℃ at rated WVDC. 10^4 Megohms min. @ +125 ℃ at rated WVDC.
Rated Voltage	See Rated Voltage Table.
Dielectric Withstanding Voltage (DWV)	250% of rated Voltage for 5 seconds.
Operating Temperature Range	-55℃ to +200℃
Temperature coefficient (TC)	C: 0±30ppm/℃; P: +90±20ppm/℃
Capacitance Drift	±0.02% or ±0.02pF, whichever is greater.
Piezoelectric Effects	None
Termination Type	See Termination Type Table.

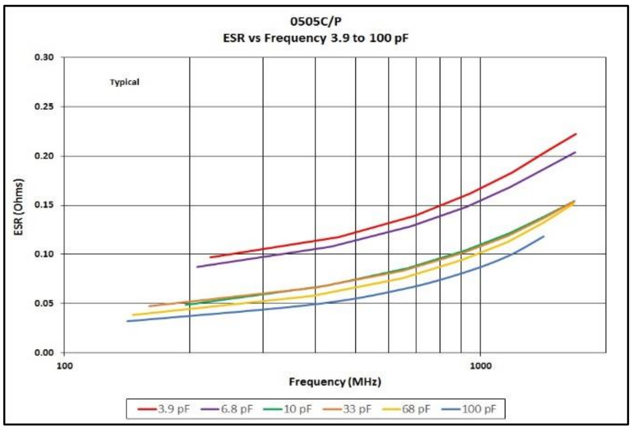
Capacitors are designed and manufactured to meet the requirements of MIL-PRF-55681 and MIL-PRF-123.

◆ Environmental Tests

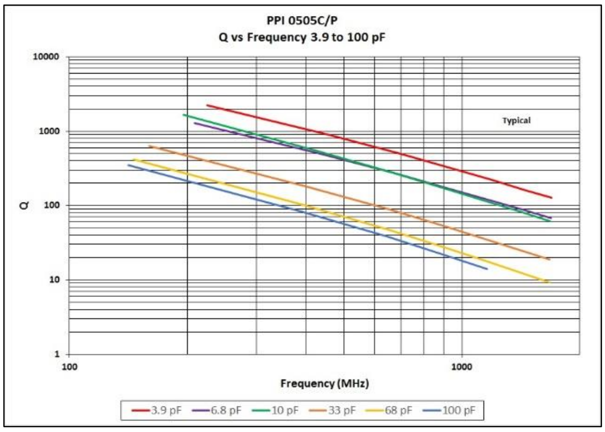
Item	Specifications	Method
Thermal shock	DWV: the initial value IR: Shall not be less than 30% of the initial value Capacitance change: no more than 0.5% or 0.5 pF, whichever is greater.	MIL-STD-202, Method 107, Condition A. At the maximum rated temperature (-55℃ and 200℃) stay 30 min,the time of removing shall not be more than 3 minutes. Perform the five cycles.
Moisture resistance		MIL-STD-202, Method 106.
Humidity (steady state)	DWV: the initial value IR: the initial value Capacitance change: no more than 0.3% or 0.3pF, whichever is greater.	MIL-STD-202, Method 103, Condition A, With 1.5 Volts D.C. applied while subjected to an environment of 85℃ with 85% relative humidity for 240 hours minimum.
Life	IR: Shall not be less than 30% of the initial value Capacitance change: no more than 2.0% or 0.5pF, whichever is greater.	MIL-STD-202, Method 108, for 2000 hours, at 200℃. 200% Rated voltage D.C. applies.
Terminal strength	Force : 10lbs typical, 5 lbs min., Duration time: 5 to 10 seconds.	MIL-STD-202, Method 211A, Test condition A. Applied a force and maintained for a period of 5 to 10 seconds. The force shall be in the direction of the axes of the terminations.

◆ 0505C/P Performance Curves

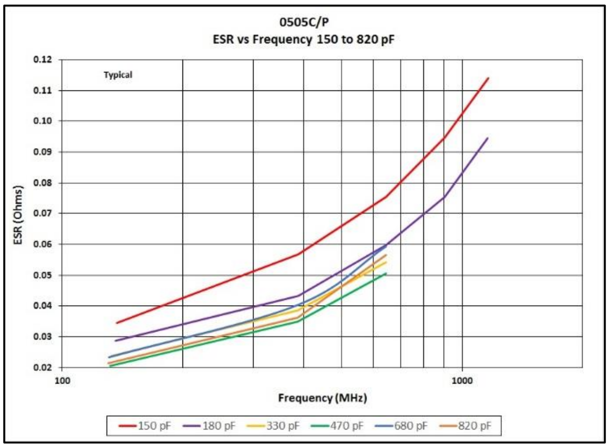
0505C/P ESR vs Capacitance



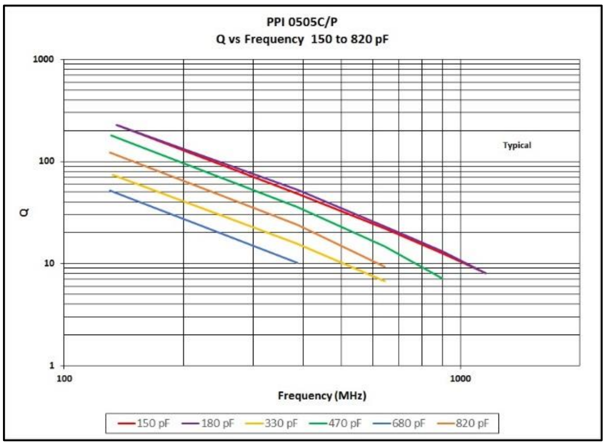
0505C/P Q vs Capacitance



0505C ESR vs Capacitance



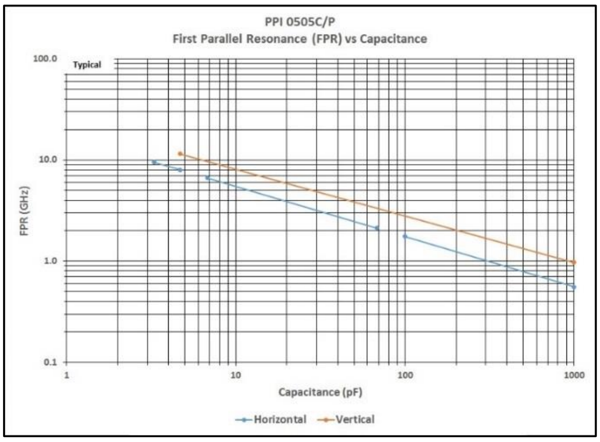
0505C Q vs Capacitance



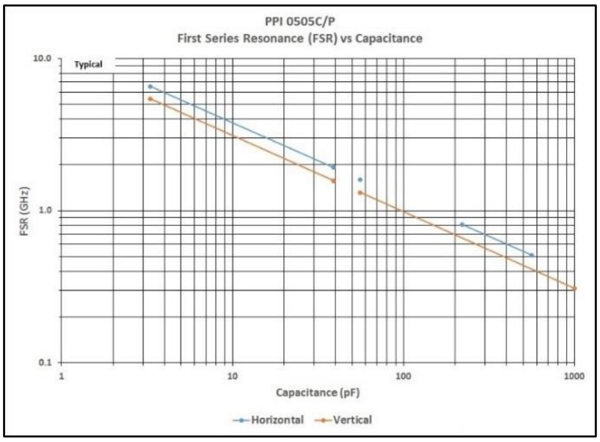
Definitions and Measurement Conditions

For a capacitor in a series configuration, i.e., mounted across a gap in a microstrip trace, with 50-Ohm source and termination resistances, the First Series Resonance, FSR, is defined as the lowest frequency at which the imaginary part of the input impedance, Im[Zin], equals zero when reference planes are at the sample edges. The FSR shall be considered as undefined (gap in plot above) if, over the measured or model-validated frequency range: (a) Im[Zin] never reaches zero; or, (b) at frequencies lower than that at which Im[Zin] = 0, Im[Zin] is not monotonic with frequency and/or the real part of the input impedance, Re[Zin], deviates more than once from montonicity. The First Series Resonance, FSR, is defined as the lowest frequency at which the imaginary part of the input impedance, Im[Zin], equals zero. Should Im[Zin] or the real part of the input impedance, Re[Zin], not be monotonic with frequency at frequencies lower than those at which Im[Zin] = 0, the FSR shall be considered as undefined. FSR is dependent on internal capacitor structure; substrate thickness and dielectric constant; capacitor orientation, as defined alongside the FPR plot; and mounting pad dimensions. The measurement conditions are: substrate – Rogers RO4350; substrate dielectric constant = 3.66; horizontal mount substrate thickness (mils) = 25; gap in microstrip trace (mils) = 15; horizontal mount microstrip trace width (mils) = 55. Reference planes at sample edges. All data has been derived from electrical models created by Modelithics, Inc., a specialty vendor contracted by PPI. The models are derived from measurements on a large number of parts disposed on several different substrates.

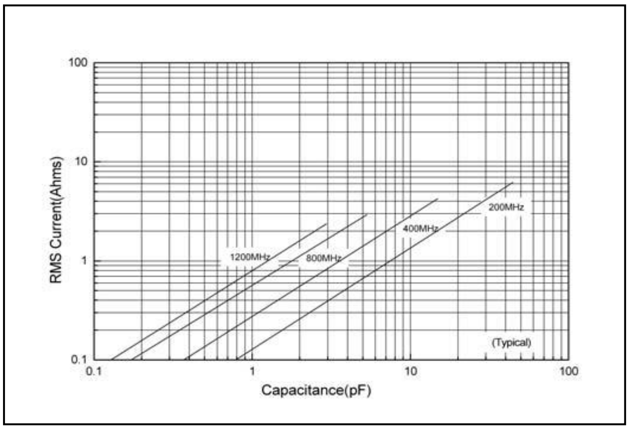
0505C/P First Parallel Resonance (FPRs)



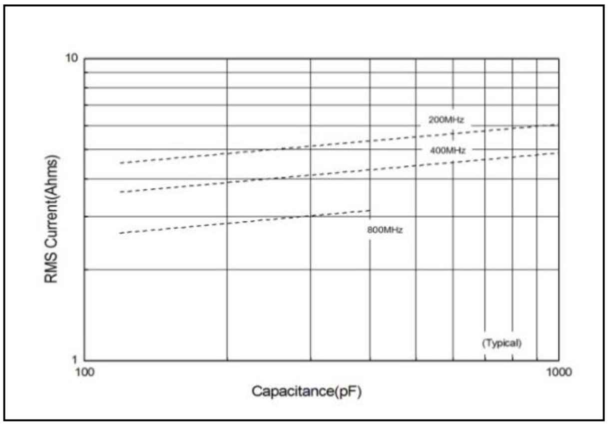
0505C/P First Series Resonance (FSRs)



0505C/P Current Rating vs Capacitance



0505C Current Rating vs Capacitance



The current depends on voltage limited:

$$I=\frac{\sqrt{2}}{2}I_{peak}=\frac{\sqrt{2}}{2}\times\frac{V_{rated}}{X_C}=\sqrt{2}\pi FCV_{rated}$$

The current depends on power dissipation limited: $I=\sqrt{\frac{P_{dissipation}}{ESR}}$

Note: If the thermal resistance of mounting surface is 40° C/W. then a power dissipation of 1.5 W will result in the current limited we can calculate the current limited:

$$I=\sqrt{\frac{P_{dissipation}}{ESR}}$$

<u>Definitions and Measurement conditions</u>:

The First Parallel Resonance, FPR, is defined as the lowest frequency at which a suckout or notch appears in |S21|. It is generally independent of substrate thickness or dielectric constant, but does depend on capacitor orientation. A horizontal orientation means the capacitor electrode planes are parallel to the plane of the substrate; a vertical orientation means the electrode planes are perpendicular to the substrate.

The measurement conditions are: substrate – Rogers RO4350; substrate dielectric constant = 3.66; horizontal mount substrate thickness (mils) = 25; gap in microstrip trace (mils) = 15; horizontal mount microstrip trace width (mils) = 55. Reference planes at sample edges.

All data has been derived from electrical models created by Modelithics, Inc., a specialty vendor contracted by PPI. The models are derived from measurements on a large number of parts disposed on several different substrates.

0505C/P (.055" x.055")

◆ Design Kits

These capacitors are 100% RoHS. Kits are available in Magnetic and Non-Magnetic that contain 10 (ten) pieces per value; 16 values per kit.

DKD0505C01 DKD0505P01	0.1pF- 2.0pF	0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.5pF	± 0.1pF
		1.6, 1.8, 2.0pF	± 0.25pF
DKD0505C02 DKD0505P02	1.0pF - 10pF	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7pF	± 0.1pF
		3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2pF	± 0.25pF
		10pF	± 5%
DKD0505C03 DKD0505P03	10pF -100pF	10, 12, 15, 18, 20, 22, 24, 27, 30, 33, 39, 47, 56, 68, 82, 100pF	± 5%
DKD0505C04	100pF-1000pF	100, 120, 150, 180, 200, 220, 240, 270, 300, 30pF,	± 5%
		390, 470, 560, 680, 820, 1000pF	± 5%
DKD0505C05 DKD0505P05	0.1pF- 2.0pF Non-Magnetic	0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.5pF	± 0.1pF
		1.6, 1.8, 2.0pF	± 0.25pF
DKD0505C06 DKD0505P06	1.0pF - 10pF Non-Magnetic	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7pF	± 0.1pF
		3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2pF	± 0.25pF
		10pF	± 5%
DKD0505C07 DKD0505P07	10pF - 100pF Non-Magnetic	10, 12, 15, 18, 20, 22, 24, 27, 30, 33, 39, 47, 56, 68, 82, 100pF	± 5%
DKD0505C08	100pF- 1000pF Non-Magnetic	100, 120, 150, 180, 200, 220, 240, 270, 300, 330pF,	± 5%
		390, 470, 560, 680, 820, 1000pF	± 5%

◆ Recommended Land Pattern Dimensions

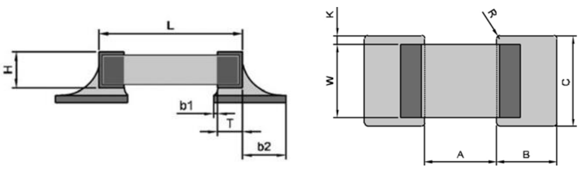
When mounting the capacitor to substrate, it's important to carefully consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

1) The greater the amount of solder, the greater the stress to the elements. This may cause the substrate to break or crack.

2) In the situation where two or more devices are mounted onto a common land, be sure to separate the device into exclusive pads by using soldering resist.

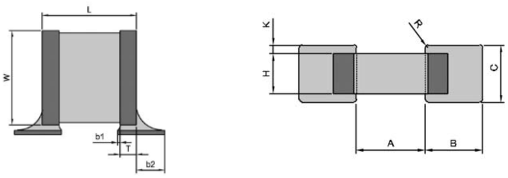
● Horizontal Mounting

Orientation	EIA	A	B	C
Horizontal	0505	0.5-0.7	0.7-0.9	1.2-1.4



● Vertical Mounting

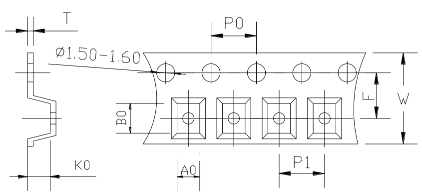
Orientation	EIA	A	B	C
Vertical	0505	0.5-0.7	0.7-0.9	1.0-1.2



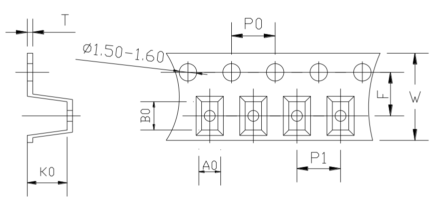
◆ Tape & Reel Specifications

Orientation	EIA	A0	B0	K0	W	P0	P1	T	F	Qty Min	Qty /reel	Tape material
Horizontal	0505	1.38	1.68	0.98	8.00	4.00	4.00	0.22	3.50	500	3000	Plastic
Vertical	0505	1.10	1.60	1.40	12.00	4.00	4.00	0.30	5.50	300	2000	Plastic

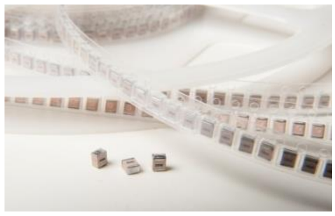
Horizontal Orientation



Vertical Orientation



1111C/P (.110” x .110”)



◆ Product Features

High Q, High Power, Low ESR/ESL, Low Noise, High Self-Resonance, Ultra-Stable Performance.

◆ Product Application

Typical Functional Applications: Bypass, Coupling, Tuning, Feedback, Impedance Matching and D.C. Blocking.
Typical Circuit Applications: UHF/Microwave RF Power Amplifiers, Mixers, Oscillators, Low Noise Amplifiers, Filter Networks, Timing Circuits and Delay Lines.

◆ 1111C/P Capacitance Table NP0=C; P90=P **1111P: 1000pF max., 1111C: 10000pF max.**

Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC
0.1	0R1	A,B	500V Code 501 or 1500V Code 152	3.6	3R6	A,B, C,D	500V Code 501 or 1500V Code 152	43	430	F,G, J,K	500V Code 501 or 1500V Code 152	510	511	F,G, J,K	100V Code 101 or 200V Code 201
0.2	0R2			3.9	3R9			47	470			560	561		
0.3	0R3			4.3	4R3			51	510			620	621		
0.4	0R4			4.7	4R7			56	560			680	681		
0.5	0R5	A,B, C,D		5.1	5R1			62	620			750	751		
0.6	0R6			5.6	5R6			68	680			820	821		
0.7	0R7			6.2	6R2			75	750			910	911		
0.8	0R8			6.8	6R8			82	820			1000	102		
0.9	0R9			7.5	7R5			91	910			1100	112*	F,G, J,K	200V Code 201
1.0	1R0			8.2	8R2			100	101			1200	122*		
1.1	1R1			9.1	9R1			110	111		300V Code 301 or 1000V Code 102	1500	152*		
1.2	1R2			10	100	F,G, J,K		120	121			1800	182*		
1.3	1R3			11	110			130	131			2200	222*		100V Code 101
1.4	1R4			12	120			150	151			2700	272*		
1.5	1R5			13	130			160	161			3000	302*		
1.6	1R6			15	150			180	181			3300	332*		
1.7	1R7			16	160			200	201			3900	392*		
1.8	1R8			18	180			220	221		200V Code 201 or 600V Code 601	4700	472*		
1.9	1R9			20	200			240	241			5100	512*		50V Code 500
2.0	2R0			22	220			270	271			5600	562*		
2.1	2R1			24	240			300	301			10000	103*		
2.2	2R2			27	270			330	331						
2.4	2R4			30	300			360	361						
2.7	2R7			33	330			390	391						
3.0	3R0			36	360			430	431						
3.3	3R3			39	390			470	471						

Remark: special capacitance, tolerance and WVDC are available, consult with PASSIVE PLUS. *** - Available in NP0 only.**

◆ Part Numbering

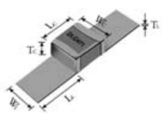
1111C 101 J W 501 X TV

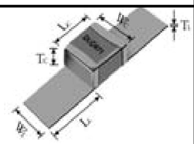
- 1111C: C=NP0; P=P90
- 101: Capacitor Code 101=10x10[1]=100pF; 1R0=1.0pF
- J: Capacitance Tolerance: See below list
- W: Termination Type
- 501: Rated Voltage
- X: Laser Marking
- TV: Add TV for Vertical Orientation

Capacitance Tolerance								
Code	A	B	C	D	F	G	J	K
Tolerance	±0.05pF	±0.1pF	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%

◆ 1111C/P Lead Type and Dimensions

unit:inch(millimeter)

Series	Term. Code	Type/ Outlines	Capacitor Dimensions				Lead Dimensions			Plated Material
			Length Lc	Width Wc	Thick. Tc	Overlap B	Length LL	Width WL	Thickness TL	
1111C 1111P	W	 Chip	.110 +.020 to -.010 (2.79 +0.51 to -0.25)	.110 ±.010 (2.79± 0.25)	.10 (2.54) max	.024 (0.60) Max	-	-	-	100%Sn Solder over Nickel Plating RoHS Compliant
	L									90%Sn10%Pb Tin/Lead Solder over Nickel Plating
1111C 1111P	MS	 Microstrip	.135 ± .015 (3.43± 0.38)	.110 ±.010 (2.79± 0.25)	.10 (2.54) max	-	.250 (6.35) min	.093 ± .005 (2.36 ±0.13)	.004±.001 (0.1±0.025)	100%Silver

Series	Term. Code	Type/ Outlines	Capacitor Dimensions				Lead Dimensions			Plated Material
			Length Lc	Width Wc	Thick. Tc	Overlap B	Length LL	Width WL	Thickness TL	
1111C 1111P	P	 Chip (Non-Mag)	.110 +.020 to -.010 (2.79 +0.51to -0.25)	.110 ±.010 (2.79± 0.25)	.10 (2.54) max	.024 (0.60) Max	-	-	-	100%Sn Solder over Copper Plating RoHS Compliant
1111C 1111P	MN	 Microstrip (Non-Mag)	.135 ± .015 (3.43± 0.38)	.110 ±.010 (2.79± 0.25)	.10 (2.54) max	-	.250 (6.35) min	.093 ± .005 (2.36± 0.13)	.004±.001 (0.1±0.025)	100%Silver

Note: “Non-Mag” means no magnetic materials. All leads are attached with high temperature solder and parts are RoHS Compliant.

◆ Performance

Item	Specifications
Quality Factor (Q)	greater than 10,000 at 1MHz.
Insulation Resistance (IR)	0.1 pF to 470 pF: 10^6Megohms min. @ +25 ℃ at rated WVDC. 10^5 Megohms min. @ +125 ℃ at rated WVDC. 510 pF to 10000 pF: 10^5 Megohms min. @ +25 ℃ at rated WVDC. 10^4 Megohms min. @ +125 ℃ at rated WVDC.
Rated Voltage	See Rated Voltage Table.
Dielectric Withstanding Voltage (DWV)	250% of Voltage for 5seconds, Rated Voltage≦500VDC 150% of Voltage for 5 seconds, 500VDC< Rated Voltage ≦1250VDC 120% of Voltage for 5 seconds, Rated Voltage>1250VDC
Operating Temperature Range	-55 ℃ to +200 ℃
Temperature coefficient (TC)	C: 0±30ppm/℃ ; P: +90±20ppm/℃
Capacitance Drift	±0.02% or ±0.02pF, whichever is greater.
Piezoelectric Effects	None
Termination Type	See Termination Type Table.

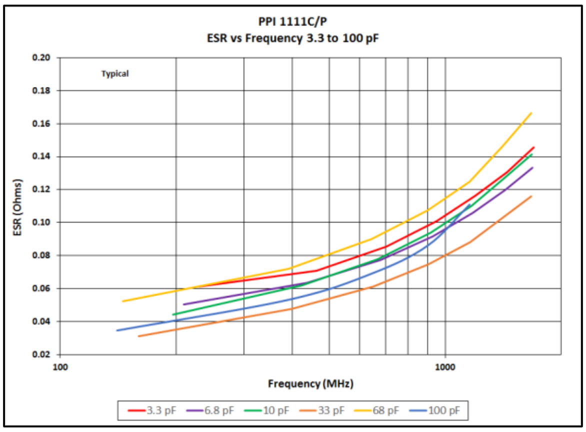
Capacitors are designed and manufactured to meet the requirements of MIL-PRF-55681 and MIL-PRF-123.

◆ Environmental Tests

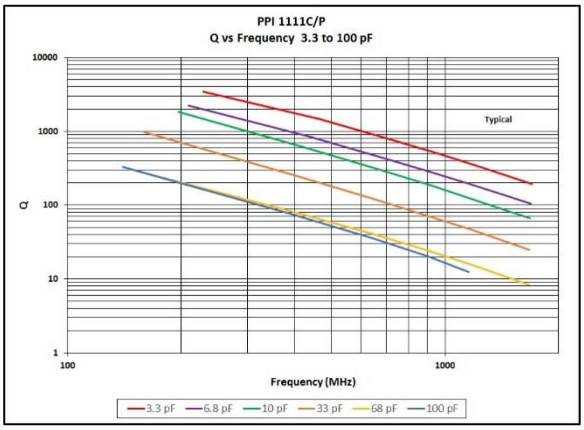
Item	Specifications	Method
Thermal shock	DWV: the initial value IR: Shall not be less than 30% of the initial value Capacitance change: no more than 0.5% or 0.5pF, whichever is greater.	MIL-STD-202, Method 107, Condition A. At the maximum rated temperature (-55℃ and 200℃) stay 30 min,the time of removing shall not be more than 3 minutes. Perform the five cycles.
Moisture resistance		MIL-STD-202, Method 106.
Humidity (steady state)	DWV: the initial value IR: the initial value Capacitance change: no more than 0.3% or 0.3pF, whichever is greater.	MIL-STD-202, Method 103, Condition A, With 1.5 Volts D.C. applied while subjected to an environment of 85℃ with 85% relative humidity for 240 hours minimum.
Life	IR: Shall not be less than 30% of the initial value Capacitance change: no more than 2.0% or 0.5pF, whichever is greater.	MIL-STD-202, Method 108, for2000hours, at 200℃. 200% of Voltage for Capacitors, RatedVoltage≦500VDC; 120% of Voltage for Capacitors, 500VDC< Rated Voltage ≦1250VDC; 100% of Voltage forCapacitors, RatedVoltage>1250VDC.
Terminal strength	Force : 10lbs typical, 5 lbs min., Duration time: 5 to 10 seconds.	MIL-STD-202, Method 211A, Test condition A. Applied a force and maintained for a period of 5 to 10 seconds. The force shall be in the direction of the axes of the terminations.

◆ 1111C/P Performance Curves

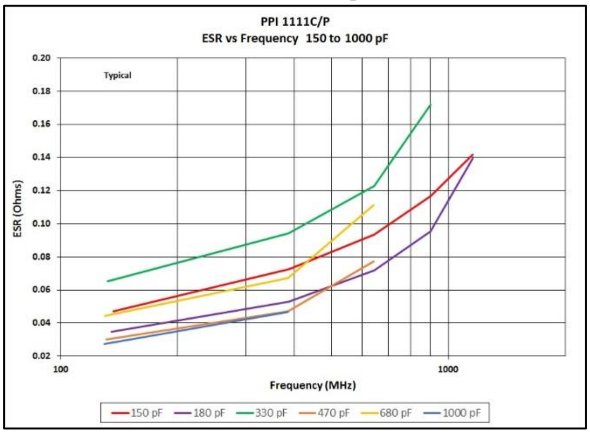
1111C/P ESR vs Capacitance



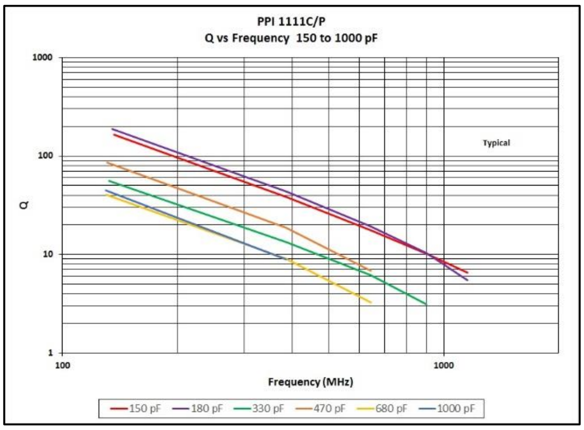
1111C/P Q vs Capacitance



1111C ESR vs Capacitance



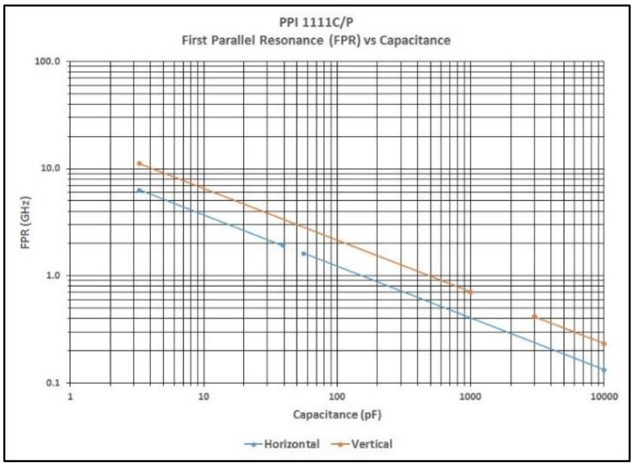
1111C Q vs Capacitance



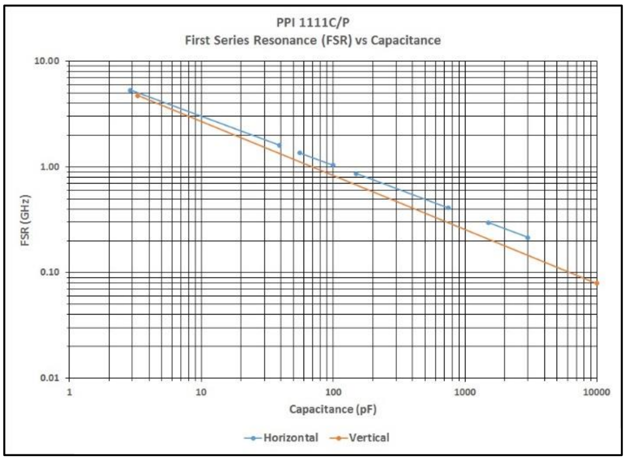
Definitions and Measurement Conditions

For a capacitor in a series configuration, i.e., mounted across a gap in a microstrip trace, with 50-Ohm source and termination resistances, the First Series Resonance, FSR, is defined as the lowest frequency at which the imaginary part of the input impedance, Im[Zin], equals zero. Should Im[Zin] or the real part of the input impedance, Re[Zin], not be monotonic with frequency at frequencies lower than those at which Im[Zin] = 0, the FSR shall be considered as undefined (gap in plot above). The First Series Resonance, FSR, is defined as the lowest frequency at which the imaginary part of the input impedance, Im[Zin], equals zero. Should Im[Zin] or the real part of the input impedance, Re[Zin], not be monotonic with frequency at frequencies lower than those at which Im[Zin] = 0, the FSR shall be considered as undefined. FSR is dependent on internal capacitor structure; substrate thickness and dielectric constant; capacitor orientation, as defined alongside the FPR plot; and mounting pad dimensions. The measurement conditions are: substrate – Rogers RO4350; substrate dielectric constant = 3.66; horizontal mount substrate thickness (mils) = 50; gap in microstrip trace (mils) = 72; horizontal mount microstrip trace width (mils) = 110. Reference planes at sample edges. All data has been derived from electrical models created by Modelithics, Inc., a specialty vendor contracted by PPI. The models are derived from measurements on a large number of parts disposed on several different substrates.

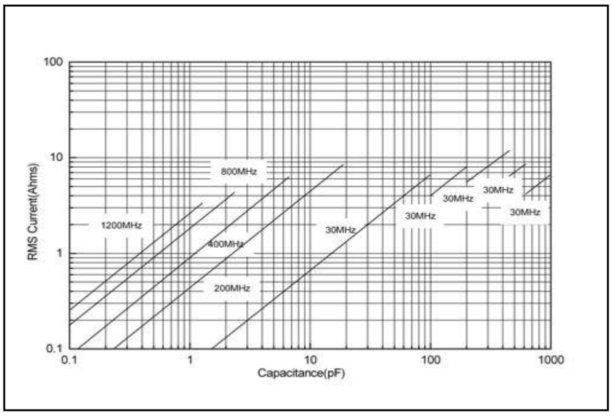
1111C/P First Parallel Resonance (FPRs)



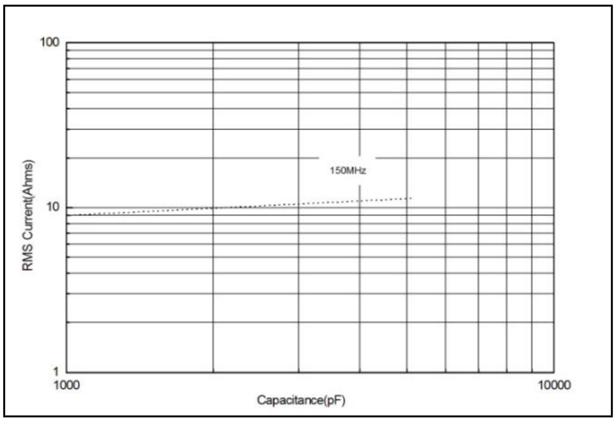
1111C/P First Series Resonance (FSRs)



1111C/P Current Rating vs Capacitance



1111C Current Rating vs Capacitance



The current depends on voltage limited:

$$I = \frac{\sqrt{2}}{2} I_{peak} = \frac{\sqrt{2}}{2} \times \frac{V_{rated}}{X_c} = \sqrt{2}\pi FCV_{rated}$$

The current depends on power dissipation limited: $I = \sqrt{\frac{P_{dissipation}}{ESR}}$

Note: If the thermal resistance of mounting surface is 20 ℃/W. then a power dissipation of 3 W will result in the current limited we can calculate the current limited: $I = \sqrt{\frac{P_{dissipation}}{ESR}}$

<u>Definitions and Measurement conditions</u>:

The First Parallel Resonance, FPR, is defined as the lowest frequency at which a suckout or notch appears in |S21|. It is generally independent of substrate thickness or dielectric constant, but does depend on capacitor orientation. A horizontal orientation means the capacitor electrode planes are parallel to the plane of the substrate; a vertical orientation means the electrode planes are perpendicular to the substrate. The measurement conditions are: substrate – Rogers RO4350; substrate dielectric constant = 3.66; horizontal mount substrate thickness (mils) = 50; gap in microstrip trace (mils) = 72; horizontal mount microstrip trace width (mils) = 110. Reference planes at sample edges. All data has been derived from electrical models created by Modelithics, Inc., a specialty vendor contracted by PPI. The models are derived from measurements on a large number of parts disposed on several different substrates.

◆ Design Kits

These capacitors are 100% RoHS. Kits are available in Magnetic and Non-Magnetic that contain 10 (ten) pieces per value.

Design Kit	Description	Values (pF)	No. of values	Toler-ances
DKD1111C01 **DKD1111P01**	1.0pF - 10pF	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7pF	16	± 0.1pF
		3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2pF		±0.25pF
		10pF		± 5%
DKD1111C02 **DKD1111P02**	10pF -100pF	10, 12, 15, 18, 20, 22, 24, 27, 30, 33, 39, 47, 56, 68, 82, 100pF	16	± 5%
DKD1111C03 **DKD1111P03**	100pF-1000pF	100, 120, 150, 180, 200, 220, 240, 270, 300, 330, 390, 470, 560, 680, 820,1000pF	16	± 5%
DKD1111C04 **DKD1111P04**	1000pF-10000pF	1000, 1100, 1200, 1500, 1800, 2000, 2200, 2700, 3000, 3300, 3900, 4700, 5600, 10000pF	14	± 5%
DKD1111C05 **DKD1111P05**	1.0pF - 10pF Non-Magnetic	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7pF	16	± 0.1pF
		3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2pF		±0.25pF
		10pF		± 5%
DKD1111C06 **DKD1111P06**	10pF - 100pF Non-Magnetic	10, 12, 15, 18, 20, 22, 24, 27, 30, 33, 39, 47, 56, 68, 82, 100pF	16	± 5%
DKD1111C07 **DKD1111P07**	100pF- 1000pF Non-Magnetic	100, 120, 150, 180, 200, 220, 240, 270, 300, 330, 390, 470, 560, 680, 820,1000pF	16	± 5%
DKD1111C08 **DKD1111P08**	1000pF- 10000pF Non-Magnetic	1000, 1100, 1200, 1500, 1800, 2000, 2200, 2700, 3000, 3300, 3900, 4700, 5600,10000pF	14	± 5%

◆ Recommended Land Pattern Dimensions

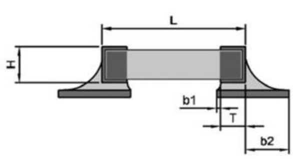
When mounting the capacitor to substrate, it's important to carefully consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

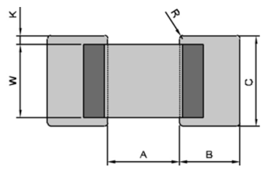
1) The greater the amount of solder, the greater the stress to the elements. This may cause the substrate to break or crack.

2) In the situation where two or more devices are mounted onto a common land, be sure to separate the device into exclusive pads by using soldering resist.

● Horizontal Mounting

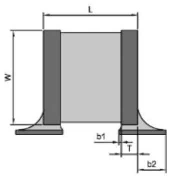
Orientation	EIA	A	B	C
Horizontal	1111	1.9	1.7	2.9

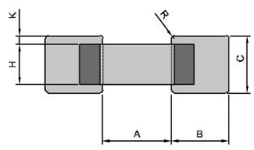




● Vertical Mounting

Orientation	EIA	A	B	C
Vertical	1111	1.9	1.7	2.5

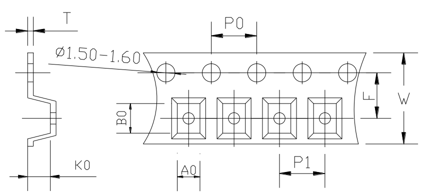




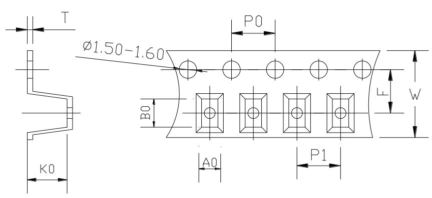
◆ Tape & Reel Specifications

Orientation	EIA	A0	B0	K0	W	P0	P1	T	F	Qty Min	Qty /reel	Tape material
Horizontal	1111	2.85	3.90	1.95	8.00	4.00	4.00	0.22	3.50	300	2000	Plastic
Vertical	1111	2.00	3.50	2.70	12.00	4.00	4.00	0.40	5.50	300	1500	Plastic
Vertical	1111	2.96	3.60	2.40	8.00	4.00	4.00	0.22	3.50	300	1500	Plastic

Horizontal Orientation



Vertical Orientation



2225C/P (.220" x .250")

◆ Product Features

High Q, High RF Current/Voltage, High RF Power, Low ESR/ESL, Ultra-Stable Performance.

◆ Product Application

Typical Functional Applications: Bypass, Coupling, Tuning, Impedance Matching and D.C. Blocking.
Typical Circuit Applications: UHF/VHF RF Power Amplifiers, Antenna Tuning, Plasma Chambers and Medical Equipment.

◆ 2225C/P Capacitance Table NP0=C; P90=P

Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC
0.5	0R5	B,C,D	2500V Code 252 or 3600V Code 362	3.9	3R9	B,C,D	2500V Code 252 or 3600V Code 362	36	360	F,G, J,K	2500V Code 252 or 3600V Code 362	330	331	F,G, J,K	1500V Code 152 or 2000V Code 202
0.6	0R6			4.3	4R3			39	390			360	361		
0.7	0R7			4.7	4R7			43	430			390	391		
0.8	0R8			5.1	5R1			47	470			430	431		
0.9	0R9			5.6	5R6			51	510			470	471		
1.0	1R0			6.2	6R2			56	560			510	511		1000V Code 102 or 1500V Code 152
1.1	1R1			6.8	6R8			62	620			560	561		
1.2	1R2			7.5	7R5			68	680			620	621		
1.3	1R3			8.2	8R2			75	750			680	681		
1.4	1R4			9.1	9R1			82	820			750	751		
1.5	1R5			10	100	F,G, J,K		91	910			820	821		
1.6	1R6			11	110			100	101			910	911		
1.7	1R7			12	120			110	111		2500V Code 252 or 3000V Code 302	1000	102		
1.8	1R8			13	130			120	121			1100	112		
1.9	1R9			15	150			130	131			1200	122		
2.0	2R0			16	160			150	151			1500	152		500V Code 501
2.1	2R1			18	180			160	161			1800	182		
2.2	2R2			20	200			180	181			2200	222		
2.4	2R4			22	220			200	201			2700	272		
2.7	2R7			24	240			220	221						
3.0	3R0			27	270			240	241						
3.3	3R3			30	300			270	271						
3.6	3R6			33	330			300	301						

Remark: special capacitance, tolerance and WVDC are available, consult with PASSIVE PLUS.

◆ Part Numbering

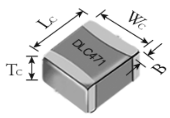
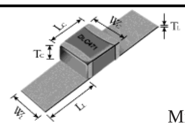
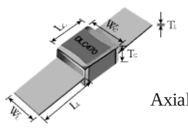
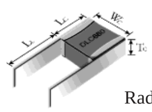
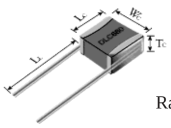
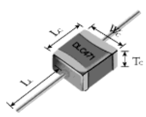
2225C 101 J W 252 X TV

- 2225C: C=NP0; P=P90
- 101: Capacitor Code 101=10x10[1]=100pF; 1R0=1.0pF
- J: Capacitance Tolerance: See below list
- W: Termination Type
- 252: Rated Voltage
- X: Laser Marking
- TV: Add TV for Vertical Orientation

Capacitance Tolerance								
Code	A	B	C	D	F	G	J	K
Tolerance	±0.05pF	±0.1pF	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%

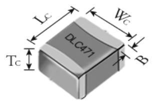
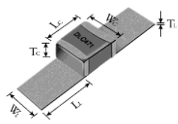
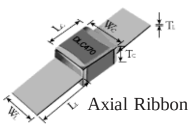
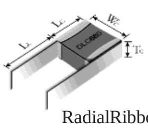
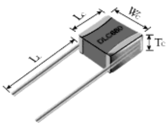
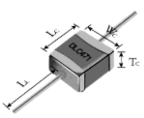
◆ 2225C/P Lead Type and Dimensions

unit: inch (millimeter)

Series	Term. Code	Type/ Outlines	Capacitor Dimensions				Lead Dimensions			Plated Material
			Length Lc	Width Wc	Thick-ness Tc	Overlap B	Length LL	Width WL	Thick-ness TL	
2225C 2225P	W	 Chip	.230 +.025 to -.010 (5.84 +0.64 to -0.25)	.250 ±.015 (6.35± 0.38)	.165 (4.19) max	.047 (1.20) max	-	-	-	100%Sn Solder over Nickel Plating RoHS Compliant
	L									90%Sn10%Pb Tin/Lead Solder over Nickel Plating
2225C 2225P	MS	 Microstrip	.245 ± .025 (6.22± 0.64)	.250±.015 (6.35± 0.38)	.150 (3.81) max	-	.500 (12.70) min	.240 ±.005 (6.1± 0.13)	.008 ±.001 (0.2± 0.025)	Silver-plated Copper
2225C 2225P	AR	 Axial Ribbon							.004 ±.001(0.1 ±0.025)	100% Silver
2225C 2225P	RR	 Radial Ribbon					.394 (10.00) min	.118± .005 (3.0± 0.13)	.012 ±.001 (0.3± 0.025)	Silver-plated Copper
2225C 2225P	RW	 Radial Wire					.787 (20.00) min	Dia.=.031±.004 (0.80 ± 0.10)		
2225C 2225P	AW	 Axial Wire					.984 (25.00) min			

◆ 2225 C /P Non-Magnetic Lead Type and Dimensions

unit:inch(millimeter)

<table>
<tr><th rowspan="2">Series</th><th rowspan="2">Term. Code</th><th rowspan="2">Type/
Outlines</th><th colspan="4">Capacitor Dimensions</th><th colspan="3">Lead Dimensions</th><th rowspan="2">Plated Material</th></tr>
<tr><th>Length
Lc</th><th>Width
Wc</th><th>Thick-
ness
Tc</th><th>Overlap
B</th><th>Length
LL</th><th>Width
WL</th><th>Thick
-ness
TL</th></tr>
<tr><td>2225C
2225P</td><td>P</td><td>
Chip (Non-Mag)</td><td>.230
+.020 to
-.010
(5.84
+0.51 to
-0.25)</td><td>.250
±.015
(6.35±
0.38)</td><td>.165
(4.19)
max</td><td>.047
(1.20)
max</td><td>-</td><td>-</td><td>-</td><td>100%Sn
Solder over
Copper
Plating
RoHS
Compliant</td></tr>
<tr><td>2225C
2225P</td><td>MN</td><td>
Microstrip (Non-Mag)</td><td rowspan="5">.245
±.025
(6.22±
0.64)</td><td rowspan="5">.250
±.015
(6.35±
0.38)</td><td rowspan="5">.150
(3.81)
max</td><td rowspan="5">-</td><td rowspan="2">.500
(12.70)
min</td><td rowspan="2">.240
±.005
(6.1±
0.13)</td><td>.008
±.001
(0.2±
0.025)</td><td>Silver-
plated
Copper</td></tr>
<tr><td>2225C
2225P</td><td>AN</td><td>
Axial Ribbon (Non-Mag)</td><td>.004
±.001
(0.1±
0.025)</td><td>100%
Silver</td></tr>
<tr><td>2225C
2225P</td><td>FN</td><td>
RadialRibbon (Non-Mag)</td><td>.394
(10.00)
min</td><td>.118
±.005
(3.0±
0.13)</td><td>.012
±.001
(0.3±
0.025)</td><td rowspan="3">Silver-
plated
Copper</td></tr>
<tr><td>2225C
2225P</td><td>RN</td><td>
Radial Wire(Non-Mag)</td><td>.787
(20.00)
min</td><td colspan="2" rowspan="2">Dia.=.031±.004
(0.80 ± 0.10)</td></tr>
<tr><td>2225C
2225P</td><td>BN</td><td>
Axial Wire (Non-Mag)</td><td>.984
(25.00)
min</td></tr>
</table>

Note: "Non-Mag" means no magnetic materials. All leads are attached with high temperature solder and parts are RoHS Compliant.

◆ Performance

Item	Specifications
Quality Factor (Q)	Greater than 10,000 at 1MHz.
Insulation Resistance (IR)	Test Voltage: 500V 10^5 Megohms min. @ +25℃ at rated WVDC. 10^4 Megohms min. @ +125℃ at rated WVDC.
Rated Voltage	See Rated Voltage Table.
Dielectric Withstanding Voltage (DWV)	250% of Voltage for 5seconds, Rated Voltage≦500VDC 150% of Voltage for 5seconds, 500VDC<RatedVoltage≦1250VDC 120% of Voltage for 5 seconds, Rated Voltage>1250VDC
Operating Temperature Range	-55℃ to +200℃
Temperature coefficient (TC)	C: 0±30ppm/℃ ; P: +90±20ppm/℃
Capacitance Drift	±0.02% or ±0.02pF, whichever is greater.
Piezoelectric Effects	None
Termination Type	See Termination Type Table.

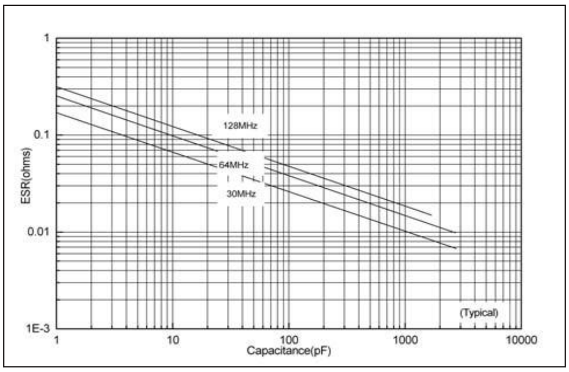
Capacitors are designed and manufactured to meet the requirements of MIL-PRF-55681 and MIL-PRF-123.

◆ Environmental Tests

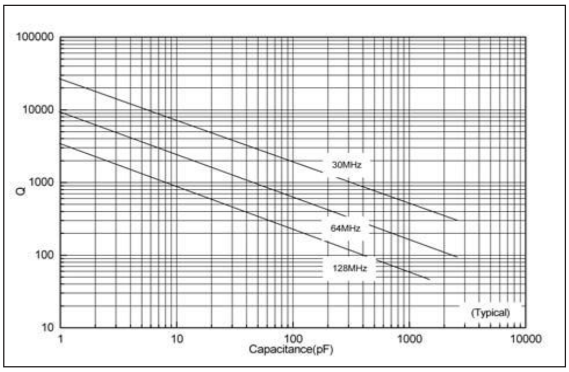
Item	Specifications	Method
Thermal shock	DWV: the initial value IR: Shall not be less than 30% of the initial value. Capacitance change: no more than 0.5% or 0.5 pF, whichever is greater.	MIL-STD-202, Method 107, Condition A. At the maximum rated temperature (-55℃ and 125℃) stay 30 min, the time of removing shall not be more than 3 minutes. Perform the five cycles.
Moisture resistance		MIL-STD-202, Method 106.
Humidity (steady state)	DWV: the initial value IR: the initial value Capacitance change: no more than 0.3% or 0.3pF, whichever is greater.	MIL-STD-202, Method 103, Condition A, With 1.5 Volts D.C. applied while subjected to an environment of 85℃ with 85% relative humidity for 240 hours minimum.
Life	IR: Shall not be less than 30% of the initial value. Capacitance change: no more than 2.0% or 0.5 pF, whichever is greater.	MIL-STD-202, Method 108, for 2000 hours, at 125 ℃, 200% of Voltage for Capacitors, Rated Voltage≦500VDC; 120% of Voltage for Capacitors, 500VDC<RatedVoltage≦1250VDC; 100% of Voltage for Capacitors, Rated Voltage>1250VDC.
Terminal strength	Force : 20lbs typical, 10 lbs min., Duration time: 5 to 10 seconds.	MIL-STD-202, Method 211A, Test condition A. Applied a force and maintained for a period of 5 to 10 seconds. The force shall be in the direction of the axes of the terminations.

◆ 2225C/P Performance Curves

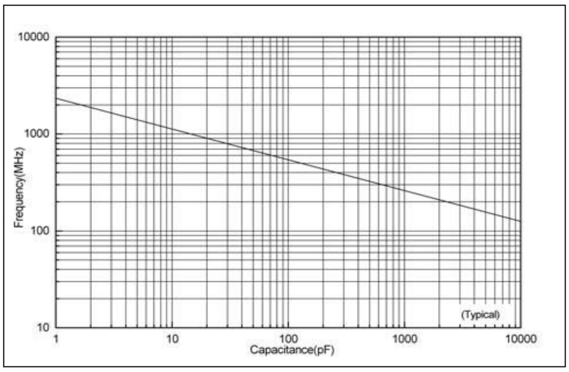
ESR vs Capacitance



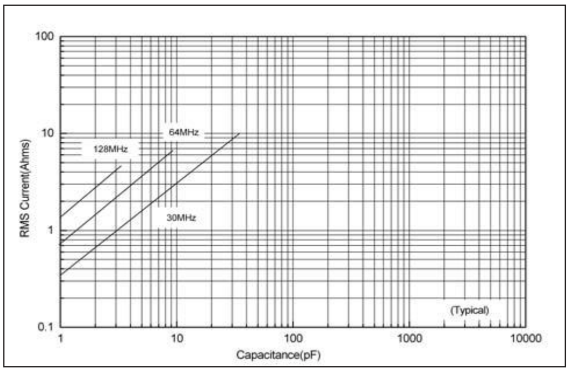
Q vs Capacitance



Series Resonance vs Capacitance



Current Rating vs Capacitance



The current depends on voltage limited:

$$I = \frac{\sqrt{2}}{2} I_{peak} = \frac{\sqrt{2}}{2} \times \frac{V_{rated}}{X} = \sqrt{2}\pi f C V_{rated}$$

$$I = \sqrt{\frac{P_{dissipation}}{ESR}}$$

The current depends on power dissipation limited:

Note: If the thermal resistance of mounting surface is 15° C /W,

then a power dissipation of 4 W will result in the current limited.

We can calculate the current limited.

◆ Recommended Land Pattern Dimensions

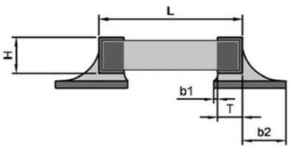
When mounting the capacitor to substrate, it's important to carefully consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

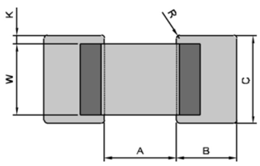
1) The greater the amount of solder, the greater the stress to the elements. This may cause the substrate to break or crack.

2) In the situation where two or more devices are mounted onto a common land, be sure to separate the device into exclusive pads by using soldering resist.

● Horizontal Mounting

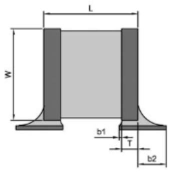
Orientation	EIA	A	B	C
Horizontal	2225	3.9	2.5	7.0

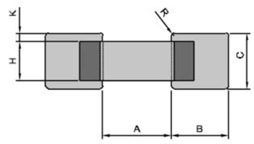




● Vertical Mounting

Orientation	EIA	A	B	C
Vertical	2225	3.9	2.5	4.0

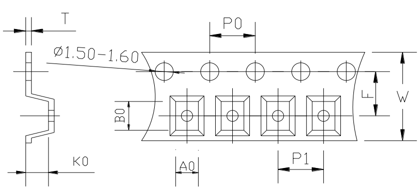




◆ Tape & Reel Specifications

Orientation	EIA	A0	B0	K0	W	P0	P1	T	F	Qty Min	Qty /reel	Tape material
Horizontal	2225	6.70	6.20	3.40	16.00	4.00	12.00	0.30	7.50	500	500	Plastic

● Horizontal Orientation



3838C/P (.380” x .380”)

◆Product Features

High Q, High RF Current/Voltage, High RF Power, Low ESR/ESL, Low Noise, Ultra-Stable Performance.

◆ Product Application

Typical Functional Applications: Bypass, Coupling, Tuning, Impedance Matching and D.C. Blocking.
Typical Circuit Applications: HF/RF Power Amplifiers, Transmitters, Antenna Tuning, Plasma Chambers, and Medical Equipment.

◆ 3838C/P Capacitance Table NP0= C; P90=P

Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC
0.5	0R5	B,C,D	3600V Code 362 or 7200V Code 722	4.7	4R7	B,C,D	3600V Code 362 or 7200V Code 722	51	510	F,G, J,K	3600V Code 362 or 7200V Code 722	560	561	F,G, J,K	2500V Code 252
0.6	0R6			5.1	5R1			56	560			620	621		
0.7	0R7			5.6	5R6			62	620			680	681		
0.8	0R8			6.2	6R2			68	680			750	751		
0.9	0R9			6.8	6R8			75	750			820	821		1000V Code 102
1.0	1R0			7.5	7R5			82	820			910	911		
1.1	1R1			8.2	8R2			91	910			1000	102		
1.2	1R2			9.1	9R1			100	101		3600V Code 362 or 7200V Code 722	1100	112		
1.3	1R3			10	100	F,G, J,K		110	111			1200	122		
1.4	1R4			11	110			120	121			1500	152		
1.5	1R5			12	120			130	131			1800	182		
1.6	1R6			13	130			150	151			2200	222		
1.7	1R7			15	150			160	161			2400	242		
1.8	1R8			16	160			180	181			2700	272		500V Code 501
1.9	1R9			18	180			200	201		3600V Code 362	3000	302		
2.0	2R0			20	200			220	221			3300	332		
2.1	2R1			22	220			240	241			3600	362		
2.2	2R2			24	240			270	271			3900	392		
2.4	2R4			27	270			300	301			4300	432		
2.7	2R7			30	300			330	331			4700	472		
3.0	3R0			33	330			360	361			5100	512		
3.3	3R3			36	360			390	391						
3.6	3R6			39	390			430	431		2500V Code 252				
3.9	3R9			43	430			470	471						
4.3	4R3			47	470			510	511						

Remark: special capacitance, tolerance and WVDC are available, consult with PASSIVE PLUS.

◆ Part Numbering

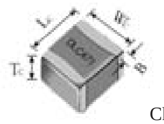
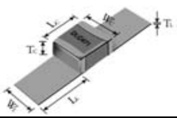
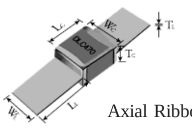
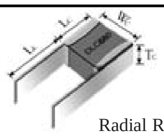
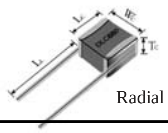
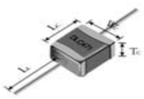
3838C 101 J W 362 X

- 3838C — C=NP0; P=P90
- 101 — Capacitor Code 101=10x10[1]=100pF; 1R0=1.0pF
- J — Capacitance Tolerance: See below list
- W — Termination Type
- 362 — Rated Voltage
- X — Laser Marking

Capacitance Tolerance								
Code	A	B	C	D	F	G	J	K
Tolerance	±0.05pF	±0.1pF	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%

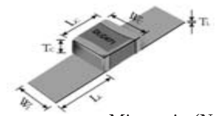
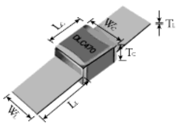
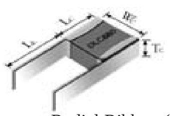
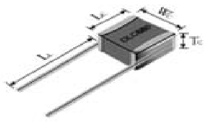
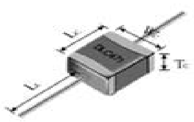
◆ 3838C/P Lead Type and Dimensions

unit:inch(millimeter)

Series	Term. Code	Type/ Outlines	Capacitor Dimensions				Lead Dimensions			Plated Material
			Length Lc	Width Wc	Thick -ness Tc	Overlap B	Length LL	Width WL	Thick- ness TL	
3838C 3838P	W	 Chip	.380+.015 to - .010 (9.65+0.38 to -0.25)	.380 ±.010 (9.65± 0.25)	.170 (4.32) max	.063 (1.60) max	-	-	-	100%Sn Solder over Nickel Plating RoHS Compliant
	L									90%Sn10%Pb Tin/Lead Solder over Nickel Plating
3838C 3838P	MS	 Microstrip	.380+.015 to -.010 (9.65+0.38 to -0.25)	.380 ±.010 (9.65± 0.25)	.177 (4.50) max	-	.750 (19.05) min	.35 ± .01 (8.89± 0.25)	.008 ± .001 (0.20± 0.025)	Silver-plated Copper
3838C 3838P	AR	 Axial Ribbon							.004 ± .001 (0.10± 0.025)	100% Silver
3838C 3838P	RR	 Radial Ribbon					.394 (10.00) Min	.118± .005 (3.0± 0.13)	.012± .001 (0.3± 0.025)	Silver-plated Copper
3838C 3838P	RW	 Radial Wire					.787 (20.00) Min	Dia.=.031±.004 0.80 ± 0.10		
3838C 3838P	AW	 Axial Wire					.984 (25.00) min			

◆ 3838C/P Non-Magnetic Lead Type and Dimensions

unit: inch (millimeter)

Series	Term. Code	Type/ Outlines	Capacitor Dimensions				Lead Dimensions			Plated Material
			Length Lc	Width Wc	Thick-ness Tc	Overlap B	Length LL	Width WL	Thick-ness TL	
3838C 3838P	P	 Chip (Non-Mag)	.380+.015 to -.010 (9.65+0.38 to -0.25)	.380±.010 (9.65±0.25)	.170 (4.32) max	.063 (1.60) max	-	-	-	100%Sn Solder over Copper Plating Non-Mag, RoHS Compliant
3838C 3838P	MN	 Microstrip (Non-Mag)	.380+.015 to -.010 (9.65+0.38 to -0.25)	.380±.010 (9.65±0.25)	.177 (4.50) max	-	.750 (19.05) min	.350 ±.010 (8.89±0.25)	.008 ±.001 (0.20±0.025)	Silver-plated Copper
3838C 3838P	AN	 Axial Ribbon (Non-Mag)							.004 ±.001 (0.10±0.025)	100% Silver
3838C 3838P	FN	 Radial Ribbon (Non-Mag)					.394 (10.00) min	.118 ±.005 (3.0±0.13)	.012±.001 (0.3±0.025)	Silver-plated Copper
3838C 3838P	RN	 Radial Wire (Non-Mag)					.787 (20.00) min	Dia.=.031±.004 (0.80 ± 0.10)		
3838C 3838P	BN	 Axial Wire (Non-Mag)					.984 (25.00) min			

Note: “Non-Mag” means no magnetic materials. All leads are attached with high temperature solder and parts are RoHS Compliant.

◆Performance

Item	Specifications
Quality Factor (Q)	Greater than 10,000 at 1MHz.
Insulation Resistance (IR)	Test Voltage: 500V 10^5 Megohms min. @ +25℃ at rated WVDC. 10^4 Megohms min. @ +125℃ at rated WVDC.
Rated Voltage	See Rated Voltage Table.
Dielectric Withstanding Voltage (DWV)	250% of Voltage for 5seconds, Rated Voltage≦500VDC 150% of Voltage for 5seconds, 500VDC<RatedVoltage≦1250VDC 120% of Voltage for 5 seconds, Rated Voltage>1250VDC
Operating Temperature Range	-55℃ to +200℃
Temperature coefficient (TC)	C: 0±30ppm/℃ ; P: +90±20ppm/℃
Capacitance Drift	±0.02% or ±0.02pF, whichever is greater.
Piezoelectric Effects	None
Termination Type	See Termination Type Table.

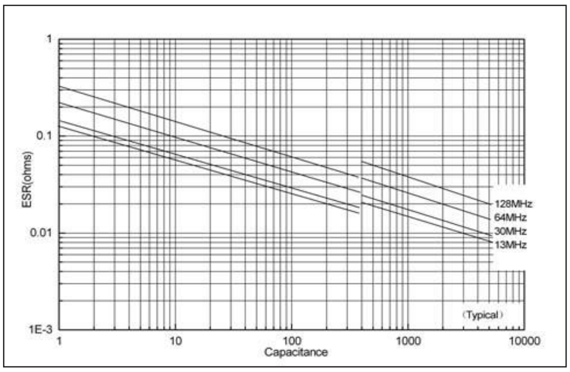
Capacitors are designed and manufactured to meet the requirements of MIL-PRF-55681 and MIL-PRF-123.

◆ Environmental Tests

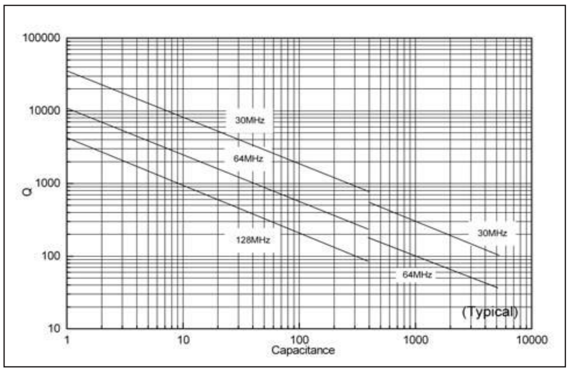
Item	Specifications	Method
Thermal shock	DWV: the initial value IR: Shall not be less than 30% of the initial value Capacitance change: no more than 0.5% or 0.5 pF. whichever is greater.	MIL-STD-202, Method 107, Condition A. At the maximum rated temperature (-55℃ and 125℃) stay 30 min, the time of removing shall not be more than 3 minutes. Perform the five cycles.
Moisture resistance		MIL-STD-202, Method 106.
Humidity (steady state)	DWV: the initial value IR: the initial value Capacitance change: no more than 0.3% or 0.3pF. whichever is greater.	MIL-STD-202, Method 103, Condition A, With 1.5 Volts D.C. applied while subjected to an environment of 85℃ with 85% relative humidity for 240 hours minimum.
Life	IR: Shall not be less than 30% of the initial value Capacitance change: no more than 2.0% or 0.5pF whichever is greater.	MIL-STD-202, Method 108,for2000hours,at125℃, 200% of Voltage for Capacitors, RatedVoltage≦500VDC; 120% of Voltage for Capacitors, 500VDC< Rated Voltage ≦ 1250VDC; 100% of Voltage for Capacitors, RatedVoltage>1250VDC.
Terminal strength	Force : 25lbs typical, 10 lbs min., Duration time: 5 to 10 seconds.	MIL-STD-202, Method 211A, Test condition A. Applied a force and maintained for a period of 5 to 10 seconds. The force shall be in the direction of the axes of the terminations.

◆ 3838C/P Performance Curves

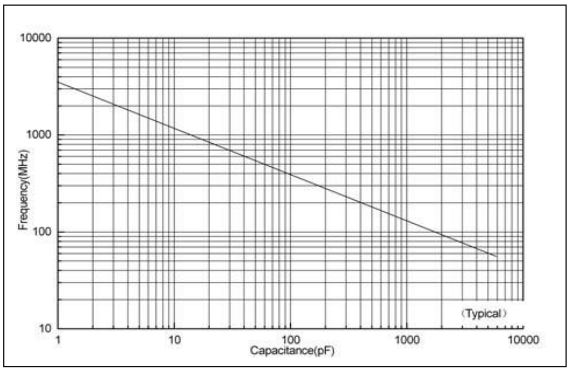
ESR vs Capacitance



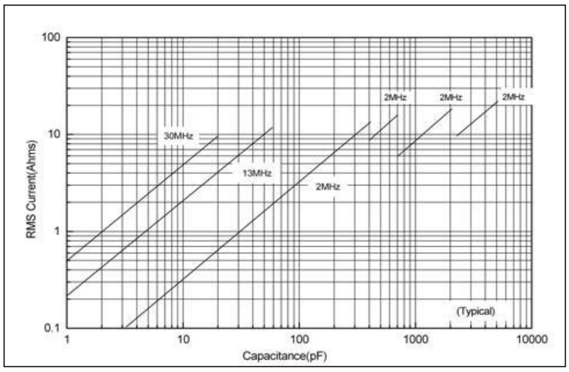
Q vs Capacitance



Series Resonance vs Capacitance



Current Rating vs Capacitance



The current depends on voltage limited: $I = \frac{\sqrt{2}}{2} I_{peak} = \frac{\sqrt{2}}{2} \times \frac{V_{rated}}{X_C} = \sqrt{2}\pi f C V_{rated}$

The current depends on power dissipation limited: $I = \sqrt{\frac{P_{dissipation}}{ESR}}$

Note: If the thermal resistance of mounting surface is 12° C/W. then a power dissipation of 5 W will result in the current limited we can calculate the current limited.

◆ Recommended Land Pattern Dimensions

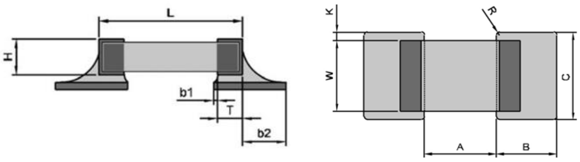
When mounting the capacitor to substrate, it's important to carefully consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

1) The greater the amount of solder, the greater the stress to the elements. This may cause the substrate to break or crack.

2) In the situation where two or more devices are mounted onto a common land, be sure to separate the device into exclusive pads by using soldering resist.

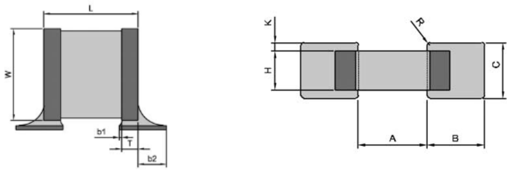
● Horizontal Mounting

Orientation	EIA	A	B	C
Horizontal	3838	7.1	3.0	10.2



● Vertical Mounting

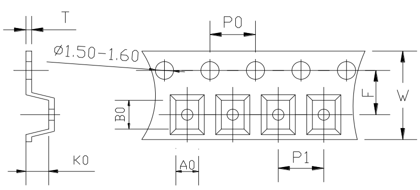
Orientation	EIA	A	B	C
Vertical	3838	7.1	3.0	5.0



◆ Tape & Reel Specifications

Orientation	EIA	A0	B0	K0	W	P0	P1	T	F	Qty Min	Qty /reel	Tape material
Horizontal	3838	10.10	10.10	3.30	16.00	4.00	16.00	0.30	7.50	50	200	Plastic

● Horizontal Orientation




PPI
470pF±5%
3KV
PPI
160pF±2%
5KV
PPI
500pF±5%
8KV
6040
7676
1313

PPI

Power Transmitter Capacitors
UHF/RF High Q Ceramic Capacitors (NPO TC)

UHF/RF High Q Ceramic Capacitors (NP0 TC)

◆ Product Features

High Q, High RF Current/Voltage, High RF Power, Low ESR/ESL, Low Noise.

◆ Part Numbering

6040	C	101	J	AR	502	X
❶	❷	❸	❹	❺	❻	❼
Dimensions Code	Temperature Coefficient	Rated Capacitance	Tolerance	Termination Type	Rated Voltage	Laser Marking

① Dimensions Code

unit:inch(millimeter)

	6040C	7676C	1313C
Length	.614+.015 ~ -.010	.760+ .015 ~ -.010	1.30 + .015 to -.010
	(15.60 + 0.38 ~ -.25)	(19.30 + 0.38 ~ -0.25)	(33.02 + 0.38 ~ to -0.25)
Width	.433 ± .01	.760 ± 0.1	1.30 ± .010
	(11.0 ± 0.25)	(19.30 ± 0.25)	(33.02 ± 0.25)
Thickness	.154 ± .008	.154 ± .008	.173 ± .008
	(3.90 ± 0.20)	(3.90 ± 0.20)	(4.40 ± 0.20)

② Temperature Coefficient: 0±30ppm/°C

③ Rated Capacitance

Capacitance is less than 10pF; for example: 1R0=1.0pF, R denotes point.

Capacitance greater than 10pF; for example: 101=100pF. The third number is the power of 10.

④ Tolerance

Code	B	C	D	F	G	J	K
Tolerance	±0.1pF	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%

⑤ Termination Type

Code	W	P	L
Type	100% Sn Soler over Nickel Plating	100% Sn Solder over Copper Plating RoHS Complian	90%Sn10%Pb Solder over Nickel Plating (Tin/Lead)

Code	MS	AR	AW	RW
Type	Microstrip	Axial Ribbon	Axial Wire	Radial Wire

Code	MN	AN	BN	RN
Type	Non-Mag Microstrip	Non-Mag Axial Ribbon	Non-Mag Axial Wire	Non-Mag Radial Wire

⑥ Rated Voltage

Code	Rated Voltage	Code	Rated Voltage
301	300V	252	2500V
501	500V	302	3000V
102	1000V	362	3600V
152	1500V	502	5000V
202	2000V	802	8000V

⑦ Laser Marking

X denotes Marking.

Capacitance is less than 10pF; for example: The marking of 1.0pF is 1R0.

Capacitance greater than 10pF; for example: The marking of 100pF is 101.

◆ Performance Requirements

Capacitors are designed and manufactured to meet the requirements of MIL-PRF-55681 and MIL-PRF-123.

6040C (.600” x .400”)

◆ Product Features

High Q, High RF Current/Voltage, High RF Power, Low ESR/ESL, Low Noise, Ultra-Stable Performance.

◆ 6040C Capacitance Table

Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC
1.0	1R0	B,C,D	5000V Code 502 Extended Voltage 8000V Code 802	33	330	F,G, J,K	5000V Code 502 Extended Voltage 8000V Code 802	820	821	F,G, J,K	2000V Code 202 Extended Voltage 3000V Code 302
1.2	1R2			39	390			1000	102		
1.5	1R5			47	470			1200	122		
1.8	1R8			56	560			1500	152		
2.2	2R2			68	680			1800	182		
2.7	2R7			82	820			2200	222		
3.3	3R3			100	101			2700	272		1000V Code 102 Extended Voltage 2000V Code 202
3.9	3R9			120	121		3000V Code 302 Extended Voltage 5000V Code 502	3300	332		
4.7	4R7			150	151			4700	472		
5.6	5R6			180	181			5100	512		
6.8	6R8			220	221			5600	562		
8.2	8R2			270	271			6800	682		
10	100	F,G, J,K		330	331						
12	120			390	391						
15	150			470	471						
18	180			560	561						
22	220			680	681						
27	270										

◆ Part Numbering

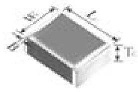
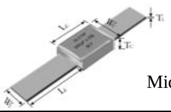
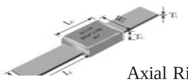
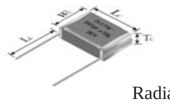
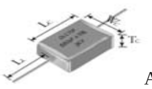
6040 101 J AR 502 X

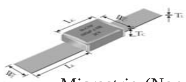
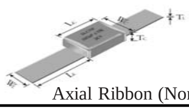
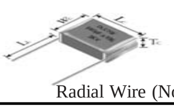
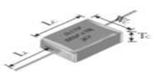
- 6040: 6040C Series
- 101: Capacitor Code — 101=10x10^1=100pF, 1R0=1.0pF
- J: Capacitance Tolerance — See below list
- AR: Termination Type
- 502: Rated Voltage
- X: Laser Marking

Capacitance Tolerance							
Code	B	C	D	F	G	J	K
Tolerance	±0.1pF	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%

◆ 6040C Lead Type and Dimensions

unit: inch(millimeter)

Series	Term. Code	Type/ Outlines	Capacitor Dimensions: Length Lc	Capacitor Dimensions: Width Wc	Capacitor Dimensions: Thick-ness Tc	Capacitor Dimensions: Overlap B	Lead Dimensions: Length LL	Lead Dimensions: Width WL	Lead Dimensions: Thick-ness TL	Plated Material
6040C	W	 Chip	.614 +.015 to -.010 (15.6 +0.38 to -0.25)	.433 ±.010 (11.0± 0.25)	.154 ± .008 (3.90 ±0.20)	.063 (1.60) max	-	-	-	100%Sn Solder over Nickel Plating RoHS Compliant
	L									90%Sn10%Pb Tin/Lead Solder over Nickel Plating
6040C	MS	 Microstrip				-	.787 (20.00) min	.35 ± .01 (8.89± 0.25)	.008 ± .001 (0.20± 0.025)	Silver-plated Copper
6040C	AR	 Axial Ribbon								
6040C	RW	 Radial Wire					.787 (20.00) min	Dia.=.03±.004 (0.80 ± 0.10)		
6040C	AW	 Axial Wire					.984 (25.00) min			

Series	Term. Code	Type/ Outlines	Capacitor Dimensions: Length Lc	Capacitor Dimensions: Width Wc	Capacitor Dimensions: Thick-ness Tc	Capacitor Dimensions: Overlap B	Lead Dimensions: Length LL	Lead Dimensions: Width WL	Lead Dimensions: Thick-ness TL	Plated Material
6040C	P	 Chip (Non-Mag)	.614 +.015 to -.010 (15.6 +0.38 to -0.25)	.433 ±.010 (11.0± 0.25)	.154 ± .008 (3.90 ±0.20)	.063 (1.60) max	-	-	-	100% Sn Solder over Copper Plating Non-Mag
6040C	MN	 Microstrip (Non-Mag)				-	.787 (20.00) min	.35 ± .01 (8.89± 0.25)	.008 ± .001 (0.20± 0.025)	Silver-plated Copper
6040C	AN	 Axial Ribbon (Non-Mag)								
6040C	RN	 Radial Wire (Non-Mag)					.787 (20.00) min	Dia.=.03±.004 (0.80 ± 0.10)		
6040C	BN	 Axial Wire (Non-Mag)					.984 (25.00) min			

Note: “Non-Mag” means no magnetic materials. All leads are attached with high temperature solder and parts are RoHS Compliant.

◆ Performance

Item	Specifications
Quality Factor (Q)	No less than 1000pF, Q value more than 2000, Test frequency 1MHz; More than 1000pF, Q value more than 2000, Test frequency 1KHz;
Insulation Resistance (IR)	Test Voltage: 500V 10^5 Megohms min. @ +25℃ at rated WVDC. 10^4 Megohms min. @ +125℃ at rated WVDC.
Rated Voltage	See Rated Voltage Table.
Dielectric Withstanding Voltage (DWV)	250% of Voltage for 5 seconds, Rated Voltage ≦500VDC 150% of Voltage for 5 seconds, 500VDC< Rated Voltage ≦1250VDC 120% of Voltage for 5 seconds, Rated Voltage >1250VDC
Operating Temperature Range	-55℃ to +175℃
Temperature coefficient (TC)	0±30ppm/℃
Capacitance Drift	±0.02% or ±0.02pF, whichever is greater.
Piezoelectric Effects	None
Termination Type	See Termination Type Table.

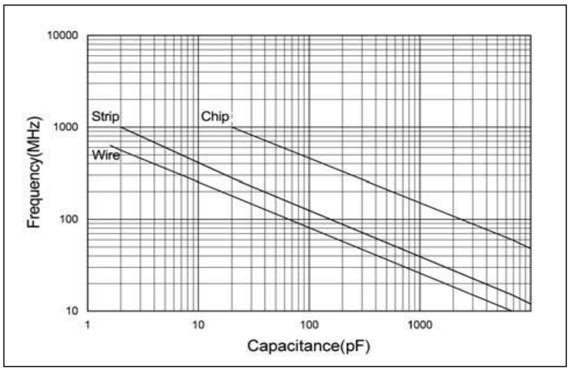
Capacitors are designed and manufactured to meet the requirements of MIL-PRF-55681 and MIL-PRF-123.

◆ Environmental Tests

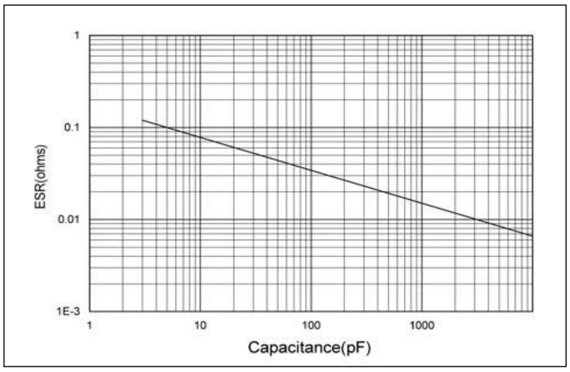
Item	Specifications	Method
Thermal shock	DWV: the initial value IR: Shall not be less than 30% of the initial value Capacitance change: no more than 0.5% or 0.5 pF, whichever is greater.	MIL-STD-202, Method 107, Condition A. At the maximum rated temperature (-55℃ and 125℃) stay 30 min, the time of removing shall not be more than 3 minutes. Perform the five cycles.
Moisture resistance		MIL-STD-202, Method 106.
Humidity (steady state)	DWV: the initial value IR: the initial value Capacitance change: no more than 0.3% or 0.3 pF, whichever is greater.	MIL-STD-202, Method 103, Condition A, With 1.5 Volts D.C. applied while subjected to an environment of 85℃ with 85% relative humidity for 240 hours minimum.
Life	IR: Shall not be less than 30% of the initial value Capacitance change: no more than 2.0% or 0.5 pF, whichever is greater.	MIL-STD-202, Method 108, for 2000 hours, at 125℃, 200% of Voltage for Capacitors, Rated Voltage ≦500VDC; 120% of Voltage for Capacitors, 500VDC < Rated Voltage ≦ 1250VDC; 100% of Voltage for Capacitors, Rated Voltage >1250VDC.
Terminal strength	Force : 25lbs typical, 20 lbs min., Duration time: 5 to 10 seconds.	MIL-STD-202, Method 211A, Test condition A. Applied a force and maintained for a period of 5 to 10 seconds. The force shall be in the direction of the axes of the terminations.

◆ 6040C Performance Curves

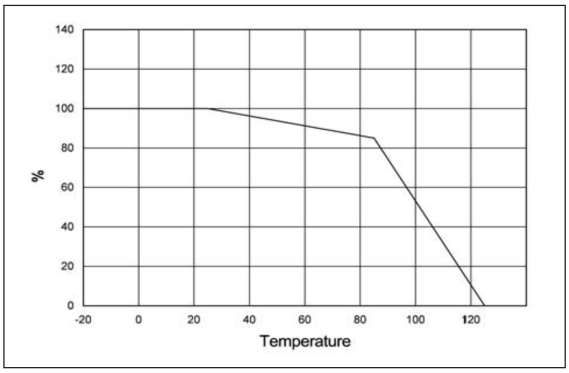
Self Resonant Frequency vs Capacitance



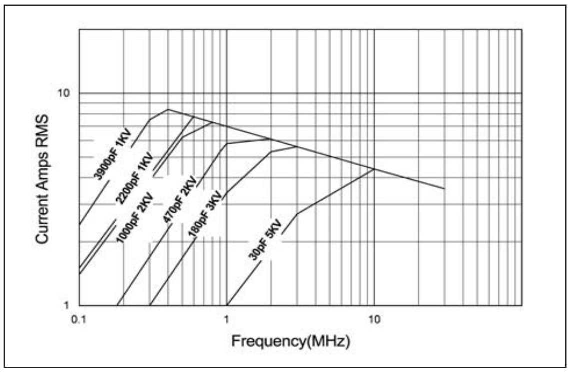
ESR vs Capacitance
Measured @ 30MHz



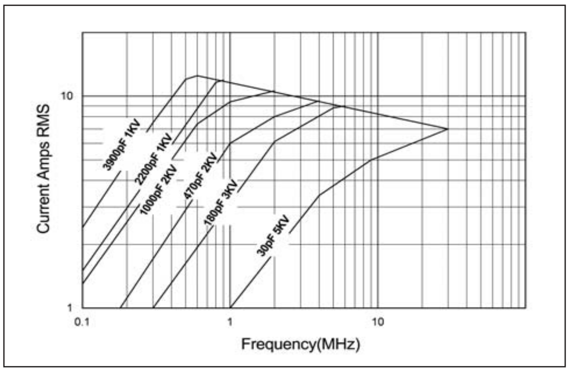
% Maximum Current vs
Ambient Temperature



6040C Wire Terminals
Rated Current vs Frequency



6040C Strip Terminals
Rated Current vs Frequency



◆ Recommended Land Pattern Dimensions

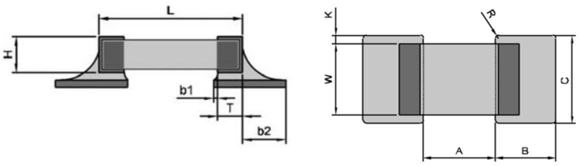
When mounting the capacitor to substrate, it's important to carefully consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

1) The greater the amount of solder, the greater the stress to the elements. This may cause the substrate to break or crack.

2) In the situation where two or more devices are mounted onto a common land, be sure to separate the device into exclusive pads by using soldering resist.

● Horizontal Mounting

Orientation	EIA	A	B	C
Horizontal	6040	13.00	3.30	11.30



7676C (.760” x .760”)

7676C (.760” x .760”)

◆ Product Features

High Q, High RF Current/Voltage, High RF Power, Low ESR/ESL, Low Noise, Ultra-Stable Performance.

◆ 7676C Capacitance Table

Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC
1.0	1R0	B,C,D	5000V Code 502; Extended 8000V Code 802	33	330	F,G, J,K	5000V Code 502; Extended 8000V Code 802	1000	102	G, J,K	3000V Code 302; Extended 5000V Code 502
1.2	1R2			39	390			1200	122		
1.5	1R5			47	470			1500	152		
1.8	1R8			56	560			1800	182		
2.2	2R2			68	680			2200	222		
2.7	2R7			82	820			2700	272		
3.3	3R3			100	101			3300	332		
3.9	3R9			120	121			4700	472		
4.7	4R7			150	151			5100	512		
5.6	5R6			180	181			5600	562		1000V Code 102; Extended 3000V Code 302
6.8	6R8			220	221			6800	682		
8.2	8R2			270	271		3000V Code 302; Extended 5000V Code 502	7500	752		
10	100	F,G, J,K		300	301			8200	822		
12	120			390	391			10000	103		
15	150			470	471			12000	123		1000V Code 102; 2000V Code202
18	180			560	561			15000	153		
22	220			680	681			18000	183		
27	270			820	821			20000	203		

◆ Part Numbering

7676C 101 J AR 802 X

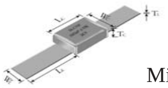
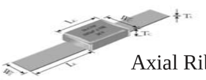
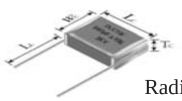
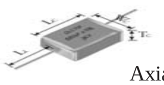
- 7676C — 7676 Series
- 101 — Capacitor Code: 101=10x10^1=100, 1R0=1.0pF
- J — Capacitance Tolerance: See below list
- AR — Termination Type
- 802 — Rated Voltage
- X — Laser Marking

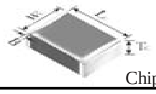
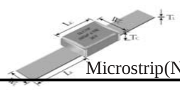
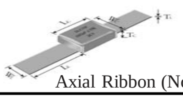
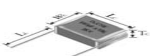
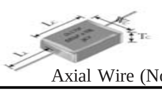
Capacitance Tolerance							
Code	B	C	D	F	G	J	K
Tolerance	±0.1pF	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%

◆ 7676C Lead Type and Dimensions

7676C (.760" x .760")

unit: inch (millimeter)

<table>
<tr><th rowspan="2">Series</th><th rowspan="2">Term. Code</th><th rowspan="2">Type/ Outlines</th><th colspan="4">Capacitor Dimensions</th><th colspan="3">Lead Dimensions</th><th rowspan="2">Plated Material</th></tr>
<tr><th>Length Lc</th><th>Width Wc</th><th>Thick -ness Tc</th><th>Overlap B</th><th>Length LL</th><th>Width WL</th><th>Thick- ness TL</th></tr>
<tr><td rowspan="2">7676C</td><td>W</td><td rowspan="2">
Chip</td><td rowspan="6">.760 +.015 to -.010 (19.3 +0.38 to -0.25)</td><td rowspan="6">.760 ±.010 (19.3± 0.25)</td><td rowspan="6">.154 ± .008 (3.90 ±0.20)</td><td rowspan="2">.063 (1.60) max</td><td rowspan="2">-</td><td rowspan="2">-</td><td rowspan="2">-</td><td>100%Sn Solder over Nickel Plating RoHS Compliant</td></tr>
<tr><td>L</td><td>90%Sn10%Pb Tin/Lead Solder over Nickel Plating</td></tr>
<tr><td>7676C</td><td>MS</td><td>
Microstrip</td><td rowspan="4">-</td><td rowspan="2">.787 (20.00) min</td><td rowspan="2">.591 ± .010 (15.0± 0.25)</td><td rowspan="2">.008 ± .001 (0.20± 0.025)</td><td rowspan="4">Silver-plated Copper</td></tr>
<tr><td>7676C</td><td>AR</td><td>
Axial Ribbon</td></tr>
<tr><td>7676C</td><td>RW</td><td>
Radial Wire</td><td>.787 (20.00) min</td><td colspan="2" rowspan="2">Dia.= .03±.004 0.80 ± 0.10</td></tr>
<tr><td>7676C</td><td>AW</td><td>
Axial Wire</td><td>1.181 (30.00) min</td></tr>
</table>

<table>
<tr><th rowspan="2">Series</th><th rowspan="2">Term. Code</th><th rowspan="2">Type/ Outlines</th><th colspan="4">Capacitor Dimensions</th><th colspan="3">Lead Dimensions</th><th rowspan="2">Plated Material</th></tr>
<tr><th>Length Lc</th><th>Width Wc</th><th>Thick -ness Tc</th><th>Overlap B</th><th>Length LL</th><th>Width WL</th><th>Thick- ness TL</th></tr>
<tr><td>7676C</td><td>P</td><td>
Chip (Non-Mag)</td><td rowspan="5">.760 +.015 to -.010 (19.3 +0.38 to -0.25)</td><td rowspan="5">.760 ±.010 (19.3± 0.25)</td><td rowspan="5">.154 ± .008 (3.90 ±0.20)</td><td>.063 (1.60) max</td><td>-</td><td>-</td><td>-</td><td>100% Sn Solder over Copper Plating</td></tr>
<tr><td>7676C</td><td>MN</td><td>
Microstrip(Non-Mag)</td><td rowspan="4">-</td><td rowspan="2">.787 (20.00) min</td><td rowspan="2">.591 ± .010 (15.0± 0.25)</td><td rowspan="2">.008 ±.00 1 (0.20 ± 0.025)</td><td rowspan="4">Silver-plated Copper</td></tr>
<tr><td>7676C</td><td>AN</td><td>
Axial Ribbon (Non-Mag)</td></tr>
<tr><td>7676C</td><td>RN</td><td>
Radial Wire (Non-Mag)</td><td>.787 (20.00) min</td><td colspan="2" rowspan="2">Dia.= .03±.004 0.80 ± 0.10</td></tr>
<tr><td>7676C</td><td>BN</td><td>
Axial Wire (Non-Mag)</td><td>1.181 (30.00) min</td></tr>
</table>

Note: "Non-Mag" means no magnetic materials. All leads are attached with high temperature solder and parts are RoHS Compliant.

◆ Performance

Item	Specifications
Quality Factor (Q)	No less than 1000pF, Q value more than 2000, Test frequency 1MHz; More than 1000pF, Q value more than 2000, Test frequency 1KHz;
Insulation Resistance (IR)	Test Voltage: 500V 10^5 Megohms min. @ +25℃ at rated WVDC. 10^4 Megohms min. @ +125℃ at rated WVDC.
Rated Voltage	See Rated Voltage Table.
Dielectric Withstanding Voltage (DWV)	250% of Voltage for 5 seconds, Rated Voltage ≦500VDC 150% of Voltage for 5 seconds, 500VDC < Rated Voltage ≦1250VDC 120% of Voltage for 5 seconds, Rated Voltage >1250VDC
Operating Temperature Range	-55℃ to +175℃
Temperature coefficient (TC)	0±30ppm/℃
Capacitance Drift	±0.02% or ±0.02pF, whichever is greater.
Piezoelectric Effects	None

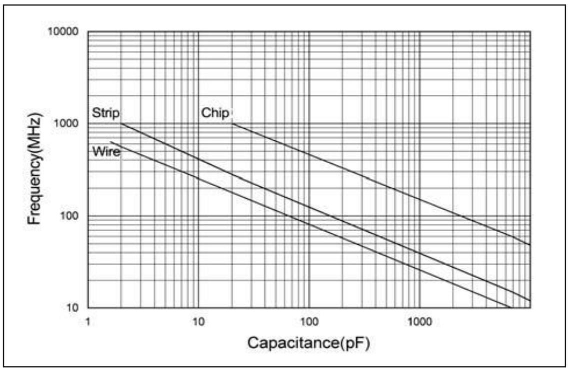
Capacitors are designed and manufactured to meet the requirements of MIL-PRF-55681 and MIL-PRF-123.

◆ Environmental Tests

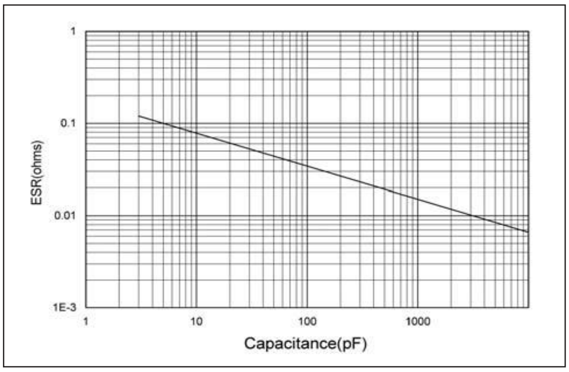
Item	Specifications	Method
Thermal shock	DWV: the initial value IR: Shall not be less than 30% of the initial value. Capacitance change: no more than 0.5% or 0.5 pF, whichever is greater.	MIL-STD-202, Method 107, Condition A. At the maximum rated temperature (-55℃ and 125℃) stay 30 min, the time of removing shall not be more than 3 minutes. Perform the five cycles.
Moisture resistance		MIL-STD-202, Method 106.
Humidity (steady state)	DWV: the initial value IR: the initial value Capacitance change: no more than 0.3% or 0.3pF, whichever is greater.	MIL-STD-202, Method 103, Condition A, With 1.5 Volts D.C. applied while subjected to an environment of 85℃ with 85% relative humidity for 240 hours minimum.
Life	IR: Shall not be less than 30% of the initial value. Capacitance change: no more than 2.0% or 0.5 pF, whichever is greater.	MIL-STD-202, Method 108, for 2000 hours, at 125℃, 200% of Voltage for Capacitors, Rated Voltage ≦500VDC; 120% of Voltage for Capacitors, 500VDC < Rated Voltage ≦ 1250VDC; 100% of Voltage for Capacitors, Rated Voltage >1250VDC.
Terminal strength	Force : 30lbs typical, Duration time: 5 to 10 seconds.	MIL-STD-202, Method 211A, Test condition A. Applied a force and maintained for a period of 5 to 10 seconds. The force shall be in the direction of the axes of the terminations.

◆ 7676C Performance Curves

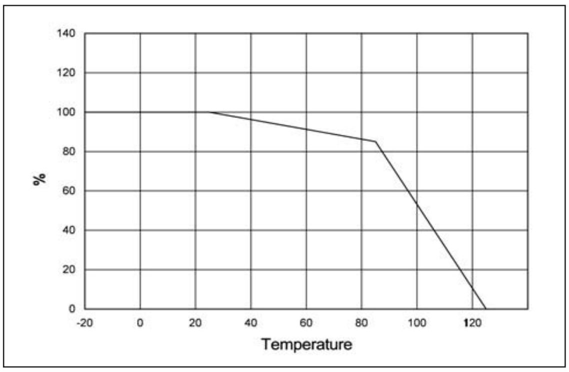
Self Resonant Frequency vs Capacitance



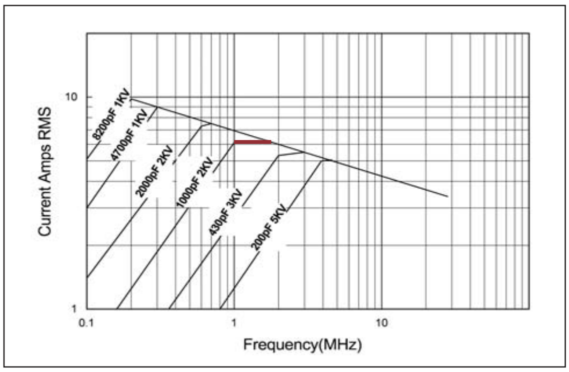
ESR vs Capacitance measured @ 30MHz



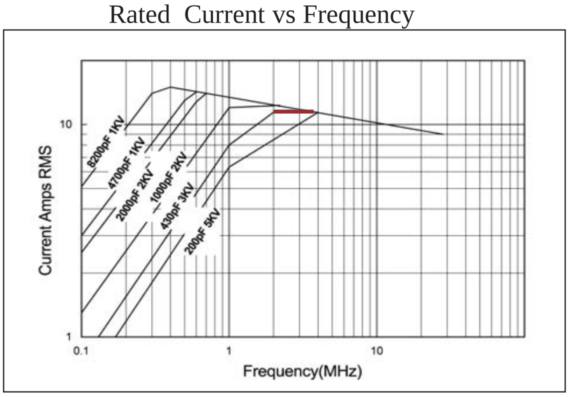
% Maximum Current vs Ambient Temperature



7676C Wire Terminals Rated Current vs Frequency



7676C Strip Terminals Rated Current vs Frequency



◆ Recommended Land Pattern Dimensions

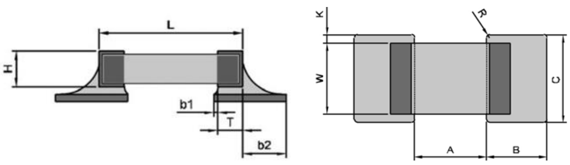
When mounting the capacitor to substrate, it's important to carefully consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

1) The greater the amount of solder, the greater the stress to the elements. This may cause the substrate to break or crack.

2) In the situation where two or more devices are mounted onto a common land, be sure to separate the device into exclusive pads by using soldering resist.

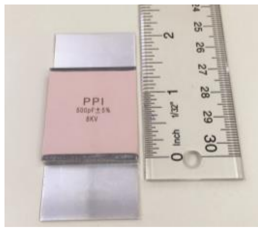
● Horizontal Mounting

Orientation	EIA	A	B	C
Horizontal	7676	16.00	3.30	19.60



1313C (1.30” x 1.30”)

1313C (1.30” x 1.30”)



◆ Product Features

High Q, High RF Current/Voltage, High RF Power, Low ESR/ESL, Low Noise, Non-Magnetic Ultra-Stable Performance.

◆ Typical Application Fields

Semiconductor manufacturing, Inductive Heating, Inductively Coupled Plasma systems, Scientific Instruments, Medical, High Energy RF Power Transfer, Matching Circuits.

◆ 1313C Capacitance Table

<table>
<tr><th>Cap. pF</th><th>Code</th><th>Tol.</th><th>Rated WVDC</th><th>Cap. pF</th><th>Code</th><th>Tol.</th><th>Rated WVDC</th><th>Cap. pF</th><th>Code</th><th>Tol.</th><th>Rated WVDC</th></tr>
<tr><td>200</td><td>201</td><td rowspan="13">G,J,K</td><td rowspan="13">10KV Code103</td><td>1800</td><td>182</td><td rowspan="3">G,J,K</td><td rowspan="3">10KV Code103</td><td>12000</td><td>123</td><td rowspan="6">J,K</td><td rowspan="6">3000V Code302</td></tr>
<tr><td>220</td><td>221</td><td>2200</td><td>222</td><td>15000</td><td>153</td></tr>
<tr><td>270</td><td>271</td><td>2700</td><td>272</td><td>22000</td><td>223</td></tr>
<tr><td>300</td><td>301</td><td>3300</td><td>332</td><td rowspan="8">G,J,K</td><td rowspan="8">5000V Code502</td><td>33000</td><td>333</td></tr>
<tr><td>330</td><td>331</td><td>4700</td><td>472</td><td>47000</td><td>473</td></tr>
<tr><td>390</td><td>391</td><td>5100</td><td>512</td><td>56000</td><td>563</td></tr>
<tr><td>470</td><td>471</td><td>5600</td><td>562</td><td>68000</td><td>683</td><td rowspan="4">J,K</td><td rowspan="4">1000V Code102</td></tr>
<tr><td>560</td><td>561</td><td>6800</td><td>682</td><td>82000</td><td>823</td></tr>
<tr><td>680</td><td>681</td><td>7500</td><td>752</td><td>100000</td><td>104</td></tr>
<tr><td>820</td><td>821</td><td>8200</td><td>822</td><td>120000</td><td>124</td></tr>
<tr><td>1000</td><td>102</td><td>10000</td><td>103</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>1200</td><td>122</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>1500</td><td>152</td></tr>
</table>

◆ Part Numbering

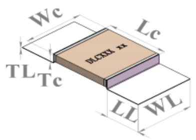
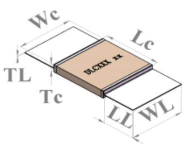
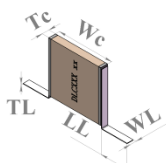
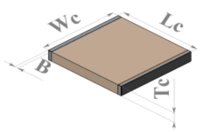
1313C 102 J MN 103 X

- 1313C — 1313 Series
- 102 — Capacitor Code: $102=10x10^2=1000$ pF
- J — Capacitance Tolerance: See below list
- MN — Termination Type
- 103 — Rated Voltage
- X — Laser Marking

Capacitance Tolerance			
Code	G	J	K
Tolerance	±2%	±5%	±10%

◆ 1313C Non-Magnetic Lead Type and Dimensions

unit: inch (millimeter)

Series	Term. Code	Type/ Outlines	Capacitor Dimensions Length Lc	Capacitor Dimensions Width Wc	Capacitor Dimensions Thick-ness Tc	Capacitor Dimensions Overlap B	Lead Dimensions Length LL	Lead Dimensions Width WL	Lead Dimensions Thickness TL	Plated Material
1313C	MN	 Microstrip (Non-Mag)	1.30 +.015 to -.010 (33.02 +0.38 to -0.25)	1.30 ±.010 (33.02± 0.25)	.173 ±.008 (4.40 ±0.20)	-	.787± 0.02 (20.00± 0.5)	1.299 ± .020 (33.0± 0.5)	.012 ± .001 (0.30± 0.025)	Silver-plated Copper
1313C	AN	 Axial Ribbon (NonMag)								
1313C	FN	 Radial Ribbon (Non-Mag)					.669± 0.012 (17.00 ± 0.3)	0.157 ±.008 (4.0± 0.2)	.012 ±.001 (0.30± 0.025)	
1313C	P	 Chip (Non-Mag)				.063 (1.60) max	-	-	-	Non-Mag, Copper Plated 100% Sn

Note: “Non-Mag” means no magnetic materials. All leads are attached with high temperature solder and parts are RoHS Compliant.

1313C (1.30” x 1.30”)

◆ Performance

Item	Specifications
Quality Factor (Q)	Less than 1000pF, Q value more than 2000, Test frequency 1MHz; Greater than 1000pF, Q value more than 2000, Test frequency 1KHz;
Insulation Resistance (IR)	Test Voltage: 500V 10^5 Megohms min. @ +25℃ at rated WVDC. 10^4 Megohms min. @ +125℃ at rated WVDC.
Rated Voltage	See Rated Voltage Table.
Dielectric Withstanding Voltage (DWV)	150% of Voltage for 5 seconds, 500VDC < Rated Voltage ≦1250VDC 120% of Voltage for 5 seconds, Rated Voltage >1250VDC
Operating Temperature Range	-55℃ to +175℃
Temperature coefficient (TC)	0±30ppm/℃
Capacitance Drift	±0.02% or ±0.02pF, whichever is greater.
Piezoelectric Effects	None

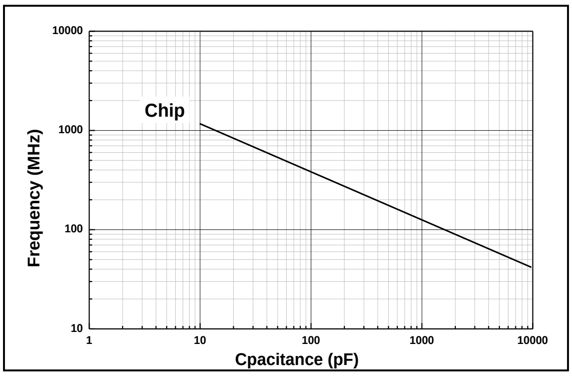
Capacitors are designed and manufactured to meet the requirements of MIL-PRF-55681 and MIL-PRF-123.

◆ Environmental Tests

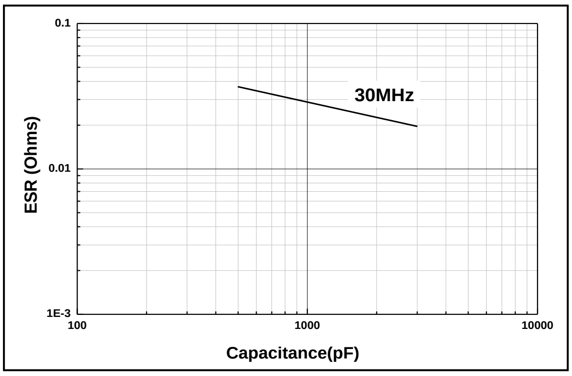
Item	Specifications	Method
Thermal shock	DWV: the initial value IR: Shall not be less than 30% of the initial value. Capacitance change: no more than 0.5% or 0.5 pF, whichever is greater.	MIL-STD-202, Method 107, Condition A. At the maximum rated temperature (-55℃ and 125℃) stay 30 min, the time of removing shall not be more than 3 minutes. Perform the five cycles.
Moisture resistance		MIL-STD-202, Method 106.
Humidity (steady state)	DWV: the initial value IR: the initial value Capacitance change: no more than 0.3% or 0.3pF, whichever is greater.	MIL-STD-202, Method 103, Condition A, With 1.5 Volts D.C. applied while subjected to an environment of 85℃ with 85% relative humidity for 240 hours minimum.
Life	IR: Shall not be less than 30% of the initial value. Capacitance change: no more than 2.0% or 0.5 pF, whichever is greater.	MIL-STD-202, Method 108, for 2000 hours, at 125℃, 120% of Voltage for Capacitors, 500VDC < Rated Voltage ≦ 1250VDC; 100% of Voltage for Capacitors, Rated Voltage >1250VDC.
Terminal strength	Force : 30lbs typical, Duration time: 5 to 10 seconds.	MIL-STD-202, Method 211A, Test condition A. Applied a force and maintained for a period of 5 to 10 seconds. The force shall be in the direction of the axes of the terminations.

◆ 1313C Performance Curves

Self Resonant Frequency vs Capacitance



ESR vs Capacitance measured @ 30MHz

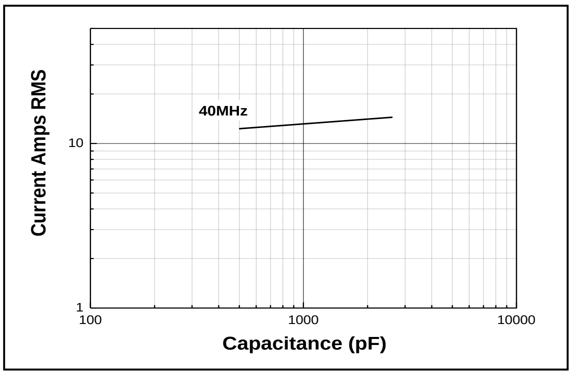


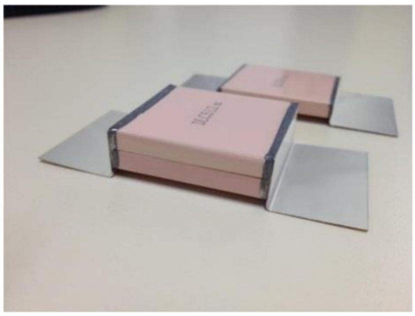
Test Conditions:

Typical responses for sample placed across a 1.1-inch gap in a 114-mil-wide Micro-strip on 60 mil FR4 PCB.

Measurements de-embedded to sample edges using TRL calibration procedures.

1313C Rated Current vs Frequency





Please contact Passive Plus, Inc. to begin discussions for a Custom Assembly.

Capacitor Assemblies Offering

◆ Product Features

High Operating Voltage, High Operating Current, Extended Capacitance, Tighter Tolerances,

High Reliability, High Q, Ultra-low ESR, Non-Magnetic.

◆ Typical Applications Field

High Power RF, Medical Electronics, Broadcast, Semiconductor Manufacturing,
High Magnetic Environments, Inductive Heating.

◆ Part Numbering

P	6	C	22P	101	F	252	X
❶ P : Parallel S : Series	❷ Number Capacitors	❸ S : Silver C : Copper	❹ Cap. Size 11P: 1111; 22P:2225; 38P: 3838; 60P: 6040; 76P:7676	❺ Capacitance	❻ Tolerance	❼ Rated Voltage	❽ Laser Marking

Capacitance: For capacitor values requiring 3 significant digits,

e.g. 1222.5pF =1222R5

e.g. P6S22P101F252X

Silver bracket assembly with six 2225C pieces in parallel, Capacitance is 100pF,
Capacitance tolerance is ±1%, WVDC is 2500 V and Laser marking.

e.g. S2S76P1222R5G203X

Silver bracket assembly with two 2225C pieces in series, Capacitance is 1222.5pF,
Capacitance tolerance is ±2%, WVDC is 20,000V and Laser marking.

◆ Capacitance and Voltage

By Buyer's requirements using existing drawings, mechanical sketches, or we can help with capable modeling of assemblies thermal rise predictions.

◆ Typical Assembly Configurations

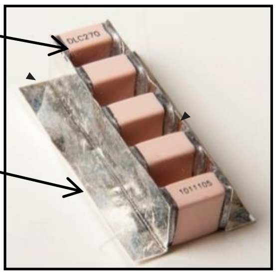
① Parallel Assemblies

unit:inch(millimeter)

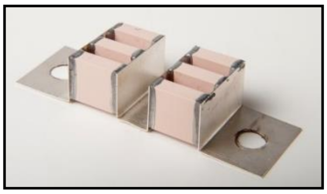
	1111P/C	2225P/C	3838P/C	6040C	7676C	1313C
Lead Material	Silver-plated Copper or silver					
Lead Thickness	.004 or .010 (0.1 or 0.25)		.010 or .020 (0.25 or 0.51)			
Lead Length (max.)	.50 (12.7)	.75 (19.8)	2.0 (50.8)			
Capacitor Spacer (typ.)	.050 or .078 (1.3 or 2)		.090 (2.3)	.050 or .157 (1.3 or 4)		
Mtg Configuration	Horizontal/Vertical					

Capacitor spacer

Lead



3838 Series/Parallel Combination



② Series Assemblies

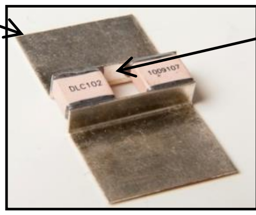
unit:inch(millimeter)

	2225P/C	3838P/C	6040C	7676C	1313C
Lead Type	L Bracket				
Lead Material	Silver-plated Copper or silver				
Lead Thickness	.010 (0.25)		.010 or .020 (0.25 or 0.51)		
Lead Length (max.)	.75 (19.8)	1.0 (25.4)			
Capacitor Spacer (typ.)	.050 to .157 (1.3 to 4)				
Mtg Configuration	Horizontal				

• Epoxy Molding Available

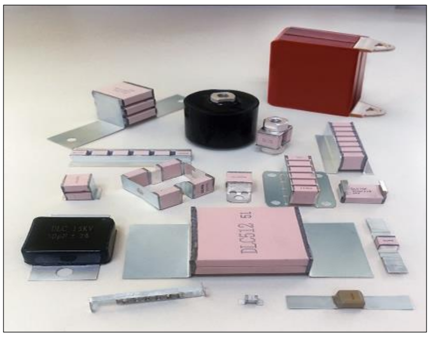
Lead

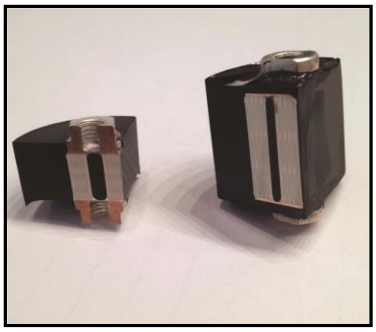
Capacitor spacer

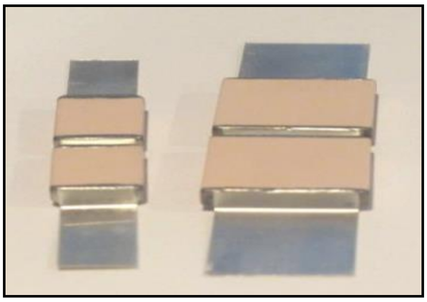


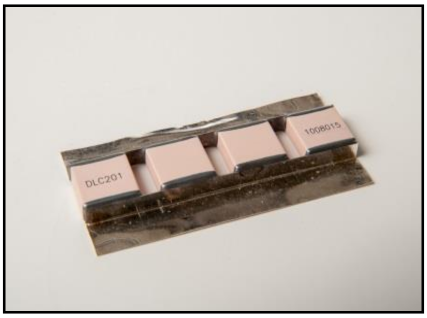
③ Other Assemblies

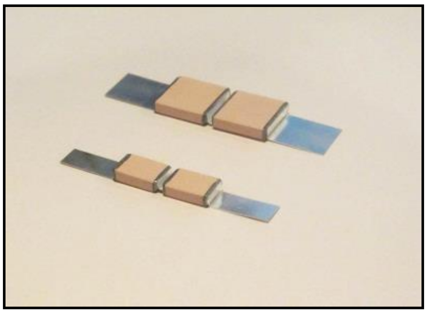
By Buyer's requirement

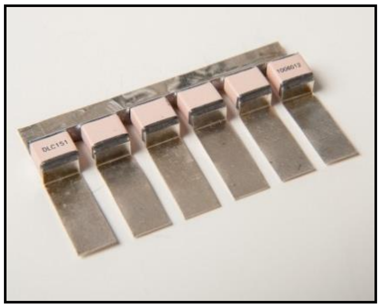


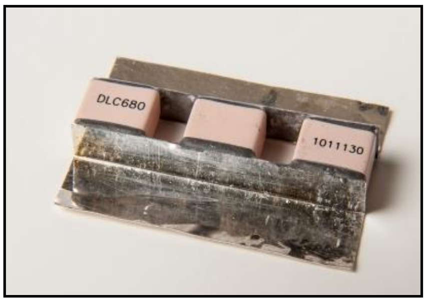


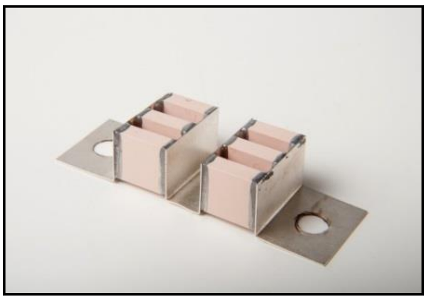


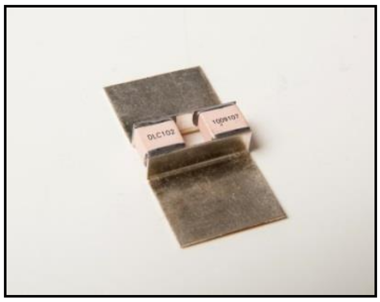












Please contact PPI (sales@passiveplus.com) to discuss custom assembly options.

EIA Low ESR Microwave Capacitors

EIA Low ESR Microwave Capacitors

◆ Product Features

Lowest ESR, Highest working voltage, High self resonance frequencies (to 25GHz).

◆ Product Application

Base station Products, L/C Filter.

◆ Part Numbering

0402	N	100	J	W	500
❶	❷	❸	❹	❺	❻
Dimensions Code	Temperature Coefficient	Rated Capacitance	Tolerance	Termination Type	Rated Voltage

① Dimensions Code

unit: inch(millimeter)

	0201N	0402N	0603N	0805N	1111N
Length	.024±.001 (0.60±0.03)	.040±.004 (1.02±0.1)	.06±.006 (1.52±0.15)	.08±.010 (2.0 + 0.25 ~ -0.25)	0.110+.020~ .010 (2.79+0.51 ~ -0.25)
Width	.012±.001 (0.30±0.03)	.020±.004 (0.51±0.1)	.030±.006 (0.76±0.15)	.05±.010 (1.2±0.25)	.110±.010 (2.79±0.25)
Thickness	.012±.001 (0.30±0.03)	.020±.004 (0.51±0.1)	.03+.005 ~ -.003 (0.76+0.13 ~ -0.08)	.057 (1.45) max	.10 (2.6) max

② Temperature Coefficient: 0±30ppm/℃

③ Rated Capacitance

Capacitance is less than 10pF; for example: 1R0=1.0pF, R denotes point.

Capacitance greater than 10pF; for example: 101=100pF, The third number is the power of 10.

④ Tolerance

Code	A	B	C	D	F	G	J	K
Tolerance	±0.05pF	±0.1pF	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%

⑤ Termination Type

Code	W
Type	100% Nickel Plated (Sn) RoHS

⑥ Rated Voltage

Code	Rated Voltage
250	25V
500	50V
251	250V
501	500V

⑦ Laser Marking

Offered on 0603N, 0805N and 1111N case sizes.

◆ Performance Requirements

Capacitors are designed and manufactured to meet the requirements of MIL-PRF-55681 and MIL-PRF-123.

◆ All products are in compliance with RoHS instruction.

0201N (.020” x .010”)

◆ 0201N Capacitance & Rated Voltage Table

Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC
0.1	0R1	A,B, C,D	25V Code 250 Or 50V Code 500	2.2	2R2	A,B, C,D	25V Code 250 Or 50V Code 500	16	160	F,G, J,K	25V Code 250 Or 50V Code 500
0.2	0R2			2.4	2R4			18	180		
0.3	0R3			2.7	2R7			20	200		
0.4	0R4			3.0	3R0			22	220		
0.5	0R5			3.3	3R3			24	240		
0.6	0R6			3.6	3R6			27	270		
0.7	0R7			3.9	3R9			30	300		
0.8	0R8			4.3	4R3			33	330		
0.9	0R9			4.7	4R7			36	360		
1.0	1R0			5.1	5R1	B, C,D		39	390		
1.1	1R1			5.6	5R6			43	430		
1.2	1R2			6.2	6R2	B,C		47	470		
1.3	1R3			6.8	6R8			51	510		
1.4	1R4			7.5	7R5			56	560		
1.5	1R5			8.2	8R2			62	620		
1.6	1R6			9.1	9R1			68	680		
1.7	1R7			10	100	F,G, J,K		75	750		
1.8	1R8			11	110			82	820		
1.9	1R9			12	120			91	910		
2.0	2R0			13	130			100	101		
2.1	2R1			15	150						

Remark: special capacitance, tolerance and WVDC are available, consult with PASSIVE PLUS.

Note: All products are in compliance with RoHS instruction.

◆ Part Numbering

0201N 101 J W 500

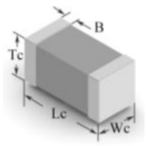
- 0201N — Series
- 101 — Rated Capacitance* (See capacitance table)
- J — Capacitance Tolerance (See capacitance table)
- W — Termination Type: Nickel, Plated 100%Sn (RoHS)
- 500 — Rated Voltage

*When capacitance is less than 1.0, use “R” for decimal

Capacitance Tolerance								
Code	A	B	C	D	F	G	J	K
Tol.	±0.05pF	±0.1pF	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%

◆ 0201N Chip Dimensions

unit:inch(millimeter)

Series	Term. Code	Type/Outlines	Capacitor Dimensions				Plated Material
			Length Lc	Width Wc	Thickness Tc	Overlap B	
0201N	W		.024±.001 (0.60±0.03)	.012±.001 (0.30±0.03)	.012±.001 (0.30±0.03)	.008 Max (0.20 Max)	Sn/Ni (RoHS)

◆ Design Kits

These capacitors are 100% RoHS. Kits are available in Magnetic termination that contain 10 (ten) pieces per value; number of values per kit varies, depending on case size and capacitance.

Kit	Description	Values	Tolerance
DKD0201N01	0201N .1pF - 2.0pF	0.1, 0.2, 0.3, 0.5, 0.7, 0.8, 0.9, 1.0, 1.3, 1.5, 1.7, 1.9, 2.0pF	+/-.1pF
DKD0201N02	0201N 1.0pF - 10pF	1.0, 1.3, 1.5, 1.7, 1.9, 2.0, 2.2, 2.7, 3.0, 3.9, 4.7, 5.6, 6.8, 7.5, 8.2pF,	+/.1pF
		10pF	+/-5%
DKD0201N03	0201N 10 - 100pF	10, 13, 15, 18, 20, 22, 27, 30, 39, 47, 56, 68, 75, 82, 91, 100pF	+/-5%

◆ Performance

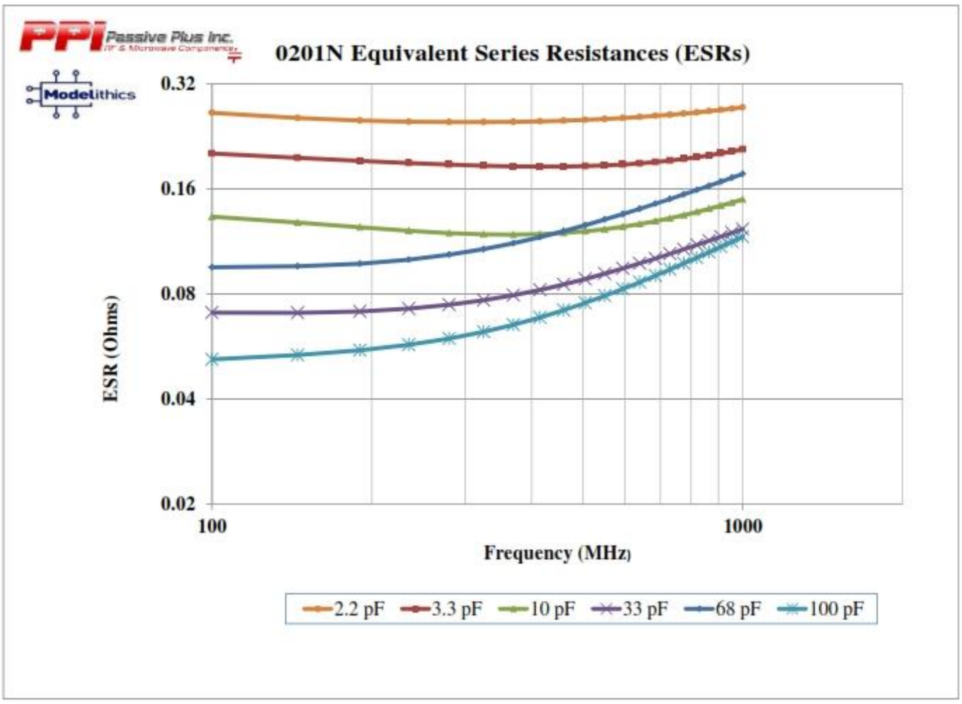
Item	Specifications
Quality Factor (Q)	2,000 min.
Insulation Resistance (IR)	10^5 Megohms min. @ +25 ℃ at rated WVDC. 10^4 Megohms min. @ +125 ℃ at rated WVDC.
Rated Voltage	25V or 50V
Dielectric Withstanding Voltage (DWV)	250% of rated Voltage for 5 seconds.
Operating Temperature Range	-55℃ to +175℃
Temperature coefficient (TC)	0±30ppm/℃
Capacitance Drift	±0.02% or ±0.02pF, whichever is greater.
Piezoelectric Effects	None

◆ Environmental Tests

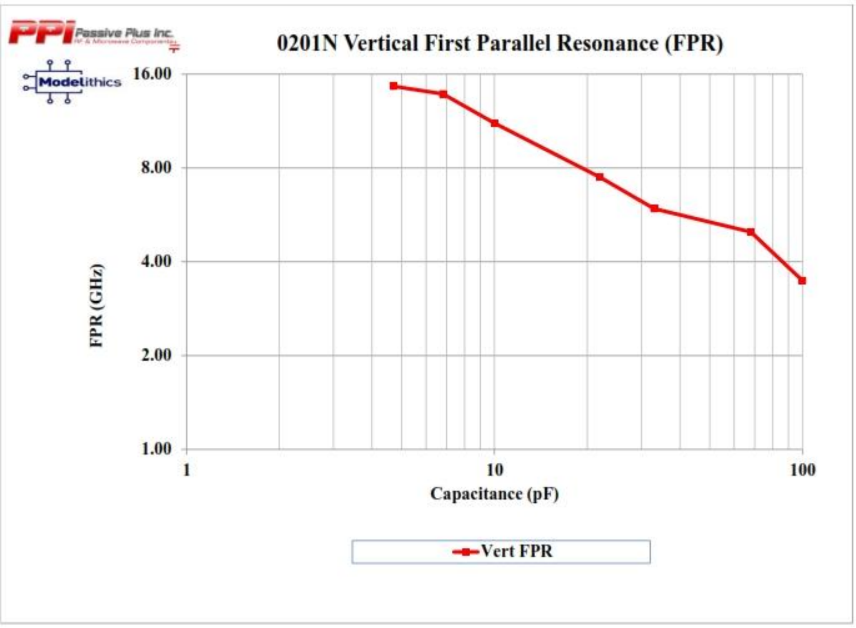
Item	Specifications	Method
Terminal Adhesion	Termination should not pull off. Ceramic should remain undamaged.	Linear pull force exerted on axial leads soldered to each terminal. 2.0lbs.
Resistance to soldering heat	No mechanical damage Capacitance change: -1.0% ~+2.0% Q>500 I.R. >10 G Ohms Breakdown voltage: 2.5 x WVDC	Preheat device to 150℃-180℃ for 60 sec. Dip in 260℃±5℃ solder for 10±1 sec. Measure after 24±2 hour cooling period.
Thermal Shock	No mechanical damage Capacitance change: ±0.5% or 0.5pF max Q>2000 I.R. >10 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 107, Condition A. At the maximum rated temperature (-55℃ and 175℃) stay 30 minutes. The time of removing shall not be more than 3 minutes. Perform the five cycles.
Humidity, Steady State	No mechanical damage Capacitance change: ±0.5% or 0.5pF max. Q>300 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 106.
Low Voltage Humidity	No mechanical damage Capacitance change: ±0.3% or 0.3pF max. Q>300 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 103, Condition A, with 1.5 Volts D.C. applied while subjected to an environment of 85℃ with 85% relative humidity for 240 hours minimum.
Life	No mechanical damage Capacitance change: ±2.0% or 0.5pF max. Q>500 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 108, for 1000 hours, at 175℃. 200% Rated voltage D.C. applied.

◆ 0201N Electrical Performance

ESR vs. Frequency



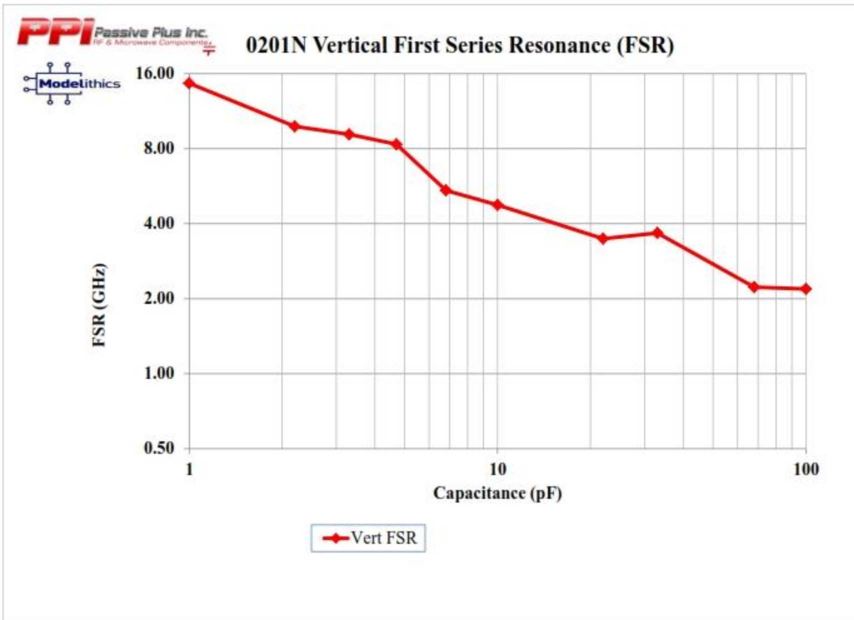
First Parallel Resonant Frequency vs. Capacitance



The First Parallel Resonance, FPR, is defined as the lowest frequency at which a suckout or notch appears in |S21|. It is generally independent of substrate thickness or dielectric constant, but does depend on capacitor orientation. A vertical orientation means the electrode planes are perpendicular to the substrate.

◆ 0201N Performance Curve

First Series Resonant Frequency vs. Capacitance



The First Series Resonance, FSR, is defined as the lowest frequency at which the imaginary part of the input impedance, Im[Zin], equals zero. Should Im[Zin] or the real part of the input impedance, Re[Zin], not be monotonic with frequency at frequencies lower than those at which Im[Zin] = 0, the FSR shall be considered as undefined. FSR is dependent on internal capacitor structure; substrate thickness and dielectric constant; capacitor orientation, as defined alongside the FPR plot; and mounting pad dimensions.

Definitions and Measurement Conditions:

The definitions on the FPR and FSR charts are for a capacitor in a series configuration, i.e., mounted across a gap in a microstrip trace with a 50-Ohm termination. The measurement conditions are: substrate -- Rogers RO3006; substrate dielectric constant = 6.15; substrate thickness (mils) = 10; gap in microstrip trace (mils) = 6.0; microstrip trace width (mils) = 14.1; **Reference planes at sample edges.**

All data has been derived from electrical models created by Modelithics, Inc., a specialty vendor contracted by PPI. The models are derived from measurements on a large number of parts disposed on several different substrates.

S-Parameters can be found on the PPI website -- http://www.passiveplus.com/index.php

◆ Recommended Land Pattern Dimensions

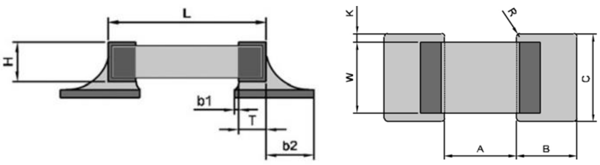
When mounting the capacitor to substrate, it's important to carefully consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

1) The greater the amount of solder, the greater the stress to the elements. This may cause the substrate to break or crack.

2) In the situation where two or more devices are mounted onto a common land, be sure to separate the device into exclusive pads by using soldering resist.

◆ Horizontal Mounting

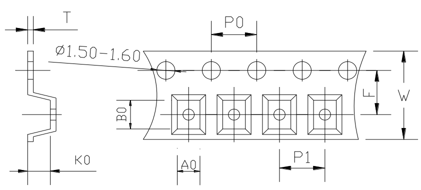
Orientation	EIA	A	B	C
Horizontal	0201	0.28	0.28	0.37



◆ Tape & Reel Specifications

Orientation	EIA	A0	B0	K0	W	P0	P1	T	F	QTY Min	QTY/ REEL	Tape Material
Horizontal	0201N	0.406	0.749	0.422	8.00	4.00	2.00	0.42	3.50	500	500	Paper

◆ Horizontal Orientation



0402N (.040" x .020")

◆ 0402N Capacitance & Rated Voltage Table

Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC
0.1	0R1	A,B, C,D	50V Code 500 or 200V Code 201 or 250V Code 251	2.0	2R0	A,B, C,D	50V Code 500 or 200V Code 201 or 250V Code 251	10	100	F,G, J,K	50V Code 500 or 200V Code 201
0.2	0R2			2.1	2R1			11	110		
0.3	0R3			2.2	2R2			12	120		
0.4	0R4			2.4	2R4			13	130		
0.5	0R5			2.7	2R7			15	150		
0.6	0R6			3.0	3R0			16	160		
0.7	0R7			3.3	3R3			18	180		
0.8	0R8			3.6	3R6	A,B, C,D	50V Code 500 or 200V Code 201	20	200		
0.9	0R9			3.9	3R9			22	220		
1.0	1R0			4.3	4R3			24	240		
1.1	1R1			4.7	4R7			27	270		
1.2	1R2			5.1	5R1			30	300	F,G, J,K	50V Code 500
1.3	1R3			5.6	5R6			33	330		
1.4	1R4			6.2	6R2						
1.5	1R5			6.8	6R8	A,B,C					
1.6	1R6			7.5	7R5						
1.7	1R7			8.2	8R2						
1.8	1R8			9.1	9R1						
1.9	1R9										

Remark: special capacitance, tolerance and WVDC are available, consult with PASSIVE PLUS.

◆ Part Numbering

0402N 100 J W 201

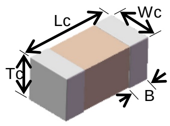
- 0402N — Series
- 100 — Rated Capacitance* (See capacitance table)
- J — Capacitance Tolerance (See capacitance table)
- W — Termination Type Nickel, Plated 100%Sn (RoHS)
- 201 — Rated Voltage

* When capacitance is less than 1.0, use “R” for decimal

Capacitance Tolerance								
Code	A	B	C	D	F	G	J	K
Tol.	±0.05pF	±0.1pF	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%

◆ 0402N Chip Dimensions

unit:inch(millimeter)

Series	Term. Code	Type/Outlines	Capacitor Dimensions				Plated Material
			Length Lc	Width Wc	Thickness Tc	Overlap B	
0402N	W		040±.004 (1.02±0.1)	.020±.004 (0.51±0.1)	.020±.004 (0.51±0.1)	.010±.006 (0.25±0.15)	Sn/Ni (RoHS)

Remark: for Non-Magnetic NP0 products please refer to page 67.

◆ Design Kits

These capacitors are 100% RoHS. Kits are available in Magnetic termination and contain 10 (ten) pieces per value; number of values per kit varies, depending on case size and capacitance.

Kit	Description	Values	Tolerance
DKD0402N01	0402N .1pF - 2.0pF	0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.2, 1.5, 1.6, 1.8, 2.0pF	+/-.1pF
DKD0402N02	0402N 1.0pF - 10pF	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7, 3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2pF,	+/.1pF
		10pF	+/-5%
DKD0402N03	0402N 10 - 33pF	10, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33pF	+/-5%

Performance

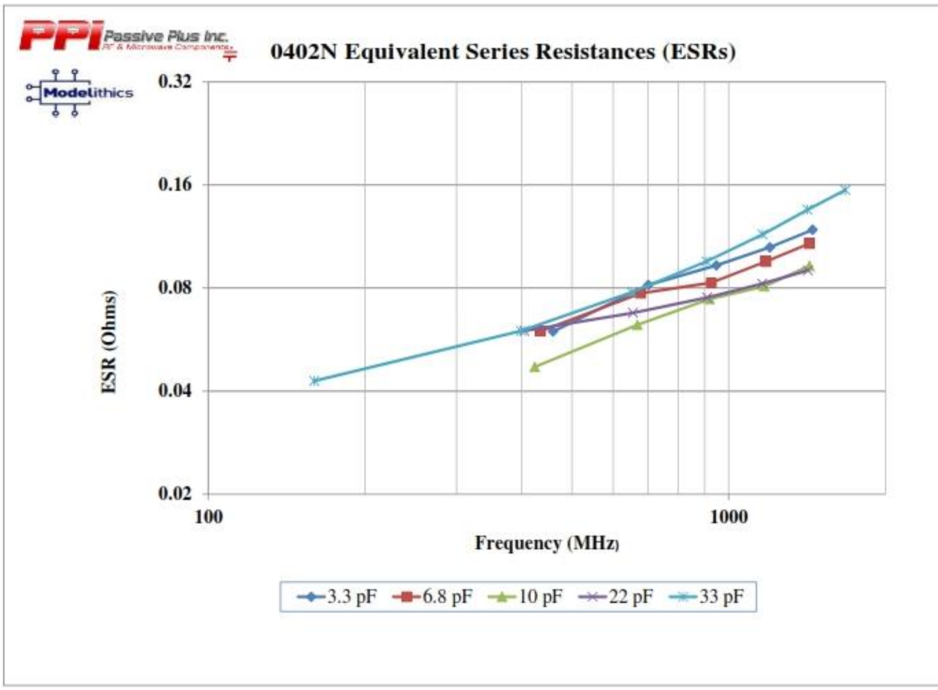
Item	Specifications
Quality Factor (Q)	2,000 min @ 1MHz.
Insulation Resistance (IR)	10^5 Megohms min. @ +25 ℃ at rated WVDC 10^4 Megohms min. @ +125 ℃ at rated WVDC
Rated Voltage	See Rated Voltage Table
Dielectric Withstanding Voltage (DWV)	250% of rated voltage for 5 seconds.
Operating Temperature Range	-55℃ to +175℃
Temperature coefficient (TC)	0±30ppm/℃
Capacitance Drift	±0.02% or ±0.02pF, whichever is greater.
Piezoelectric Effects	None

Environmental Tests

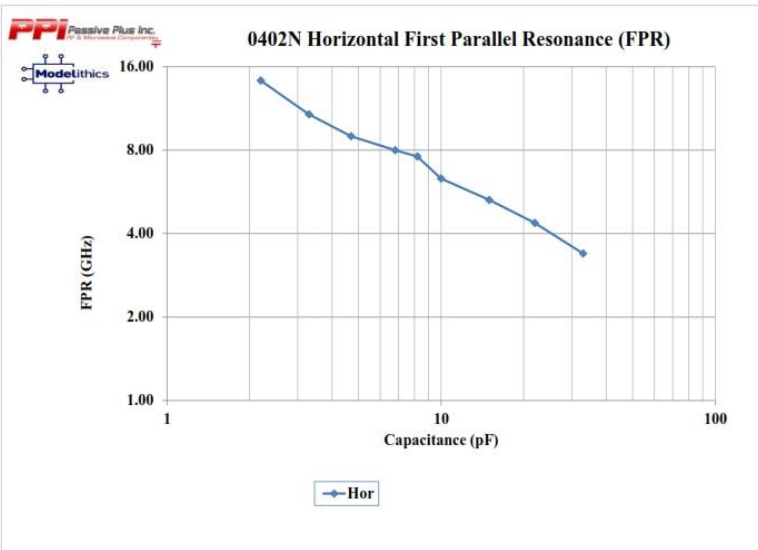
Item	Specifications	Method
Terminal Adhesion	Termination should not pull off. Ceramic should remain undamaged.	Linear pull force exerted on axial leads soldered to each terminal. 2.0lbs.
Resistance To soldering heat	No mechanical damage Capacitance change: -1.0% ~ +2.0% Q>500 I.R. >10 G Ohms Breakdown voltage: 2.5 x WVDC	Preheat device to 150℃-180℃ for 60 sec. Dip in 260℃±5℃ solder for 10±1 sec. Measure after 24±2 hour cooling period.
Thermal Shock	No mechanical damage Capacitance change: ±0.5% or 0.5pF max Q>2000 I.R. >10 G Ohms Breakdown voltage: 2.5x WVDC	MIL-STD-202, Method 107, Condition A. At the maximum rated temperature (-55℃ and 175℃) stay 30 minutes. The time of removing shall not be more than 3 minutes. Perform the five cycles.
Humidity, Steady State	No mechanical damage Capacitance change: ±0.5% or 0.5pF max. Q>300 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 106.
Low Voltage Humidity	No mechanical damage Capacitance change: ±0.3% or 0.3pF max. Q>300 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 103, Condition A, with 1.5 Volts D.C. applied while subjected to an environment of 85℃ with 85% relative humidity for 240 hours minimum.
Life	No mechanical damage Capacitance change: ±2.0% or 0.5pF max. Q>500 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 108, for 1000 hours, at 175℃. 200% Rated voltage D.C. applied.

◆ 0402N Electrical Performance

ESR vs. Frequency

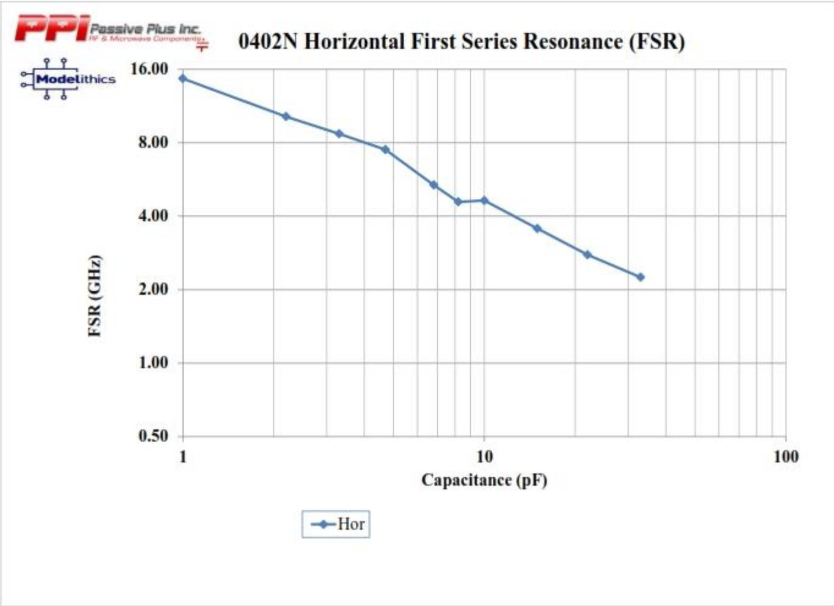


First Parallel Resonant Frequency vs. Capacitance



The First Parallel Resonance, FPR, is defined as the lowest frequency at which a suckout or notch appears in |S21|. It is generally independent of substrate thickness or dielectric constant, but does depend on capacitor orientation. A horizontal orientation means the electrode planes are parallel to the substrate.

First Series Resonant Frequency vs. Capacitance



The First Series Resonance, FSR, is defined as the lowest frequency at which the imaginary part of the input impedance, Im[Zin], equals zero. Should Im[Zin] or the real part of the input impedance, Re[Zin], not be monotonic with frequency at frequencies lower than those at which Im[Zin] = 0, the FSR shall be considered as undefined. FSR is dependent on internal capacitor structure; substrate thickness and dielectric constant; capacitor orientation, as defined alongside the FPR plot; and mounting pad dimensions.

Definitions and Measurement conditions:

The definitions on the charts are for a capacitor in a series configuration, i.e., mounted across a gap in a microstrip trace with a 50-Ohm termination. The measurement conditions are: substrate -- Rogers RO4350; substrate dielectric constant = 3.48; substrate thickness (mils) = 10; gap in microstrip trace (mils) = 15; microstrip trace width (mils) = 22; **Reference planes at sample edges.**

All data has been derived from electrical models created by Modelithics, Inc., a specialty vendor contracted by PPI. The models are derived from measurements on a large number of parts disposed on several different substrates.

S-Parameters can be found on the PPI Website--http://www.passiveplus.com/index.php

◆ Recommended Land Pattern Dimensions

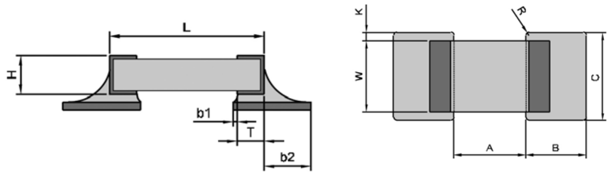
When mounting the capacitor to substrate, it's important to carefully consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

1) The greater the amount of solder, the greater the stress to the elements. This may cause the substrate to break or crack.

2) In the situation where two or more devices are mounted onto a common land, be sure to separate the device into exclusive pads by using soldering resist.

● Horizontal Mounting

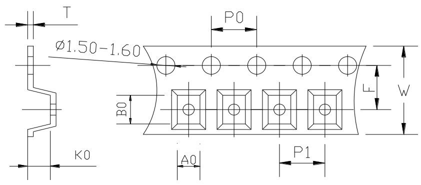
Orientation	EIA	A	B	C
Horizontal	0402	0.41	0.41	0.54



◆ Tape & Reel Specifications

Orientation	EIA	A0	B0	K0	W	P0	P1	T	F	QTY Min	QTY/ REEL	Tape Material
Horizontal	0402N	0.60	1.10	1.00	8.00	4.00	2.00	0.20	3.50	500	500	Paper

● Horizontal Orientation



0603N (.060" x .030")

◆ 0603N Capacitance & Rated Voltage Table

Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC
0.1	0R1			2.2	2R2			16	160		
0.2	0R2			2.4	2R4			18	180		
0.3	0R3			2.7	2R7			20	200		
0.4	0R4			3.0	3R0			22	220		
0.5	0R5			3.3	3R3	A,B, C,D		24	240		
0.6	0R6			3.6	3R6			27	270		
0.7	0R7			3.9	3R9			30	300		
0.8	0R8			4.3	4R3			33	330		
0.9	0R9			4.7	4R7			36	360		
1.0	1R0			5.1	5R1			39	390	F,G, J,K	250V Code 251
1.1	1R1	A,B, C,D	250V Code 251	5.6	5R6		250V Code 251	43	430		
1.2	1R2			6.2	6R2			47	470		
1.3	1R3			6.8	6R8			51	510		
1.4	1R4			7.5	7R5	A, B,C		56	560		
1.5	1R5			8.2	8R2			62	620		
1.6	1R6			9.1	9R1			68	680		
1.7	1R7			10	100			75	750		
1.8	1R8			11	110			82	820		
1.9	1R9			12	120	F,G, J,K		91	910		
2.0	2R0			13	130			100	101		
2.1	2R1			15	150						

Remark: special capacitance, tolerance and WVDC are available, consult with PASSIVE PLUS.

◆ Part Numbering

0603N 101 J W 251

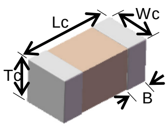
- 0603N — Series
- 101 — Rated Capacitance * (See capacitance table)
- J — Capacitance Tolerance (See capacitance table)
- W — Termination Type: Nickel,Plated 100%Sn(RoHS)
- 251 — Rated Voltage

* When capacitance is less than 1.0, use “R” for decimal

Capacitance Tolerance								
Code	A	B	C	D	F	G	J	K
Tol.	±0.05pF	±0.1pF	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%

◆ 0603N Chip Dimensions

unit: inch (millimeter)

Series	Term. Code	Type/Outlines	Capacitor Dimensions				Plated Material
			Length Lc	Width Wc	Thickness Tc	Overlap B	
0603N	W		.062±.006 (1.57±0.15)	.032±.006 (0.81±0.15)	.030 ±.005 ~ -.003 (0.76 +0.13 ~ -0.08)	.014±.006 (0.35±0.15)	Sn/Ni (RoHS)

Remark: for Non-Magnetic NP0 products please refer to page 94.

◆ Design Kits

These capacitors are 100% RoHS. Kits are available in Magnetic termination and contain 10 (ten) pieces per value; number of values per kit varies, depending on case size and capacitance.

Kit	Description	Values	Tolerance
DKD0603N01	0603N .1pF - 2.0pF	0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.5, 1.6, 1.8, 2.0pF	+/-.1pF
DKD0603N02	0603N 1.0pF - 10pF	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7, 3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2pF,	+/.1pF
		10pF	+/-5%
DKD0603N03	0603N 10 - 100pF	10, 12, 15, 18, 20, 22, 24, 27, 30, 33, 39, 47, 56, 68, 82, 100pF	+/-5%

◆ Performance

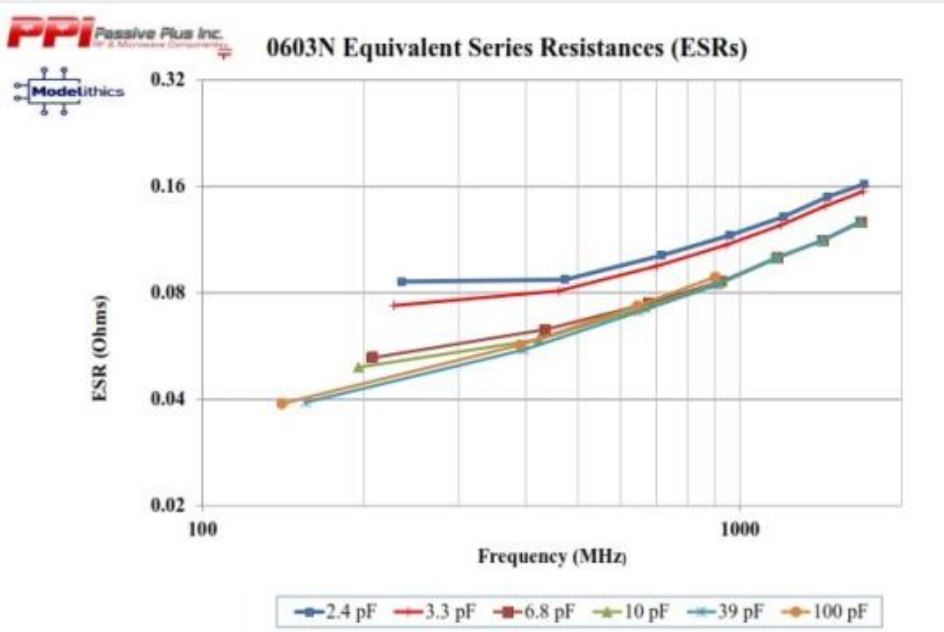
Item	Specifications
Quality Factor (Q)	2,000 min.
Insulation Resistance (IR)	10^5 Megohms min. @ +25 ℃ at rated WVDC. 10^4 Megohms min. @ +125 ℃ at rated WVDC.
Rated Voltage	250V
Dielectric Withstanding Voltage (DWV)	250% of rated Voltage for 5 seconds.
Operating Temperature Range	-55℃ to +175℃
Temperature coefficient (TC)	0±30ppm/℃
Capacitance Drift	±0.02% or ±0.02pF, whichever is greater.
Piezoelectric Effects	None

◆ Environmental Tests

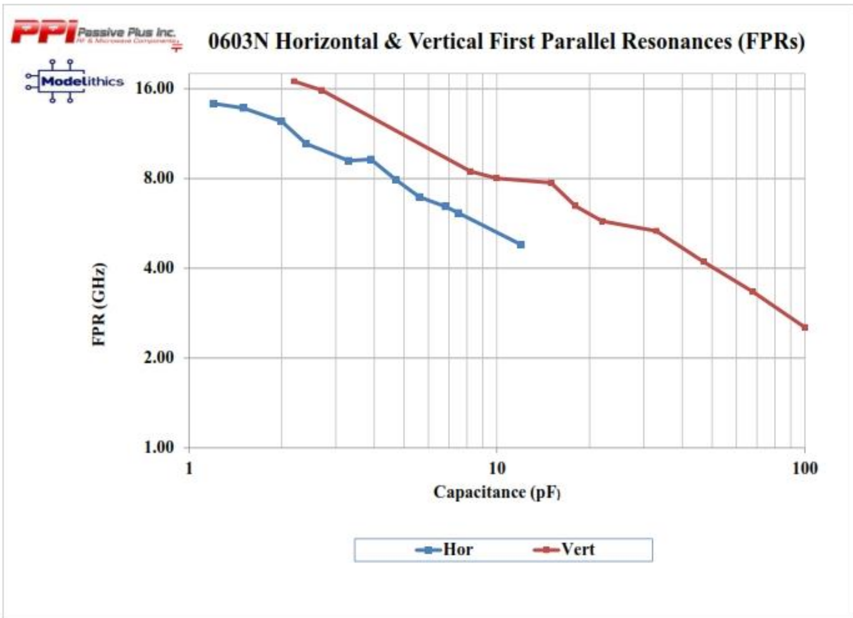
Item	Specifications	Method
Terminal Adhesion	Termination should not pull off. Ceramic should remain undamaged.	Linear pull force exerted on axial leads soldered to each terminal. 2.0lbs.
Resistance To soldering heat	No mechanical damage Capacitance change: -1.0% ~+2.0% Q>500 I.R. >10 G Ohms Breakdown voltage: 2.5 x WVDC	Preheat device to 150℃-180 ℃ for 60 sec. Dip in 260℃±5 ℃ solder for 10±1 sec. Measure after 24±2 hour cooling period.
Thermal Shock	No mechanical damage Capacitance change: ±0.5% or 0.5pF max Q>2000 I.R. >10 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 107, Condition A. At the maximum rated temperature (-55 ℃ and 175 ℃) stay 30 minutes. The time of removing shall not be more than 3 minutes. Perform the five cycles.
Humidity, Steady State	No mechanical damage Capacitance change: ±0.5% or 0.5pF max. Q>300 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 106.
Low Voltage Humidity	No mechanical damage Capacitance change: ±0.3% or 0.3pF max. Q>300 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 103, Condition A, with 1.5 Volts D.C. applied while subjected to an environment of 85 ℃ with 85% relative humidity for 240 hours minimum.
Life	No mechanical damage Capacitance change: ±2.0% or 0.5pF max. Q>500 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 108, for 1000 hours, at 175 ℃. 200% Rated voltage D.C. applied.

◆ 0603N Electrical Performance Curves

ESR vs. Frequency

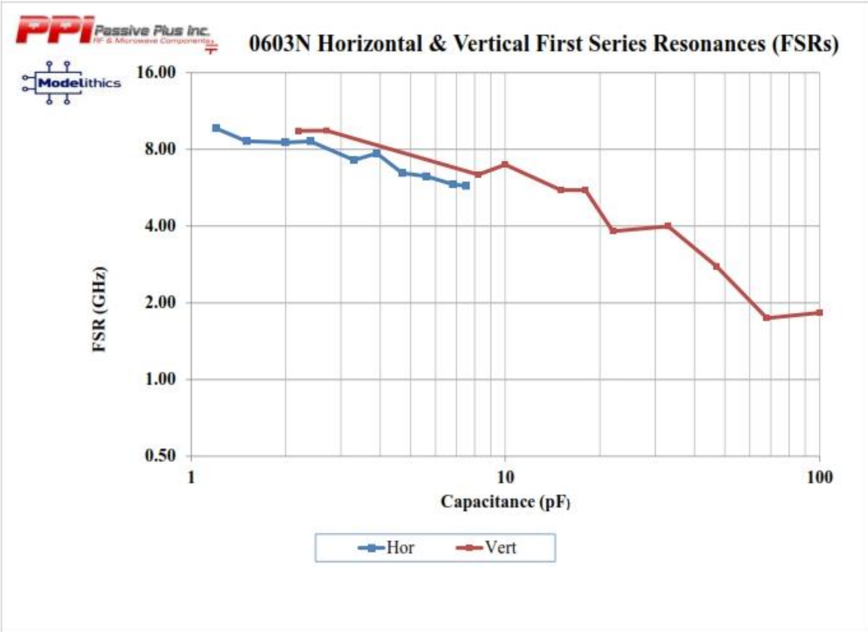


First Parallel Resonant Frequency vs. Capacitance



The First Parallel Resonance, FPR, is defined as the lowest frequency at which a suckout or notch appears in |S21|. It is generally independent of substrate thickness or dielectric constant, but does depend on capacitor orientation. A horizontal orientation means the capacitor electrode planes are parallel to the plane of the substrate; a vertical orientation means the electrode planes are perpendicular to the substrate.

First Series Resonant Frequency vs. Capacitance



The First Series Resonance, FSR, is defined as the lowest frequency at which the imaginary part of the input impedance, Im[Zin], equals zero. Should Im[Zin] or the real part of the input impedance, Re[Zin], not be monotonic with frequency at frequencies lower than those at which Im[Zin] = 0, the FSR shall be considered as undefined. FSR is dependent on internal capacitor structure; substrate thickness and dielectric constant; capacitor orientation, as defined alongside the FPR plot; and mounting pad dimensions.

Definitions and Measurement conditions:

The definitions on the charts are for a capacitor in a series configuration, i.e., mounted across a gap in a microstrip trace with a 50-Ohm termination. The measurement conditions are: substrate -- Rogers RT/duroid® 5880; substrate dielectric constant = 2.20; substrate thickness (mils) = 10; gap in microstrip trace (mils) = 23.7; microstrip trace width (mils) = 30.0; **Reference planes at sample edges.**

All data has been derived from electrical models created by Modelithics, Inc., a specialty vendor contracted by PPI. The models are derived from measurements on a large number of parts disposed on several different substrates.

S-Parameters can be found on the PPI Website-- http://www.passiveplus.com/index.php

◆ Recommended Land Pattern Dimensions

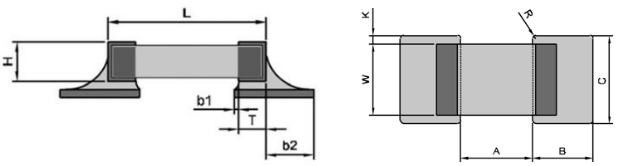
When mounting the capacitor to substrate, it's important to carefully consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

1) The greater the amount of solder, the greater the stress to the elements. This may cause the substrate to break or crack.

2) In the situation where two or more devices are mounted onto a common land, be sure to separate the device into exclusive pads by using soldering resist.

● Horizontal Mounting

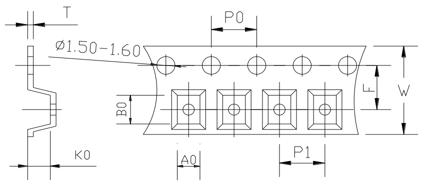
Orientation	EIA	A	B	C
Horizontal	0603	0.70	0.90	0.90



◆ Tape & Reel Specifications

Orientation	EIA	A0	B0	K0	W	P0	P1	T	F	QTY Min	QTY/ REEL	Tape Material
Horizontal	0603N	0.95	1.80	0.85	8.00	4.00	4.00	0.20	3.50	500	500	Paper

● Horizontal Orientation



0708N (.070”x .080”)

◆ 0708N Capacitance & Rated Voltage Table

Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC
1.0	1R0	B,C	500V Code 501	3.9	3R9	B,C	500V Code 501	22	220	G,J	500V Code 501
1.1	1R1			4.3	4R3			24	240		
1.2	1R2			4.7	4R7			27	270		
1.3	1R3			5.1	5R1			30	300		
1.4	1R4			5.6	5R6			33	330		
1.5	1R5			6.2	6R2			36	360		
1.6	1R6			6.8	6R8			39	390		
1.7	1R7			7.5	7R5			43	430		
1.8	1R8			8.2	8R2			47	470		
1.9	1R9			9.1	9R1			51	510		
2.0	2R0			10	100	G,J		56	560		
2.1	2R1			11	110			62	620		
2.2	2R2			12	120			68	680		
2.4	2R4			13	130			75	750		
2.7	2R7			15	150			82	820		
3.0	3R0			16	160			91	910		
3.3	3R3			18	180			100	101		
3.6	3R6			20	200						

Remark: special capacitance, tolerance and WVDC are available, consult with PASSIVE PLUS.

◆ Part Numbering

0708N 101 J W 501

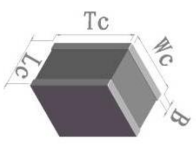
- 0708N — Series
- 101 — Rated Capacitance* (See capacitance table)
- J — Capacitance Tolerance (See capacitance table)
- W — Termination Type Nickel, Plated 100%Sn(RoHS)
- 501 — Rated Voltage

*When capacitance is less than 1.0, use “R” for decimal

Capacitance Tolerance						
Code	B	C	D	G	J	K
Tol.	±0.1pF	±0.25pF	±0.5pF	±2%	±5%	±10%

◆ 0708N Chip Dimensions

unit:inch(millimeter)

Series	Term. Code	Type/Outlines	Capacitor Dimensions				Plated Material
			Length Lc	Width Wc	Thickness Tc	Overlap B	
0708N	W	 Chip	.070±0.015 (1.78 ±0.38)	.080±.010 (2.03±0.25)	.115 (2.92)max	0.020±.010 (0.50±0.25)	Sn/Ni (RoHS)

Note: When horizontally mounted, the electrodes are in vertical position

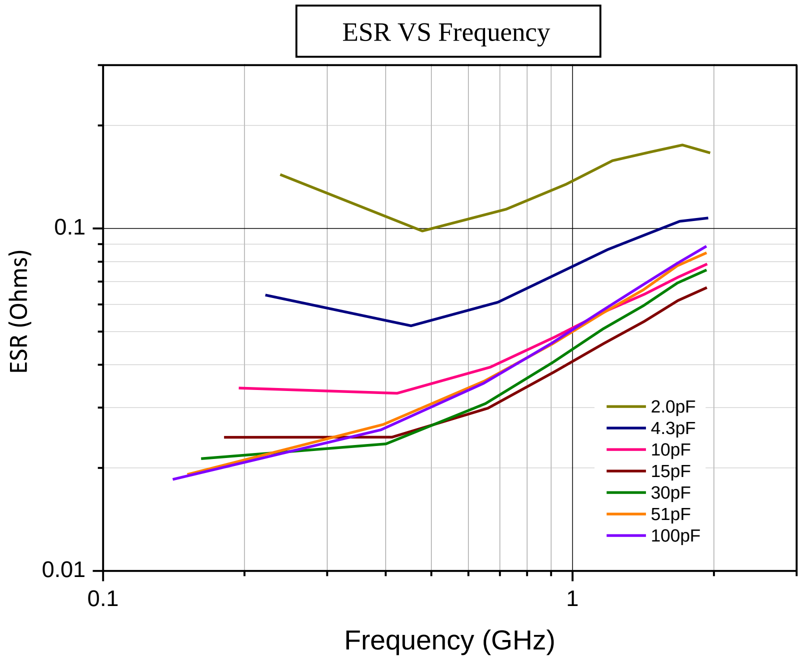
◆ Performance

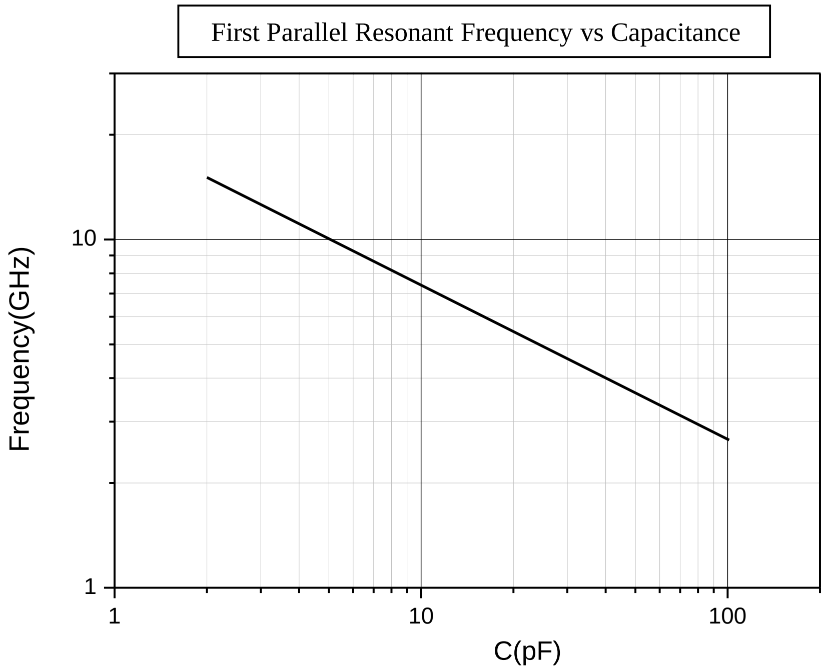
Item	Specifications
Quality Factor (Q)	2,000 min.
Insulation Resistance (IR)	10^5 Megohms min. @ +25 ℃ at rated WVDC. 10^4 Megohms min. @ +125 ℃ at rated WVDC.
Rated Voltage	See Capacitance Table
Dielectric Withstanding Voltage (DWV)	250% of Voltage for 5 seconds, Rated Voltage≤500VDC
Operating Temperature Range	-55℃ to +175℃
Temperature coefficient (TC)	0±30ppm/℃
Capacitance Drift	±0.02% or ±0.02pF, whichever is greater.
Piezoelectric Effects	None

◆ Environmental Tests

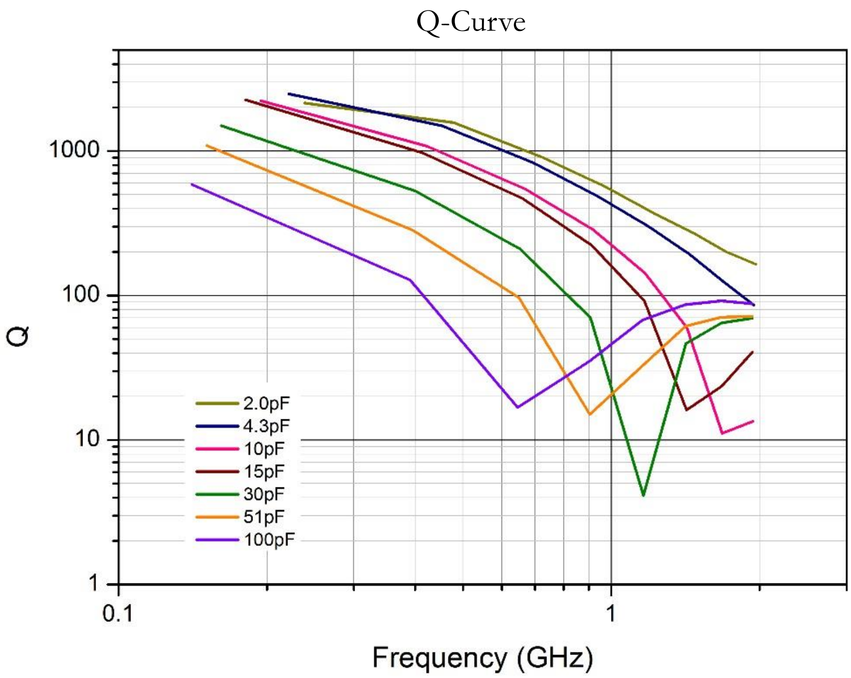
Item	Specifications	Method
Terminal Adhesion	Termination should not pull off. Ceramic should remain undamaged.	Linear pull force exerted on axial leads soldered to each terminal. 2.0lbs.
Resistance To soldering heat	No mechanical damage Capacitance change: -1.0% ~+2.0% Q>500 I.R. >10 G Ohms Breakdown voltage: 2.5 x WVDC	Preheat device to 150℃ -180℃ for 60 sec. Dip in 260℃±5℃ solder for 10±1 sec. Measure after 24±2 hour cooling period.
Thermal Shock	No mechanical damage Capacitance change: ±0.5% or 0.5pF max Q>500 I.R. >10 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 107, Condition A. At the maximum rated temperature (-55℃ and 175℃) stay 30 minutes. The time of removing shall not be more than 3 minutes. Perform the five cycles.
Humidity, Steady State	No mechanical damage Capacitance change: ±0.5% or 0.5pF max. Q>300 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 106.
Low Voltage Humidity	No mechanical damage Capacitance change: ±0.3% or 0.3pF max. Q>300 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 103, Condition A, with 1.5 Volts D.C. applied while subjected to an environment of 85℃ with 85% relative humidity for 240 hours minimum.
Life	No mechanical damage Capacitance change: ±2.0% or 0.5pF max. Q>500 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 108, for 1000 hours, at 175 ℃. 200% of Voltage for Capacitors, Rated Voltage ≤ 500VDC

◆ 0708N Electrical Performance Curves





◆ 0708N Electrical Performance Curves



◆ Recommended Land Pattern Dimensions

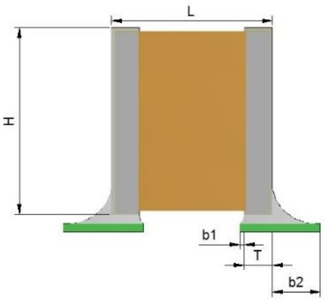
When mounting the capacitor to substrate, it's important to carefully consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

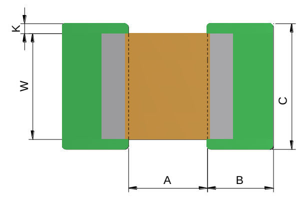
1) The greater the amount of solder, the greater the stress to the elements. This may cause the substrate to break or crack.

2) In the situation where two or more devices are mounted onto a common land, be sure to separate the device into exclusive pads by using soldering resist.

● Horizontal Mounting

Orientation	EIA	A	B	C
Horizontal	0708	0.90	1.00	2.90

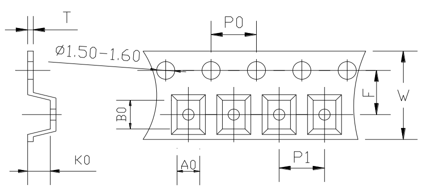




◆ Tape & Reel Specifications

Orientation	EIA	A0	B0	K0	W	P0	P1	T	F	QTY Min	QTY/ REEL	Tape Material
Horizontal	0708N	2.30	3.60	2.70	8.00	4.00	4.00	0.254	3.50	500	500	Paper

● Horizontal Orientation



0805N (.080” x .050”)

◆0805N Capacitance & Rated Voltage Table

Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC
0.1	0R1	A,B, C,D	250V Code 251	3.0	3R0	A,B, C,D	250V Code 251	30	300	F,G, J,K	250V Code 251
0.2	0R2			3.3	3R3			33	330		
0.3	0R3			3.6	3R6			36	360		
0.4	0R4			3.9	3R9			39	390		
0.5	0R5			4.3	4R3			43	430		
0.6	0R6			4.7	4R7			47	470		
0.7	0R7			5.1	5R1			51	510		
0.8	0R8			5.6	5R6			56	560		
0.9	0R9			6.2	6R2			62	620		
1.0	1R0			6.8	6R8	B,C		68	680		
1.1	1R1			7.5	7R5			75	750		
1.2	1R2			8.2	8R2			82	820		
1.3	1R3			9.1	9R1			91	910		
1.4	1R4			10	100	F,G, J,K		100	100		
1.5	1R5			11	110			110	111		
1.6	1R6			12	120			120	121		
1.7	1R7			13	130			130	131		
1.8	1R8			15	150			150	151		
1.9	1R9			16	160			160	161		
2.0	2R0			18	180			180	181		
2.1	2R1			20	200			200	201		
2.2	2R2			22	220			220	221		
2.4	2R4			24	240						
2.7	2R7			27	270						

Remark: special capacitance, tolerance and WVDC are available, consult with PASSIVE PLUS.

◆ Part Numbering

0805N 101 J W 251 X

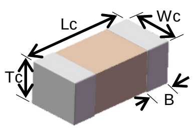
- 0805N — Series
- 101 — Rated Capacitance* (See capacitance table)
- J — Capacitance Tolerance (See capacitance table)
- W — Termination Type: Nickel, Plated 100%Sn(RoHS)
- 251 — Rated Voltage
- X — Laser Marking

*When capacitance is less than 1.0, use “R” for decimal

Capacitance Tolerance								
Code	A	B	C	D	F	G	J	K
Tol.	±0.05pF	±0.1pF	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%

◆ 0805N Chip Dimensions

unit:inch(millimeter)

Series	Term. Code	Type/Outlines	Capacitor Dimensions				Plated Material
			Length Lc	Width Wc	Thickness Tc	Overlap B	
0805N	W		.080±.008 (2.03±0.20)	.050±.008 (1.27±0.20)	.040± .006 (1.02±0.15)	0.020±.010 (0.50±0.25)	Sn/Ni (RoHS)

Remark: for Non-Magnetic NP0 products please refer to page 94.

◆ Design Kits

These capacitors are 100% RoHS. Kits are available in Magnetic termination and contain 10 (ten) pieces per value; number of values per kit varies, depending on case size and capacitance.

Kits	Description	Values	Tolerances
DKD0805N01	0805N .1pF - 2.0pF	0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.2, 1.5, 1.6, 1.8, 2.0pF	+/-.1pF
DKD0805N02	0805N 1.0pF - 10pF	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7, 3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2pF,	+/-.1pF
		10pF	+/-5%
DKD0805N03	0805N 10pF - 100pF	10, 12, 15, 18, 20, 22, 24, 27, 30, 33, 39, 47, 56, 68, 82, 100pF	+/-5%
DKD0805N04	0805N 10pF - 220pF	10, 15, 18, 20, 24, 27, 30, 39, 47, 56, 68, 82, 100, 120, 150, 180, 220pF	+/-5%

◆ Performance

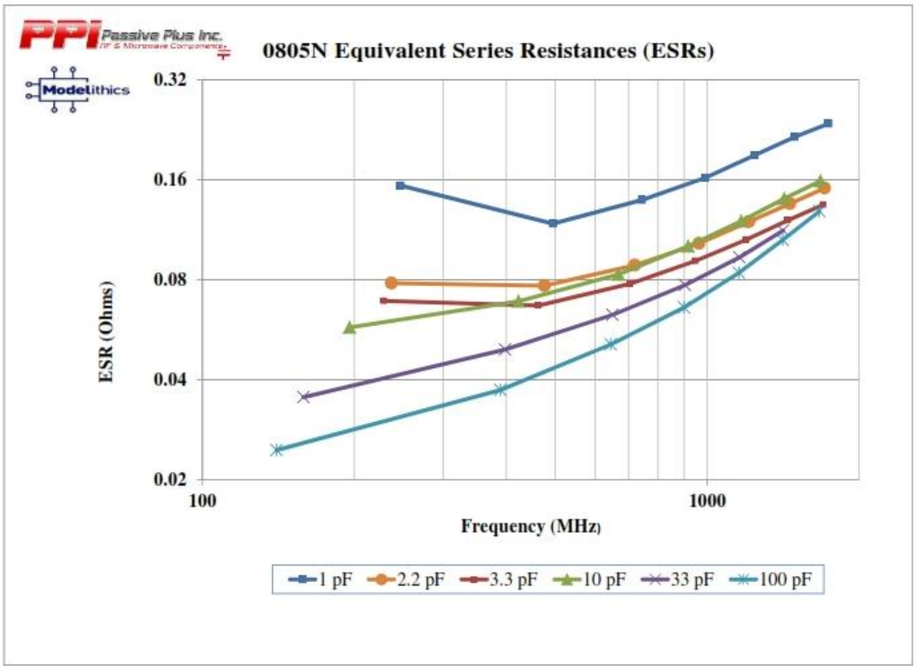
Item	Specifications
Quality Factor (Q)	2,000 min.
Insulation Resistance (IR)	10^5 Megohms min. @ +25 ℃ at rated WVDC. 10^4 Megohms min. @ +125 ℃ at rated WVDC.
Rated Voltage	250V
Dielectric Withstanding Voltage (DWV)	250% of rated Voltage for 5 seconds.
Operating Temperature Range	-55℃ to +175℃
Temperature coefficient (TC)	0±30ppm/℃
Capacitance Drift	±0.02% or ±0.02pF, whichever is greater.
Piezoelectric Effects	None

◆ Environmental Tests

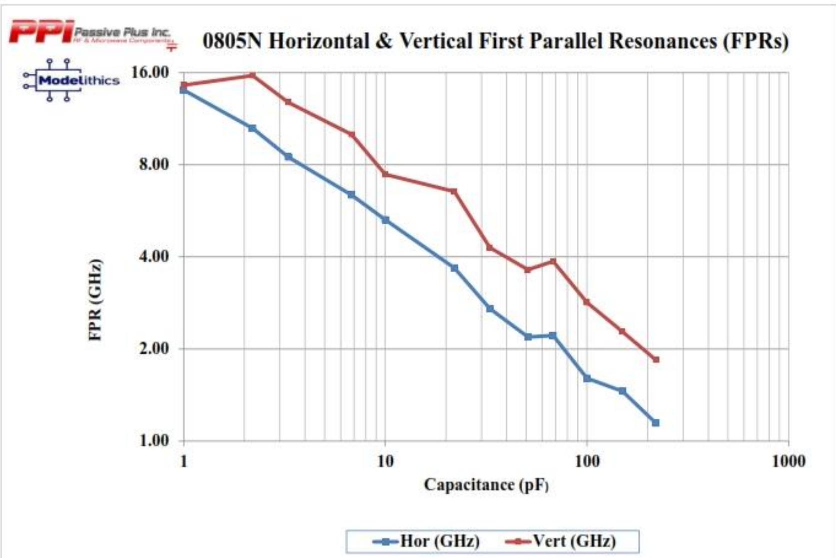
Item	Specifications	Method
Terminal Adhesion	Termination should not pull off. Ceramic should remain undamaged.	Linear pull force exerted on axial leads soldered to each terminal. 2.0lbs.
Resistance To soldering heat	No mechanical damage Capacitance change: -1.0% ~+2.0% Q>500 I.R. >10 G Ohms Breakdown voltage: 2.5 x WVDC	Preheat device to 150 ℃-180 ℃ for 60 sec. Dip in 260℃±5℃solder for 10±1 sec. Measure after 24±2 hour cooling period.
Thermal Shock	No mechanical damage Capacitance change: ±0.5% or 0.5pF max Q>2000 I.R. >10 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 107, Condition A. At the maximum rated temperature(-55 ℃ and 175 ℃) stay 30 minutes. The time of removing shall not be more than 3 minutes. Perform the five cycles.
Humidity, Steady State	No mechanical damage Capacitance change: ±0.5% or 0.5pF max. Q>300 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 106.
Low Voltage Humidity	No mechanical damage Capacitance change: ±0.3% or 0.3pF max. Q>300 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 103, Condition A, with 1.5 Volts D.C. applied while subjected to an environment of 85 ℃ with 85% relative humidity for 240 hours minimum.
Life	No mechanical damage Capacitance change: ±2.0% or 0.5pF max. Q>500 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 108, for 1000 hours, at 175 ℃. 200% Rated voltage D.C. applied.

◆ 0805N Electrical Performance

ESR vs. Frequency

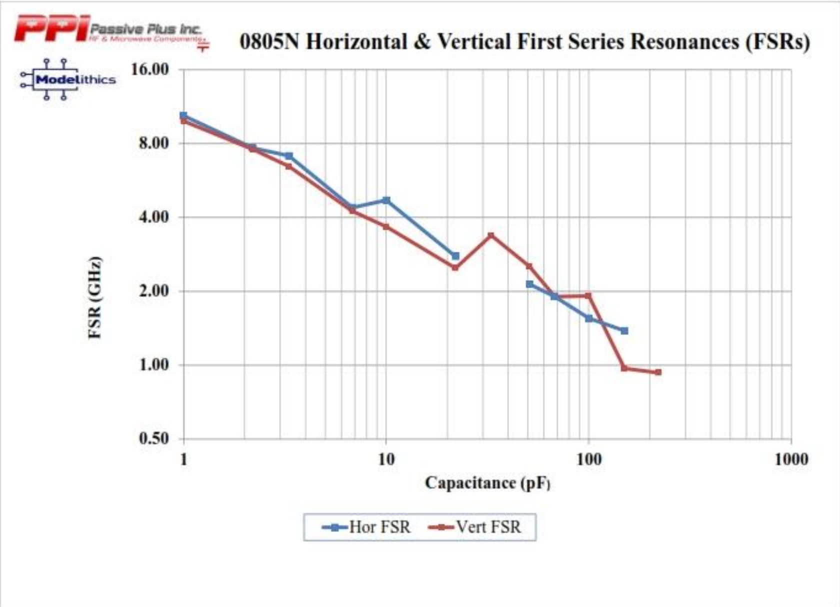


First Parallel Resonant Frequency vs. Capacitance



The First Parallel Resonance, FPR, is defined as the lowest frequency at which a suckout or notch appears in |S21|. It is generally independent of substrate thickness or dielectric constant, but does depend on capacitor orientation. A horizontal orientation means the capacitor electrode planes are parallel to the plane of the substrate; a vertical orientation means the electrode planes are perpendicular to the substrate.

First Series Resonant Frequency vs. Capacitance



The First Series Resonance, FSR, is defined as the lowest frequency at which the imaginary part of the input impedance, Im[Zin], equals zero. Should Im[Zin] or the real part of the input impedance, Re[Zin], not be monotonic with frequency at frequencies lower than those at which Im[Zin] = 0, the FSR shall be considered as undefined. FSR is dependent on internal capacitor structure; substrate thickness and dielectric constant; capacitor orientation, as defined alongside the FPR plot; and mounting pad dimensions.

<u>Definitions and Measurement conditions:</u>

The definitions on the charts are for a capacitor in a series configuration, i.e., mounted across a gap in a microstrip trace with a 50-Ohm termination. The measurement conditions are: substrate -- Rogers RO3003; substrate dielectric constant = 3.00; substrate thickness (mils) = 23; gap in microstrip trace (mils) = 23.6; microstrip trace width (mils) = 57.1; **Reference planes at sample edges**.

All data has been derived from electrical models created by Modelithics, Inc., a specialty vendor contracted by PPI. The models are derived from measurements on a large number of parts disposed on several different substrates.

S-Parameters can be found on the PPI Website -- http://www.passiveplus.com/index.php

◆ Recommended Land Pattern Dimensions

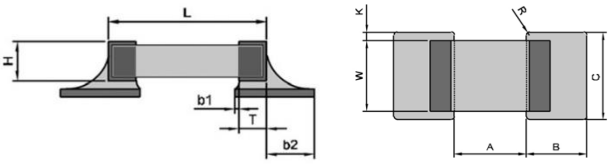
When mounting the capacitor to substrate, it's important to carefully consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

1) The greater the amount of solder, the greater the stress to the elements. This may cause the substrate to break or crack.

2) In the situation where two or more devices are mounted onto a common land, be sure to separate the device into exclusive pads by using soldering resist.

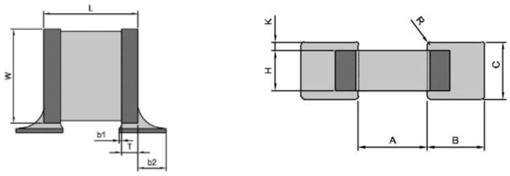
● Horizontal Mounting

Orientation	EIA	A	B	C
Horizontal	0805	1.10	1.10	1.40



● Vertical Mounting

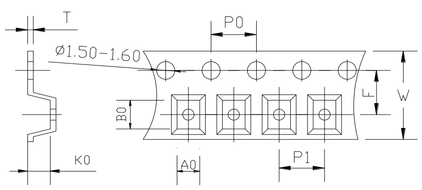
Orientation	EIA	A	B	C
Vertical	0805	1.10	1.10	1.40



◆ Tape & Reel Specifications

Orientation	EIA	A0	B0	K0	W	P0	P1	T	F	QTY Min	QTY/ REEL	Tape Material
Horizontal	0805N	1.60	1.60	2.40	8.00	4.00	4.00	0.20	3.50	500	500	Paper

● Horizontal Orientation



1111N (.110"x .110")

◆ 1111N Capacitance & Rated Voltage Table

Cap. pF	Code	Tol.	WVDC V	Cap. pF	Code	Tol.	WVDC V	Cap. pF	Code	Tol.	WVDC V	Cap. pF	Code	Tol.	WVDC V
0.2	0R2	A, B, C,D	500V Code 501 Or 1000V Code 102	3.0	3R0	A, B, C, D	500V Code 501 Or 1000V Code 102	27	270	F, G, J, K	500V Code 501 Or 1000V Code 102	220	221	F, G, J, K	200V Code 201 500V Code 501
0.3	0R3			3.3	3R3			30	300			240	241		
0.4	0R4			3.6	3R6			33	330			270	271		
0.5	0R5			3.9	3R9			36	360			300	301		
0.6	0R6			4.3	4R3			39	390			330	331		
0.7	0R7			4.7	4R7			43	430			360	361		
0.8	0R8			5.1	5R1			47	470			390	391		
0.9	0R9			5.6	5R6			51	510			430	431	G, J, K	
1.0	1R0			6.2	6R2			56	560			470	471		
1.1	1R1			6.8	6R8			62	620			510	511		100V Code 101 500V Code 501
1.2	1R2			7.5	7R5			68	680			560	561		
1.3	1R3			8.2	8R2			75	750			620	621		50V Code 500
1.4	1R4			9.1	9R1			82	820			680	681		
1.5	1R5			10	100	F, G, J, K		91	910			750	751		
1.6	1R6			11	110			100	100		300V Code 301 600V Code 601	820	821		
1.7	1R7			12	120			110	111			910	911		
1.8	1R8			13	130			120	121			1000	102		
1.9	1R9			15	150			130	131						
2.0	2R0			16	160			150	151						
2.1	2R1			18	180			160	161						
2.2	2R2			20	200			180	181						
2.4	2R4			22	220			200	201						
2.7	2R7			24	240										

Remark: special capacitance, tolerance and WVDC are available, consult with PASSIVE PLUS.

◆ Part Numbering

1111N 101 J W 501 X TV

- 1111N — Series
- 101 — Rated Capacitance* (See capacitance table)
- J — Capacitance Tolerance (See capacitance table)
- W — Termination Type Nickel, Plated 100%Sn(RoHS)
- 501 — Rated Voltage
- X — Laser Marking
- TV — Add TV for Vertical Orientation

*When capacitance is less than 1.0, use “R” for decimal

Capacitance Tolerance								
Code	A	B	C	D	F	G	J	K
Tol.	±0.05pF	±0.1pF	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%

◆ 1111N Chip Dimensions

unit:inch(millimeter)

Series	Term. Code	Type/Outlines	Capacitor Dimensions Length Lc	Width Wc	Thickness Tc	Overlap B	Plated Material
1111N	W		.110 ±.020 ~ -.010 (2.79 +0.51 ~ -0.25)	.110±.015 (2.79±0.38)	.10 (2.6) Max	0.015 0.024 Max.	Sn/Ni (RoHS)

Remark: for Non-Magnetic NP0 products please refer to page 94.

◆ Design Kits

These capacitors are 100% RoHS. Kits are available in Magnetic termination and contain 10 (ten) pieces per value; number of values per kit varies, depending on case size and capacitance.

Kit	Description	Values	Tolerances
DKD1111N01	1111N 0.2pF - 10pF	0.2, 0.5, 0.7, 0.8, 1.0, 1.2, 1.5, 1.8, 2.0, 2.4, 2.7, 3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2pF,	+/-.1pF
		10pF	+/-5%
DKD1111N02	1111N 10-100pF	10, 12, 15, 18, 20, 22, 24, 27, 30, 33, 39, 47, 56, 68, 82, 100pF	+/-5%
DKD1111N03	1111N 100-1000pF	100, 120, 150, 180, 200, 220, 240, 270, 300, 390, 470, 560, 680, 820, 1000pF	+/-5%

◆ Performance

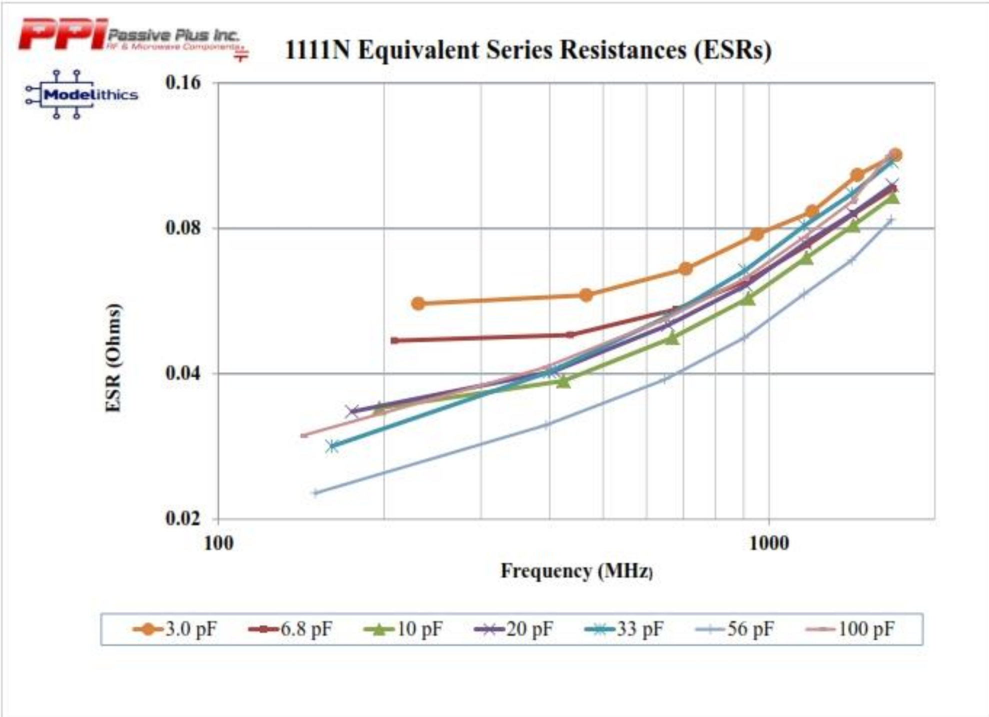
Item	Specifications
Quality Factor (Q)	2,000 min.
Insulation Resistance (IR)	10^5 Megohms min. @ +25 ℃ at rated WVDC. 10^4 Megohms min. @ +125 ℃ at rated WVDC.
Rated Voltage	See Capacitance Table
Dielectric Withstanding Voltage (DWV)	250% of Voltage for 5 seconds, Rated Voltage≤500VDC 150%of Voltage for 5seconds, 500VDC<RatedVoltage≤1250VDC 120% of Voltage for 5 seconds, Rated Voltage>1250VDC
Operating Temperature Range	-55℃ to +175℃
Temperature coefficient (TC)	0±30ppm/℃
Capacitance Drift	±0.02% or ±0.02pF, whichever is greater.
Piezoelectric Effects	None

◆ Environmental Tests

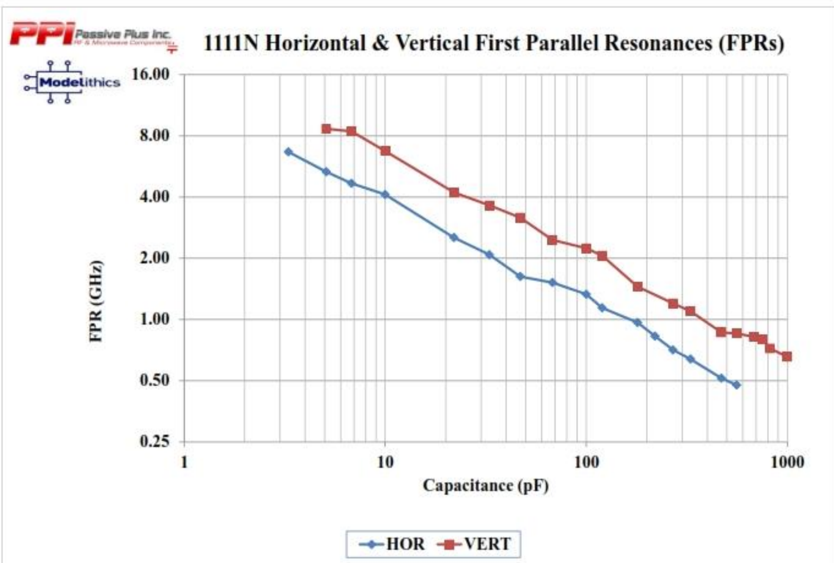
Item	Specifications	Method
Terminal Adhesion	Termination should not pull off. Ceramic should remain undamaged.	Linear pull force exerted on axial leads soldered to each terminal. 2.0lbs.
Resistance To soldering heat	No mechanical damage Capacitance change: -1.0% ~+2.0% Q>500 I.R. >10 G Ohms Breakdown voltage: 2.5 x WVDC	Preheat device to 150℃ -180℃ for 60 sec. Dip in 260℃±5 ℃ solder for 10±1 sec. Measure after 24±2 hour cooling period.
Thermal Shock	No mechanical damage Capacitance change: ±0.5% or 0.5pF max Q>500 I.R. >10 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 107, Condition A. At the maximum rated temperature (-55℃ and 175℃) stay 30 minutes. The time of removing shall not be more than 3 minutes. Perform the five cycles.
Humidity, Steady State	No mechanical damage Capacitance change: ±0.5% or 0.5pF max. Q>300 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 106.
Low Voltage Humidity	No mechanical damage Capacitance change: ±0.3% or 0.3pF max. Q>300 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 103, Condition A, with 1.5 Volts D.C. applied while subjected to an environment of 85℃ with 85% relative humidity for 240 hours minimum.
Life	No mechanical damage Capacitance change: ±2.0% or 0.5pF max. Q>500 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	MIL-STD-202, Method 108, for 1000 hours, at 175℃. 200% of Voltage for Capacitors, Rated Voltage ≤500VDC 120% of Voltage for Capacitors, 500VDC < Rated Voltage ≤1250VDC 100% of Voltage for Capacitors, Rated Voltage > 1250VDC

◆ 1111N Electrical Performance Curves

ESR vs. Frequency

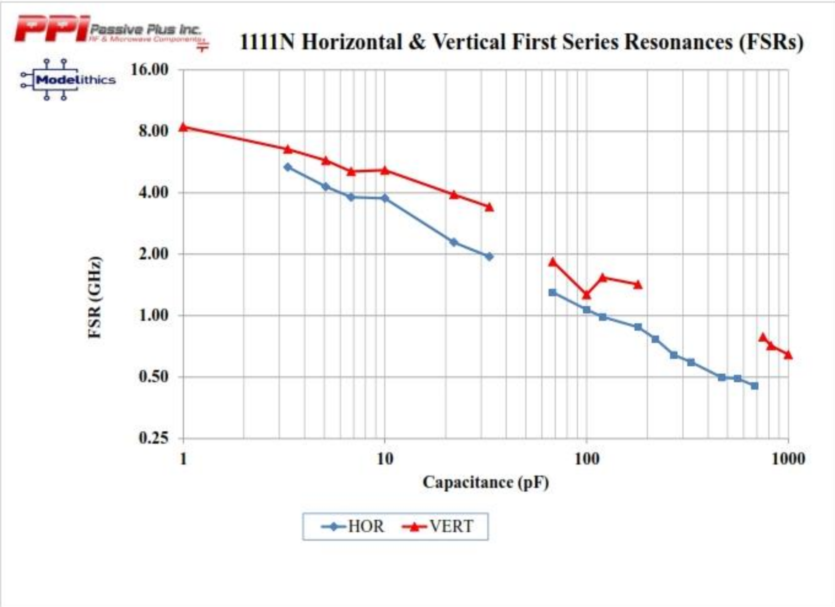


First Parallel Resonant Frequency vs. Capacitance



The First Parallel Resonance, FPR, is defined as the lowest frequency at which a suckout or notch appears in |S21|. It is generally independent of substrate thickness or dielectric constant, but does depend on capacitor orientation. A horizontal orientation means the capacitor electrode planes are parallel to the plane of the substrate; a vertical orientation means the electrode planes are perpendicular to the substrate.

First Series Resonant Frequency vs. Capacitance



The First Series Resonance, FSR, is defined as the lowest frequency at which the imaginary part of the input impedance, Im[Zin], equals zero. Should Im[Zin] or the real part of the input impedance, Re[Zin], not be monotonic with frequency at frequencies lower than those at which Im[Zin] = 0, the FSR shall be considered as undefined. FSR is dependent on internal capacitor structure; substrate thickness and dielectric constant; capacitor orientation, as defined alongside the FPR plot; and mounting pad dimensions.

Definitions and Measurement conditions:

The definitions on the charts are for a capacitor in a series configuration, i.e., mounted across a gap in a microstrip trace with a 50-Ohm termination. The measurement conditions are: substrate -- Rogers RO4350; substrate dielectric constant = 3.48; horizontal mount substrate thickness (mils) = 55; vertical mount substrate thickness (mils) = 45; gap in microstrip trace, horizontal or vertical mount (mils) = 61.1; horizontal mount microstrip trace width (mils) = 123.7; vertical mount microstrip trace width (mils) = 101.0. **Reference planes at sample edges.**

All data has been derived from electrical models created by Modelithics, Inc., a specialty vendor contracted by PPI. The models are derived from measurements on a large number of parts disposed on several different substrates.

S-Parameters can be found on the PPI Website -- http://www.passiveplus.com/index.php

◆ Recommended Land Pattern Dimensions

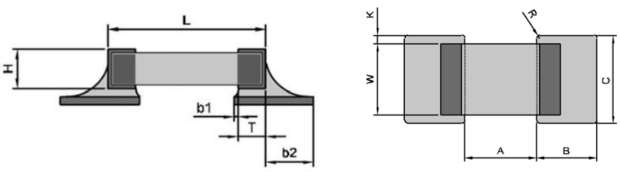
When mounting the capacitor to substrate, it's important to carefully consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

1) The greater the amount of solder, the greater the stress to the elements. This may cause the substrate to break or crack.

2) In the situation where two or more devices are mounted onto a common land, be sure to separate the device into exclusive pads by using soldering resist.

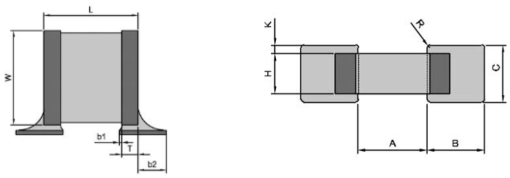
● Horizontal Mounting

Orientation	EIA	A	B	C
Horizontal	1111	1.90	1.70	2.90



● Vertical Mounting

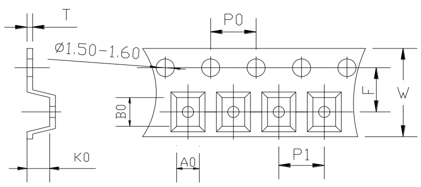
Orientation	EIA	A	B	C
Vertical	1111	1.90	1.70	2.50



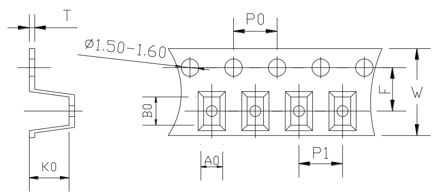
◆ Tape & Reel Specifications

Orientation	EIA	A0	B0	K0	W	P0	P1	T	F	QTY Min	QTY/ REEL	Tape Material
Horizontal	1111N	2.92	3.51	2.34	8.00	4.00	4.00	0.254	3.50	500	500	Embossed
Vertical	1111N	2.92	3.51	2.34	8.00	4.00	4.00	0.254	3.50	500	500	Embossed

● Horizontal Orientation



● Vertical Orientation



X7R RF By-Pass Capacitors

0505X (.055”x .055”)

◆ 0505X Capacitance & Rated Voltage Table

Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC
470	471	K,M	50V Code 500	1500	152	K,M	50V Code 500	4700	472	K,M	50V Code 500
560	561			1800	182			5000	502		
680	681			2200	222			5600	562		
820	821			2700	272			6800	682		
1000	102			3300	332			8200	822		
1200	122			3900	392			10000	103		

Remark: special capacitance, tolerance and WVDC are available, consult with PASSIVE PLUS.

◆ 0505X Dimensions

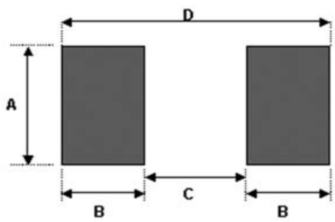
unit:inch(millimeter)

Series	Term. Code	Type/Outlines	Length(Lc)	Width(Wc)	Thickness(Tc)	B	Plated Material
0505X	W	 Chip	.055+.015 ~ -.010 (1.40+0.38 ~ -0.25)	.055±.015 (1.40±0.38)	.057 (1.45) max	.014 ±.006 (.356 ±0.152)	Sn/Ni
	P						Sn/Cu
	L						Sn (90%)/Pb(10%)
	C						Ag/Pb
	CA						Au/Ni

◆ 0505X Recommended Mounting Pads

Size	A Min.	B Min.	C Min.	D Min.
VERT	.070"	.050"	.030"	.130"
HORIZ	.080"	.050"	.030"	.130"

VERT= Vertical Mount, HORIZ = Horizontal Mount



◆ Performance

Item	Specifications
Operating Temperature Range	-55℃ to +125℃
Insulation Resistance (IR)	Insulation resistance @ +25℃ >1000ΩF . Insulation resistance @ +125℃ >100ΩF.
Temp Voltage Coefficient	+15/-25% △C (-55℃ to +125℃)
Dielectric Withstanding Voltage (DWV)	2.5X WVDC, 5 seconds.
Max Dissipation Factor	.025(2.5%) Max
Test Parameters	1KHz, 1.0VRMS, 25℃.
Terminal Strength	5lbs min per Mil-STD-202 method 211
Aging	3% max per decade hour
Working Voltage	See table

0505X (.055” x .055”)

◆ Part Numbering

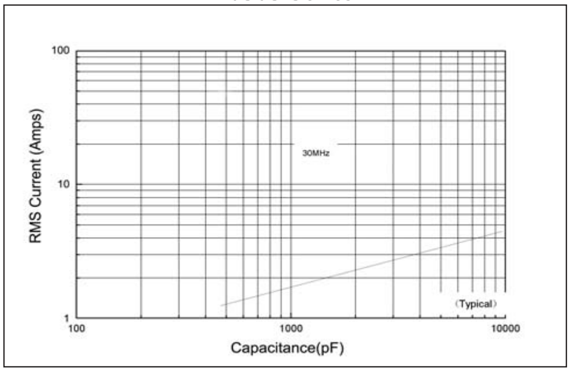
0505 X 10 3 M W 50 0

- 0505 — Case Size
- X — X7R Dielectric
- 10 — Capacitance Code -First 2 significant digits for capacitance
- 3 — Indicates number of zeros following digits of capacitance in pF
- M — Capacitance Tolerance (M tolerance =±20%)
- W — Termination Choices: W=Sn/Ni(RoHS), L=Sn(90%)Pb(l0%)Ni, C=Ag/Pb, CA=Au/Ni
- 50 — WVDC First 2 significant digits for Voltage
- 0 — Indicates number of zeros following digits of Voltage

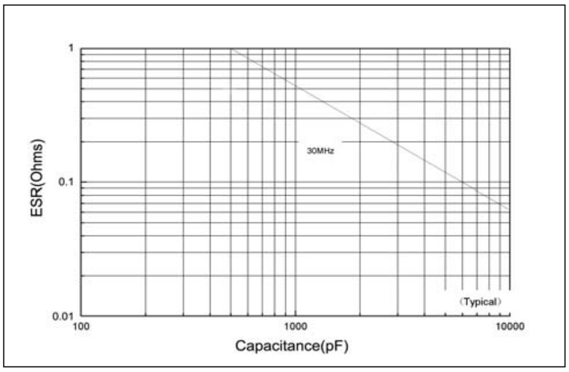
NOTE: Available in Vertical Tape & Reel Orientation Upon Request.

◆ 0505X Performance Curves

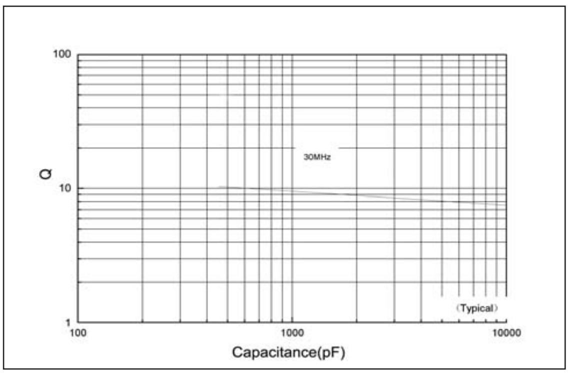
Current Rating vs Capacitance
0505 Series



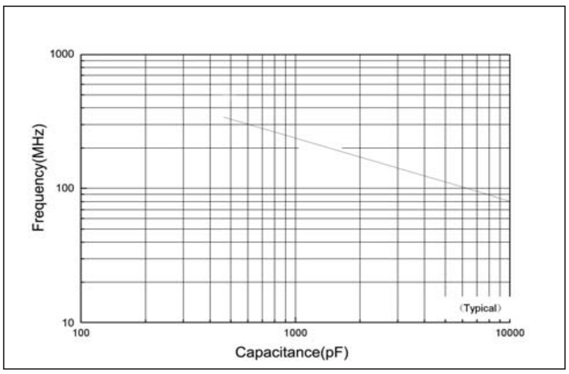
ESR vs Capacitance
0505 Series



Q vs Capacitance
0505 Series



Series Resonance vs Capacitance
0505 Series



1111X (.110” x .110”)

◆ 1111X Capacitance & Rated Voltage Table

Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC	Cap. pF	Code	Tol.	Rated WVDC
4700	472	K,M	50V Code 500	15000	153	K,M	50V Code 500	47000	473	K,M	50V Code 500
5600	562			18000	183			50000	503		
6800	682			22000	223			56000	563		
8200	822			27000	273			68000	683		
10000	103			33000	333			82000	823		
12000	123			39000	393			100000	104		

Remark: special capacitance, tolerance and WVDC are available, consult with PASSIVE PLUS.

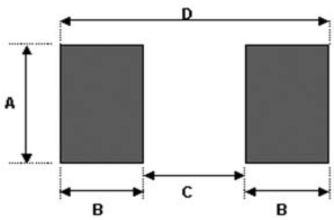
◆ 1111X Dimensions

unit:inch(millimeter)

Series	Term. Code	Type/Outlines	Length(Lc)	Width(Wc)	Thickness(Tc)	B	Plated Material
1111X	W	 Chip	.110+.025 ~ -.010 (2.79+0.64 ~ -0.25)	.110±.015 (2.79±0.38)	.102 (2.59) Max	.020 ±.010 (0.508 ±0.25)	Sn/Ni
	P						Sn/Cu
	L						Sn (90%)/Pb(10%)
	C						Ag/Pb
	CA						Au/Ni

◆ 1111X Recommended Mounting Pads

Size	A Min.	B Min.	C Min.	D Min.
VERT	.120"	.050"	.075"	.175"
HORIZ	.130"	.050"	.075"	.175"



VERT= Vertical Mount, HORIZ = Horizontal Mount

◆ Performance

Item	Specifications
Operating Temperature Range	-55℃ to +125℃
Insulation Resistance (IR)	Insulation resistance @ +25℃ >1000ΩF Insulation resistance @ +125℃ >100ΩF
Temp Voltage Coefficient	+15/-25% △C (-55℃ to +125℃)
Dielectric Withstanding Voltage (DWV)	2.5X WVDC, 5 seconds.
Max Dissipation Factor	.025 (2.5%) Max
Test Parameters	1KHz,1.0VRMS,25℃

◆ Part Numbering

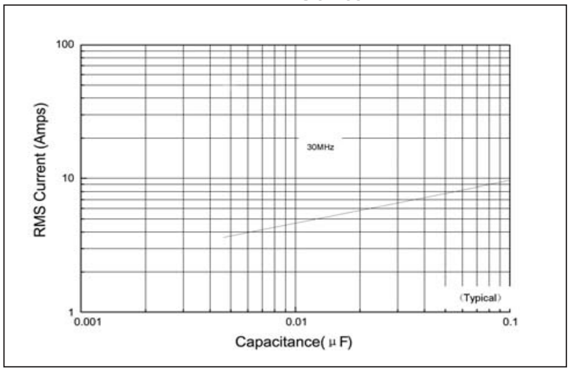
1111 X 10 4 M W 50 0

- 1111 — Case Size
- X — X7R Dielectric
- 10 — Capacitance Code
  -First 2 significant digits for capacitance
- 4 — Indicates number of zeros following digits of capacitance in pF
- M — Capacitance Tolerance (M tolerance =±20%)
- W — Termination Choices: W=Sn/Ni, L=Sn(90%)Pb(10%)Ni, C=Ag/Pb, CA=Au/Ni
- 50 — WVDC First 2 significant digits for Voltage
- 0 — Indicates number of zeros following digits of Voltage

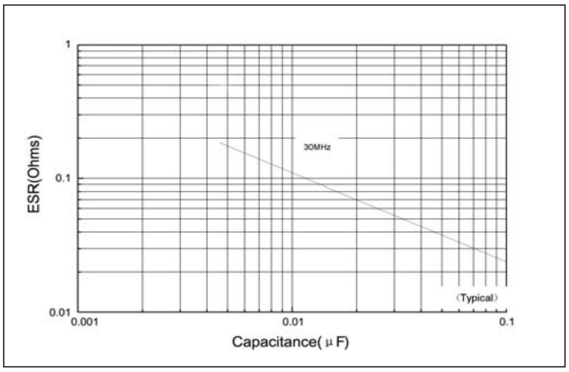
◆ 1111X Performance Curves

NOTE: Available in Vertical Tape & Reel Orientation Upon Request.

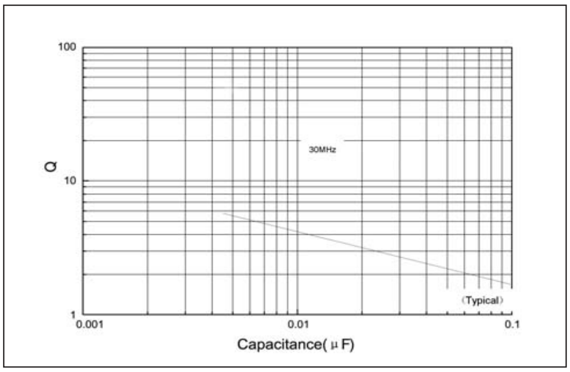
Current Rating vs Capacitance
1111 Series



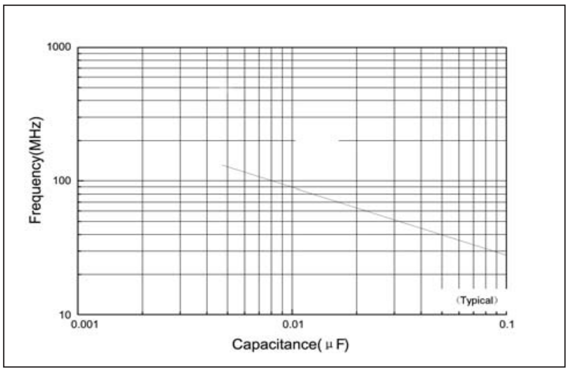
ESR vs Capacitance
1111 Series



Q vs Capacitance
1111 Series



Series Resonance vs Capacitance
1111 Series



2225X (.220” x .250”)

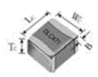
◆ 2225X Capacitance & Rated Voltage Table

Cap. uF	Code	Tol.	Rated WVDC	Cap. uF	Code	Tol.	Rated WVDC	Cap. uF	Code	Tol.	Rated WVDC
0.010	103	K,M	300V Code 301	0.082	823	K,M	200V Code 201	0.330	334	K,M	150V Code 151
0.012	123			0.100	104			0.470	474		
0.015	153			0.120	124			0.560	564		
0.022	223			0.150	154			0.680	684		
0.033	333		250V Code 251	0.220	224			0.820	824		100V Code 101
0.047	473							1.000	105		
0.068	683										

Remark: special capacitance, tolerance and WVDC are available, consult with PASSIVE PLUS.

◆ 2225X Dimensions

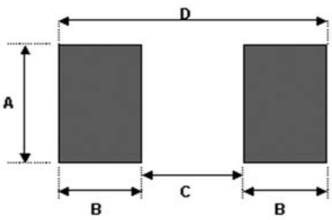
unit:inch(millimeter)

Series	Term. Code	Type/Outlines	Length (Lc)	Width (Wc)	Thickness (Tc)	B	Plated Material
2225X	W	 Chip	.230+.020 ~ -.012 (5.84+0.51 ~ -0.30)	.250±.015 (6.35±0.38)	.165 (4.19) Max	.030 ±.015 (0.762 ±0.38)	Sn/Ni (RoHS)
	P						Cu (RoHS)
	L						Sn (90%)/Pb(10%)
	C						Ag/Pb
	CA						Au/Ni

◆ 2225X Recommended Mounting Pads

Size	A Min.	B Min.	C Min.	D Min.
VERT	.185"	.050"	.200"	.300"
HORIZ	.280"	.050"	.200"	.300"

VERT= Vertical Mount, HORIZ = Horizontal Mount

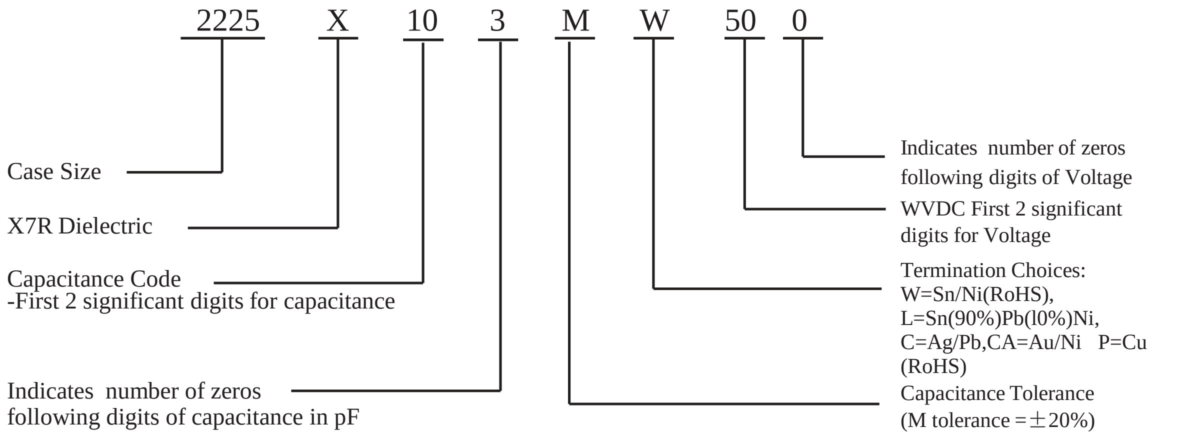


◆ Performance

Item	Specifications
Operating Temperature Range	-55℃to +125℃
Insulation Resistance (IR)	Insulation resistance @ +25℃ >1000ΩF Insulation resistance @ +125℃ >100ΩF
Temp Voltage Coefficient	±15%Maximum
Dielectric Withstanding Voltage (DWV)	2.5X WVDC, 5 seconds.
Max Dissipation Factor	.025(2.5%)Max
Test Parameters	1KHz,1.0VRMS,25℃

2225X (.220" x .250")

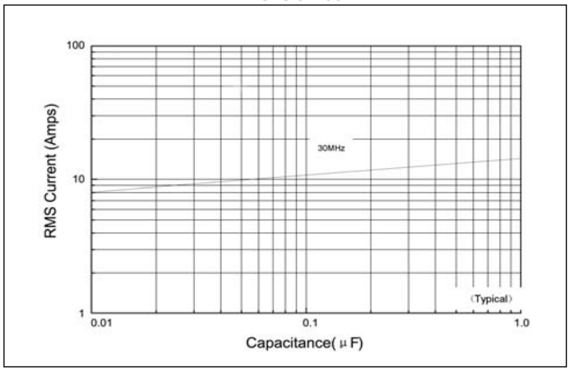
◆ Part Numbering



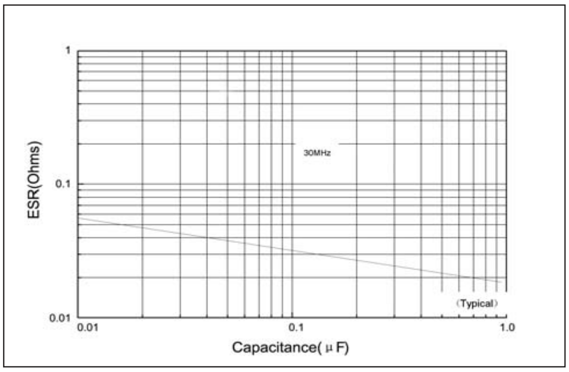
◆ 2225X Performance Curves

NOTE: Available in Vertical Tape & Reel Orientation Upon Request.

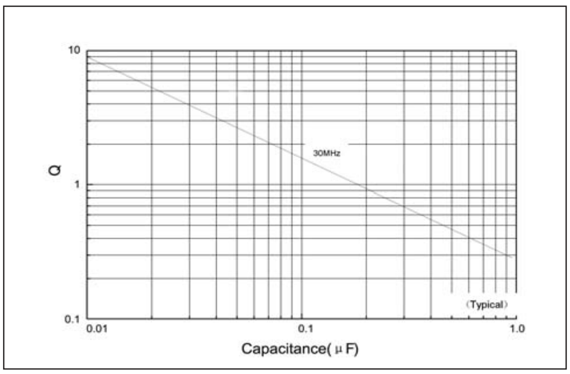
Current Rating vs Capacitance
2225 Series



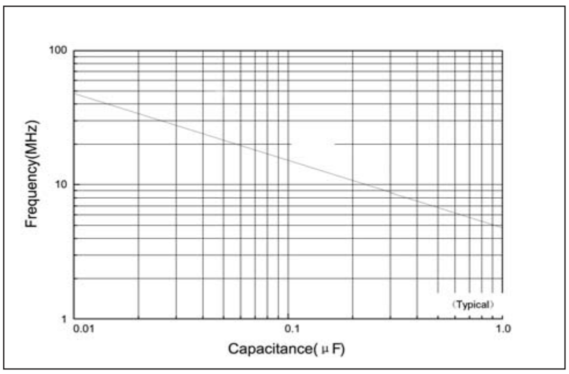
ESR vs Capacitance
2225 Series

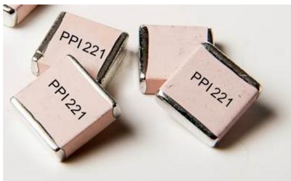


Q vs Capacitance
2225 Series



Series Resonance vs Capacitance
2225 Series




PPI221
PPI221
PPI221

EIA High Q Non-Magnetic Multilayer Ceramic Capacitors

NP0 Dielectric Non-Magnetic Multilayer Ceramic Capacitors

◆ Product Features

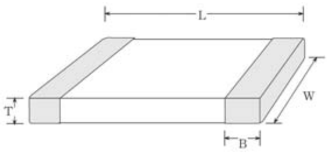
Non-Magnetism, Suitable for MRI

◆ Part Numbering

C	0603	CG	101	J	500	P	T
❶	❷	❸	❹	❺	❻	❼	❽
Chip Capacitor	Dimensions	Temperature Coefficient	Rated Capacitance	Tolerance	Rated Voltage	Termination Type	Packing Type

① Chip Capacitor

② Dimensions



Type	Dimensions (Unit: mm)				
	L	W	T（max）	B(min)	B(max)
0603	1.6±0.1	0.8±0.1	0.8±0.1	0.20	0.50
0805	2.0±0.2	1.2±0.2	1.40	0.25	0.70
1206	3.2±0.2	1.6±0.2	1.40	0.25	0.76
1210	3.2±0.2	2.5±0.2	2.00	0.25	0.76

③ Temperature Coefficient

Code(EIA)	Temperature Coefficients	Operating Temperature Range
CG (C0G)	0±30ppm/℃	-55℃~ +125℃

④ Rated Capacitance

Code	Capacitance
1R5	1.5pF
101	100pF

⑤ Tolerance

Code	Tolerance	Capacitance Range
B	±0.1pF	<10pF
C	±025pF	
D	±0.5pF	
F	±1%	≥10pF
G	±2%	
J	±5%	

⑥ Rated Voltage

Code	Rated Voltage (DC)	Code	Rated Voltage (DC)
25	25V	251	250V
50	50V	501	500V
101	100V	102	1000V
201	200V	202	2000V

⑦ Termination Type

Code	Termination Type
P	Non-magnetic Copper Plated 100% Sn (RoHS)

⑧ Packing Type

Code	Packing Type
T	Tape carrier packing

◆ Rated Capacitance Range Table (Unit:pF)

	Size	0603					0805				1206							1210						
Cap.pF	code	25V	50V	100V	200V	250V	50V	100V	200V	250V	50V	100V	200V	250V	500V	1000V	2000V	50V	100V	200V	250V	500V	1000V	2000V
10	100	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
15	150	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
22	220	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
33	330	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
47	470	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
68	680	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
100	101	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
150	151	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
220	221	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
330	331	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
470	471	■	■	■			■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■
680	681	■	■				■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	
1000	102	■	■				■	■	■	■	■	■	■	■	■			■	■	■	■	■	■	
1500	152						■	■	■	■	■	■	■	■	■			■	■	■	■	■		
2200	222						■	■			■	■	■	■	■			■	■	■	■	■		
3300	332										■	■	■	■	■			■	■	■	■	■		
4700	472										■	■	■	■				■	■	■	■	■		
6800	682										■	■	■	■				■	■	■	■			
10000	103										■	■						■	■	■	■			
15000	153																	■	■					

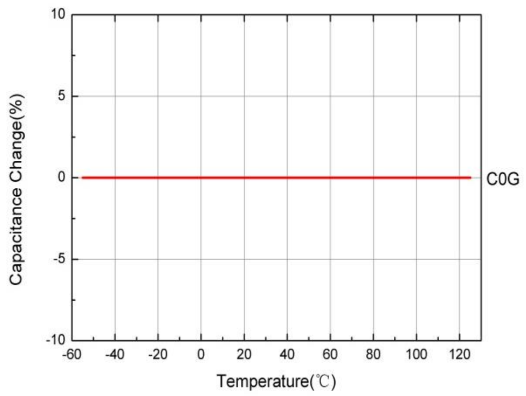
Remark: special capacitance, tolerance and WVDC are available, consult with PASSIVE PLUS.

◆ Tape & Reel Specifications

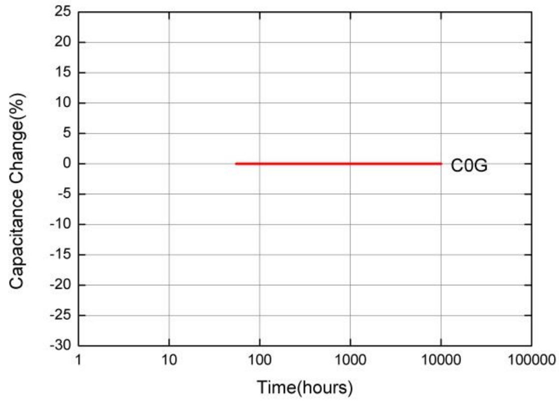
Orientation	EIA	A0	B0	K0	W	P0	P1	T	F	MIN /REEL	QTY/ REEL	TAPE MATERIAL
Horizontal	0603	1.05	1.80	0.90	8.00	4.00	4.00	0.90	3.50	1000	4000	Paper
Horizontal	0805	1.40	2.20	1.20	8.00	4.00	4.00	0.22	3.50	1000	3000	Plastic
Horizontal	1206	1.91	3.51	1.30	8.00	4.00	4.00	0.25	3.50	1000	3000	Plastic
Horizontal	1210	2.85	3.50	1.95	8.00	4.00	4.00	0.25	3.50	1000	3000	Plastic

◆ Characteristics Curve

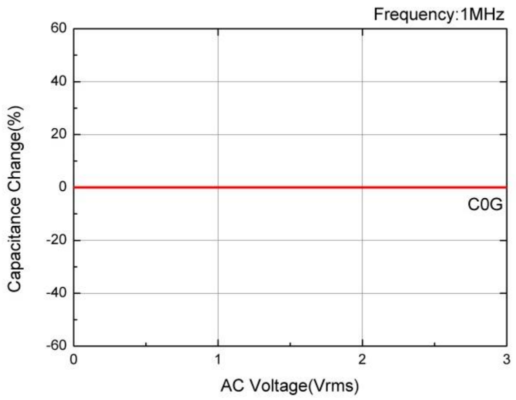
Capacitance vs Temperature



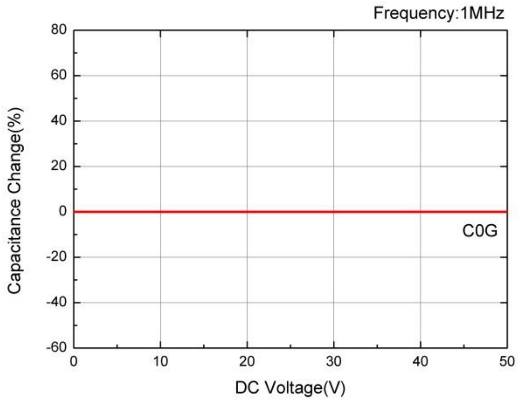
Capacitance Change vs Aging



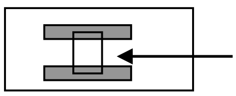
Capacitance Change vs AC Voltage



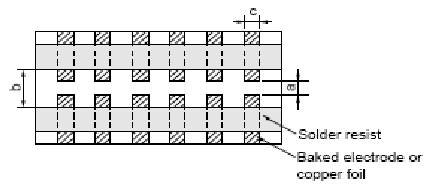
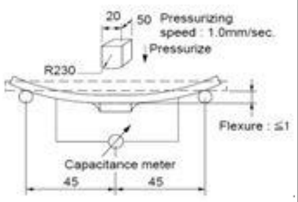
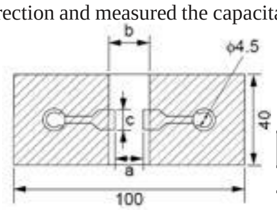
Capacitance Change vs DC Voltage



◆ Specifications and Test Methods

<table>
<tr><th>NO.</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>1</td><td>Operating Temperature Range</td><td>-55 ℃ ~ +125 ℃</td><td></td></tr>
<tr><td>2</td><td>Rated Voltage</td><td>See pages 68</td><td>The rated voltage means the maximum direct voltage or peak value of pulse voltage which may be applied continuously to a capacitor</td></tr>
<tr><td>3</td><td>Appearance</td><td>No defects or abnormality</td><td>Visual inspection</td></tr>
<tr><td>4</td><td>Dimensions</td><td>See the previous pages</td><td>Callipers inspection</td></tr>
<tr><td>5</td><td>Dielectric Strength</td><td>No defects or abnormality</td><td>2.5 RV for 5 seconds, RV ≦500VDC;
1.5 RV for 5 seconds, 500VDC < RV ≦1250V DC;
1.2 RV for 5 seconds, RV >1250VDC;
RV-Rated Voltage,</td></tr>
<tr><td>6</td><td>Insulation Resistance</td><td>More than 10GΩ</td><td>The insulation resistance shall be measured with the rated voltage at 25° C, 75%oRH and within 1 minute of charging.</td></tr>
<tr><td>7</td><td>Capacitance</td><td>Within the specified tolerance</td><td rowspan="2">The capacitance/Q shall be measured at 25 ℃ with the frequency and voltage shown in the table.
<table><tr><th>Frequency</th><th>Voltage</th></tr><tr><td>1±0.1MHz</td><td>1±0.2Vrms</td></tr></table></td></tr>
<tr><td>8</td><td>Q</td><td>Q is not less than 1000</td></tr>
<tr><td>9</td><td>Temperature Coefficient</td><td>0±30ppm/℃
Capacitance drift:
Within 0.3% or 0.05pF
(whichever is greater)</td><td>The temperature cycling sequential is from the step 1 through 5. The temperature coefficient shall be within the specified tolerance for the temperature coefficient. The temperature coefficient equals [(Ci-C3)/C3]/(Ti-T3). The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in the Step 1, 3 and 5 by the capacitance value in Step 3.
<table><tr><th>Step</th><th>Temperature</th></tr><tr><td>1</td><td>25±2 ℃</td></tr><tr><td>2</td><td>55±3 ℃</td></tr><tr><td>3</td><td>25±2 ℃</td></tr><tr><td>4</td><td>125±3 ℃</td></tr><tr><td>5</td><td>25±2 ℃</td></tr></table></td></tr>
<tr><td>10</td><td>Adhesive strength of termination</td><td>No removal of the terminations or other defect shall occur</td><td>Solder a capacitor to test jig (glass epoxy board) shown in fig below using a eutectic solder, then apply 10N force in the direction of the arrow.
The soldering should be done either by hand iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.

10Newton
Glass Epoxy Resin Board</td></tr>
</table>

◆ Specifications and Test Methods

<table>
<tr><th>NO.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defect or abnormality</td><td rowspan="3">Solder the capacitor to test jig (glass epoxy board) shown in fig below. Soldering should be done either by hand iron of using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock. The capacitor shall be subjected to a simple harmonic motion having a total amplitude of 1.5 mm. The frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, shall be traversed in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3 mutually perpendicular directions (total 6 hours).

</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance</td></tr>
<tr><td>Q</td><td>Q≥1000</td></tr>
<tr><td>12</td><td colspan="2">Deflection</td><td>No cracking or marking defects shall occur, Δ C/C<5%

</td><td>Solder the capacitor to the glass epoxy boards shown in below fig. Then apply a force in the direction and measured the capacitance.


<table><tr><th>Size</th><th>a</th><th>b</th><th>C</th></tr><tr><td>0603</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>0805</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>1206</td><td>2.2</td><td>5.0</td><td>2.0</td></tr></table></td></tr>
<tr><td>13</td><td colspan="2">Solderability of Termination</td><td>More than 75% of the terminations is to be soldered evenly and continuously.</td><td>Immerse the capacitor first in an ethanol solution of rosin. Preheat at 80 ℃ to 120 ℃ for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 250±5 ℃.</td></tr>
<tr><td rowspan="4">14</td><td rowspan="4">Resistance to Soldering Heat</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Preheat capacitor at 120 ℃ to 200 ℃ for 1 minute. Then immerse the capacitor in a eutectic solder at 260 ℃ to 265 ℃ for 10±1 second, the immersed depth is 10mm. Set it for 24±2 hours at room.</td></tr>
<tr><td>Capacitance Range</td><td>Less than ±2.5% or ±0.25pF (Whichever is larger)</td></tr>
<tr><td>Q</td><td>Q≥1000</td></tr>
<tr><td>Insulation Resistance</td><td>More than 10GΩ</td></tr>
</table>

◆ Specifications and Test Methods

<table>
<tr><th>NO.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td rowspan="4">15</td><td rowspan="4">Temperature Cycle</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11).
Perform the five cycles according to the four heat treatments listed in the following table.
Set it for 24±2 hours at room temperature.
<table><tr><th>Step</th><th>Temperature(℃)</th><th>Time(minutes)</th></tr><tr><td>1</td><td>Min.operating temp. -3 to 0</td><td>30±3</td></tr><tr><td>2</td><td>Room temperature</td><td>2to3</td></tr><tr><td>3</td><td>Max.operating temp. -3 to 0</td><td>30±3</td></tr><tr><td>4</td><td>Room temperature</td><td>2to3</td></tr></table></td></tr>
<tr><td>Capacitance Range</td><td>Less than ±2.5% or ±0.25pF (Whichever is larger)</td></tr>
<tr><td>Q</td><td>Q≥1000</td></tr>
<tr><td>Insulation Resistance</td><td>More than 10GΩ</td></tr>
<tr><td rowspan="4">16</td><td rowspan="4">Humidity Steady State</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Set the capacitor at 40±2 ℃ and 90% to 95% humidity for 500 ±12 hours.
Remove and let sit for 24 ±2 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance Range</td><td>Less than ±5% or ±0.5pF (Whichever is larger)</td></tr>
<tr><td>Q</td><td>Q≥1000</td></tr>
<tr><td>Insulation Resistance</td><td>More than 1GΩ</td></tr>
<tr><td rowspan="4">17</td><td rowspan="4">Humidity Load</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Apply the rated voltage(500Vmax) at 40±2 ℃ and 90% to 95% humidity for 500±12 hours.
Remove and let sit for 24±2 hours at room temperature, then measure.
The charge/discharge current is less than 50mA.</td></tr>
<tr><td>Capacitance Range</td><td>Less than ±7.5% or ±0.75pF (Whichever is larger)</td></tr>
<tr><td>Q</td><td>Q≥1000</td></tr>
<tr><td>Insulation Resistance</td><td>More than 1GΩ</td></tr>
<tr><td rowspan="4">18</td><td rowspan="4">High Temperature Load</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Apply a voltage for 1000±12 hours at 125±3 ℃, and set it for 24±2 hours at room temperature, then easure.
The charge/discharge current is less than 50mA.
Apply voltage:
＜500V, apply 200% rated voltage;
500V, apply 150% rated voltage;
＞500V, apply 120% rated voltage;</td></tr>
<tr><td>Capacitance Range</td><td>Less than ±3% or ±0.3pF (Whichever is larger)</td></tr>
<tr><td>Q</td><td>Q≥1000</td></tr>
<tr><td>Insulation Resistance</td><td>More than 1GΩ</td></tr>
</table>

X7R Dielectric Non-Magnetic Multilayer Ceramic Capacitors

◆ Product Features

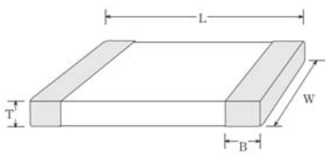
Non-Magnetism, Suitable for MRI

◆ Part Numbering

C	0603	X	222	K	500	P
❶ Chip Capacitor	❷ Dimensions	❸ Temperature Characteristic	❹ Rated Capacitance	❺ Tolerance	❻ Rated Voltage	❼ Termination Type

① Chip Capacitor

② Dimensions



Type	Dimensions (Unit:mm)				
	L	W	T（max）	B(min)	B(max)
0603	1.6±0.1	0.8±0.1	0.8±0.1	0.20	0.50
0805	2.0±0.2	1.2±0.2	1.40	0.25	0.70
1206	3.2±0.2	1.6±0.2	1.40	0.25	0.76
1210	3.2±0.2	2.5±0.2	2.00	0.25	0.76

③ Temperature Characteristics

Code (EIA)	Temperature Coefficients	Operating Temperature Range
X(X7R)	±15%	-55℃~ +125℃

④ Rated Capacitance

Code	Capacitance
102	1000pF
222	2200pF

⑤ Tolerance

Code	Tolerance
J	±5%
K	±10%
M	±20%

⑥ Rated Voltage

Code	Rated Voltage (DC)	Code	Rated Voltage (DC)
25	25V	251	250V
50	50V	501	500V
101	100V	102	1000V
201	200V	202	2000V

⑦ Termination Type

Code	Termination Type
P	Non-magnetic Copper Plated 100% Sn(RoHS)

⑧ Packaging Type

Depending on quantity required,
parts will be supplied on cut tape or tape & reel.

◆ Rated Capacitance Range Table

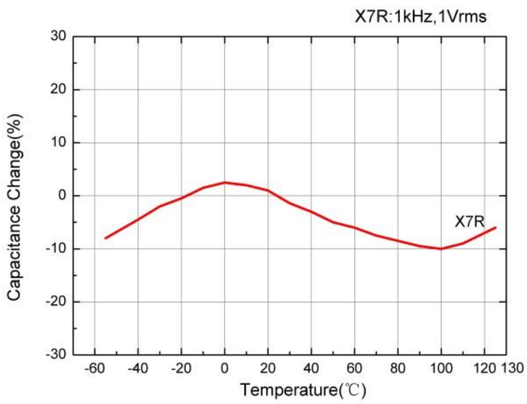
	Size	0603					0805				1206							1210						
cap	code	25V	50V	100V	200V	250V	50V	100V	200V	250V	50V	100V	200V	250V	500V	1000V	2000V	50V	100V	200V	250V	500V	1000V	2000V
330pF	331	■	■	■	■	■										■	■						■	■
470pF	471	■	■	■	■	■	■	■	■	■						■	■	■	■	■	■	■	■	■
680pF	681	■	■	■	■	■	■	■	■	■						■	■	■	■	■	■	■	■	■
1nF	102	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1.5nF	152	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2.2nF	222	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
3.3nF	332	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■
4.7nF	472	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■
6.8nF	682	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	
10nF	103	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	
15nF	153	■	■	■	■		■	■	■	■	■	■	■	■	■			■	■	■	■	■	■	
22nF	223	■	■	■			■	■	■	■	■	■	■	■	■			■	■	■	■	■	■	
33nF	333	■	■	■			■	■	■	■	■	■	■	■	■			■	■	■	■	■	■	
47nF	473	■	■				■	■	■	■	■	■	■	■	■			■	■	■	■	■		
68nF	683	■	■				■	■	■		■	■	■	■				■	■	■	■	■		
0.1uF	104	■	■				■	■			■	■	■	■				■	■	■	■	■		
0.15uF	154						■				■	■	■					■	■	■	■	■		
0.22nF	224										■	■						■	■	■	■			
0.33nF	334																	■	■	■	■			
0.47uF	474																	■	■	■				
0.68uF	684																	■	■	■				
1uF	105																	■						

◆ Tape & Reel Specifications

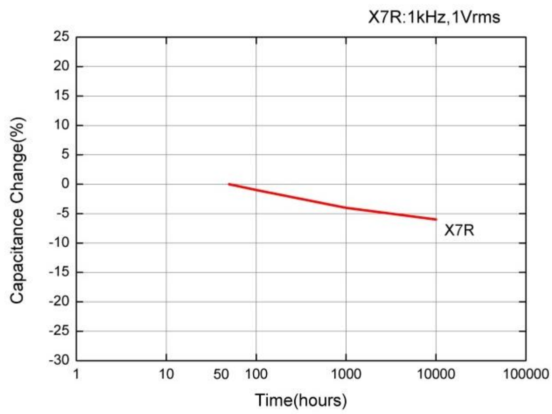
Orientation	EIA	A0	B0	K0	W	P0	P1	T	F	MIN /REEL	QTY/ REEL	TAPE MATERIAL
Horizontal	0603	1.05	1.80	0.90	8.00	4.00	4.00	0.90	3.50	1000	4000	Paper
Horizontal	0805	1.40	2.20	1.20	8.00	4.00	4.00	0.22	3.50	1000	3000	Plastic
Horizontal	1206	1.91	3.51	1.30	8.00	4.00	4.00	0.25	3.50	1000	3000	Plastic
Horizontal	1210	2.85	3.50	1.95	8.00	4.00	4.00	0.25	3.50	1000	3000	Plastic

◆ Characteristics Curve

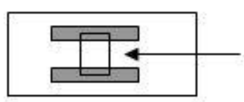
Capacitance vs Temperature



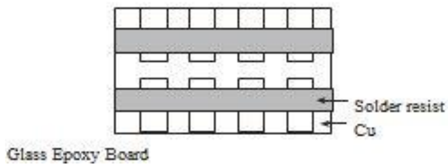
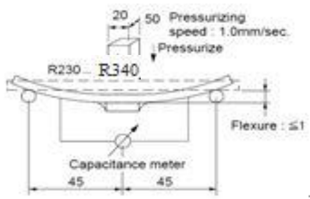
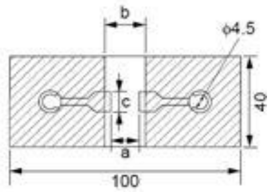
Capacitance Change vs Aging



◆ Specifications and Test Methods

<table>
<tr><th>NO.</th><th>Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td>1</td><td>Operating Temperature Range</td><td>-55 ℃ ~ +125 ℃</td><td></td></tr>
<tr><td>2</td><td>Rated Voltage</td><td>See pages 73</td><td>The rated voltage means the maximum direct voltage or peak value of pulse voltage which may be applied continuously to a capacitor</td></tr>
<tr><td>3</td><td>Appearance</td><td>No defects or abnormality</td><td>Visual inspection</td></tr>
<tr><td>4</td><td>Dimensions</td><td>See the previous pages</td><td>Callipers inspection</td></tr>
<tr><td>5</td><td>Dielectric Strength</td><td>No defects or abnormality</td><td>No failure shall be observed when the given coefficient of the ratedvoltage is applied betweentheterminationsfor1toS seconds, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>6</td><td>Insulation Resistance</td><td>More than 100MΩ·uF</td><td>The insulation resistance shall be measured with the testing voltage at normal temperature and with humidity, within 2 minute of charging.</td></tr>
<tr><td>7</td><td>Capacitance</td><td>Within the specified tolerance</td><td rowspan="2">The capacitance D.F. shall be measured at 25 ℃ with the frequency and voltage shown in the table.<table><tr><th></th><th>Frequency</th><th>Voltage</th></tr><tr><td>X7R</td><td>1±0.1KHz</td><td>1±0.2Vrms</td></tr></table></td></tr>
<tr><td>8</td><td>Dissipation Factor (D.F.)</td><td>D.F≤ 5%</td></tr>
<tr><td>9</td><td>Temperature Coefficient</td><td>± 15%</td><td>Refer to the test methods of general ceramic Chip capacitors.</td></tr>
<tr><td>10</td><td>Adhesive strength of Termination</td><td>No removal of the terminations or other defect shall occur</td><td>Solder a capacitor to test jig (glass epoxy board) shown in fig below using a eutectic solder, then apply 10N force in the direction of the arrow.
The soldering should be done either by hand iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.

10Newton
Glass Epoxy Resin Board</td></tr>
</table>

◆ Specifications and Test Methods

<table>
<tr><th>NO.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td rowspan="3">11</td><td rowspan="3">Vibration Resistance</td><td>Appearance</td><td>No defect or abnormality</td><td rowspan="3">Solder the capacitor to test jig (glass epoxy board) shown in fig below. Soldering should be done either by hand iron of using the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock. The capacitor shall be subjected to a simple harmonic motion having a total amplitude of 1.5mm. The frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, shall be traversed in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3 mutually perpendicular directions (total 6 hours)
</td></tr>
<tr><td>Capacitance</td><td>Within the specified tolerance</td></tr>
<tr><td>D.F.</td><td>D.F≤5%</td></tr>
<tr><td>12</td><td colspan="2">Deflection</td><td>No cracking or marking defects shall occur, Δ C/C<12.5%
</td><td>Solder the capacitor to test jig (glass epoxy board) direction shown in below fig.
<table><tr><th>Size</th><th>a</th><th>b</th><th>c</th></tr><tr><td>0603</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>0805</td><td>1.2</td><td>4.0</td><td>1.65</td></tr></table></td></tr>
<tr><td>13</td><td colspan="2">Solderability of Termination</td><td>More than 75% of the terminations is to be soldered evenly and continuously.</td><td>Immerse the capacitor first in a ethanol solution of rosin. Preheat at 80 ℃ to 120 ℃ for 10 to 30 seconds. After preheating, immerse in eutectic solder solution for 2±0.5 seconds at 250±5 ℃.</td></tr>
<tr><td rowspan="4">14</td><td rowspan="4">Resistance to Soldering Heat</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Preheat capacitor at 120 ℃ to 200 ℃ for 1 minute. Then immerse the capacitor in a eutectic solder at 260 ℃ to 265 ℃ for 10±1 seconds, Set it for 24±2 hours at room temperature, then measure.</td></tr>
<tr><td>Capacitance Range</td><td>Less than ±7.5%</td></tr>
<tr><td>D.F.</td><td>D.F≤5%</td></tr>
<tr><td>Insulation Resistance</td><td>I.R: More than 100MΩ·uF</td></tr>
</table>

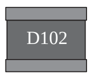
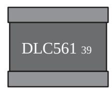
◆ Specifications and Test Methods

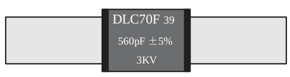
<table>
<tr><th>NO.</th><th colspan="2">Item</th><th>Specification</th><th>Test Method</th></tr>
<tr><td rowspan="4">15</td><td rowspan="4">Temperature Cycle</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (11).
Perform the five cycles according to the four heat treatments listed in the following table.
Set it for 24±2 hours at room temperature.
<table><tr><th>Step</th><th>Temperature(℃)</th><th>Time(minutes)</th></tr><tr><td>1</td><td>Min.operating temp. -3 to 0</td><td>30±3</td></tr><tr><td>2</td><td>Room temperature</td><td>2to3</td></tr><tr><td>3</td><td>Max.operating temp. -3 to 0</td><td>30±3</td></tr><tr><td>4</td><td>Room temperature</td><td>2to3</td></tr></table></td></tr>
<tr><td>Capacitance Range</td><td>≤7.5%</td></tr>
<tr><td>D.F</td><td>D.F≤5%</td></tr>
<tr><td>Insulation Resistance</td><td>More than 100MΩ·uF</td></tr>
<tr><td rowspan="4">16</td><td rowspan="4">Humidity Steady State</td><td>Appearance</td><td>No defect or abnormality</td><td rowspan="4">Sit the capacitor at 40±2 ℃ and 90% to 95% humidity for 500±12 hours.temperature, then measure.</td></tr>
<tr><td>Capacitance Range</td><td>≤12.%</td></tr>
<tr><td>D.F</td><td>D.F≤5%</td></tr>
<tr><td>Insulation Resistance</td><td>More than 50MΩ·uF</td></tr>
<tr><td rowspan="4">17</td><td rowspan="4">High Temperature Load</td><td>Appearance</td><td>No marking defects</td><td rowspan="4">Apply a DC voltage of 150% of the rated voltage for 1000 hours at the maximun operating temperature, and set it for 48 hours at room temperature, then measure.
The charge/discharge current is less than 50mA.</td></tr>
<tr><td>Capacitance Range</td><td>≤12.5%</td></tr>
<tr><td>D.F</td><td>D.F≤5%</td></tr>
<tr><td>Insulation Resistance</td><td>More than 50MΩ·uF</td></tr>
</table>

◆ Laser Marking

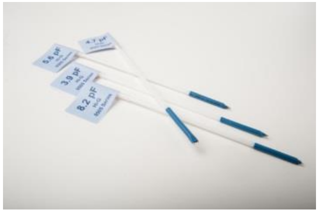
Most of Passive Plus products are identified by laser marking technology. Generally it can be visually observed. Under normal storage and application, the marking will not disappear.

Passive Plus applies different kinds of laser marking methods on different sizes of capacitors. See the below tables for detail.

Capacitor Series	1111C/1111P	2225C/2225P	3838C/3838P
Example			
Meaning	102:1000pF	222:2200pF 3A: capacitor identification code	561:560pF 39: Capacitor identification code

Capacitor Series	6040C	7676C
Example		
Meaning	Capacitance:560pF Tolerance:±5% WVDC:3000V 39: Capacitor identification code	Capacitance:100pF Tolerance:±5% WVDC:8000V 3P: Capacitor identification code

If the customer needs a special laser marking, please contact Passive Plus directly.


5.6 pF
4.7 pF
3.9 pF
8.2 pF

PPI

Custom and Engineering Design Kits

Standard Design Kits

According to the customer's demand, PPI can provide many kinds of tool kits for engineers to design and debug the circuit. All of our products satisfy the requirement of RoHS instruction.

PPI also offers kits for Non-Magnetic MRI applications. Engineering design kits are also available in multiple sizes as well. All kits are RoHS Compliant

◆ High-Q Capacitor Design Kits

Design Kit	Description	Values	No. of Values	Tolerances
DKD0505C01 DKD0505P01	0.1pF- 2.0pF	0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.5pF	16	+/- 0.1pF
		1.6, 1.8, 2.0pF		+/- 0.25pF
DKD0505C02 DKD0505P02	1.0pF - 10pF	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7pF,	16	+/- 0.1pF
		3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2pF		+/- 0.25pF
		10pF		+/- 5%
DKD0505C03 DKD0505P03	10pF – 100pF	10, 12, 15, 18, 20, 22, 24, 27, 30, 33pF	16	+/- 5%
		39, 47, 56, 68, 82, 100pF		
DKD0505C04	100pF- 1000pF	100, 120, 150, 180, 200, 220, 240, 270, 300, 330pF	16	+/- 5%
		390, 470, 560, 680, 820, 1000pF		
DKD0505C05 DKD0505P05	0.1pF- 2.0pF Non-Magnetic	0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.5pF	16	+/- 0.1pF
		1.6, 1.8, 2.0pF		+/- 0.25pF
DKD0505C06 DKD0505P06	1.0pF - 10pF Non-Magnetic	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7pF	16	+/- 0.1pF
		3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2pF,		+/- 0.25pF
		10pF		+/- 5%
DKD0505C07 DKD0505P07	10pF – 100pF Non-Magnetic	10, 12, 15, 18, 20, 22, 24, 27, 30, 33pF	16	+/- 5%
		39, 47, 56, 68, 82, 100pF		
DKD0505C08	100pF- 1000pF Non-Magnetic	100, 120, 150, 180, 200, 220, 240, 270, 300, 330pF	16	+/- 5%
		390. 470, 560, 680, 820, 1000pF		

◆ High-Q Capacitor Design Kits

Design Kit	Description	Values (pF)	No. of values	Toler-ances
DKD1111C01 DKD1111P01	1.0pF - 10pF	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7, pF	16	± 0.1pF
		3.0,3.3,3.9, 4.7, 5.6, 6.8, 8.2pF		± 0.25pF
		10pF		± 5%
DKD1111C02 DKD1111P02	10pF -100pF	10, 12, 15, 18, 20, 22, 24, 27, 30, 33, 39, 47, 56, 68, 82, 100pF	16	± 5%
DKD1111C03 DKD1111P03	100pF-1000pF	100, 120, 150, 180, 200, 220, 240, 270, 300, 330, 390, 470, 560, 680, 820,1000 pF	16	± 5%
DKD1111C04 DKD1111P04	1000pF-10000pF	1000, 1100, 1200, 1500, 1800, 2200, 2700, 3000, 3300, 3900, 4700, 5100, 5600, 10000 pF	14	± 5%
DKD1111C05 DKD1111P05	1.0pF - 10pF Non-magnetic	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7, pF	16	± 0.1pF
		3.0,3.3,3.9, 4.7, 5.6, 6.8, 8.2pF		± 0.25pF
		10pF		± 5%
DKD1111C06 DKD1111P06	10pF - 100pF Non-magnetic	10, 12, 15, 18, 20, 22, 24, 27, 30, 33, 39, 47, 56, 68, 82, 100pF	16	± 5%
DKD1111C07 DKD1111P07	100pF- 1000pF Non-magnetic	100, 120, 150, 180, 200, 220, 240, 270, 300, 330, 390, 470, 560, 680, 820,1000 pF	16	± 5%
DKD1111C08 DKD1111P08	1000pF- 10000pF Non-magnetic	1000, 1100, 1200, 1500, 1800, 2200, 2700, 3000, 3300, 3900, 4700, 5100, 5600, 10000 pF	14	± 5%

◆ EIA Low ESR Design Kits

Design Kit	Description	Values	No. of Values	Tolerance
DKD0201N01	0201N .1pF - 2.0pF	0.1, 0.2, 0.3, 0.5, 0.7, 0.8, 0.9, 1.0, 1.3, 1.5, 1.7, 1.9, 2.0pF	13	+/-.1pF
DKD0201N02	0201N 1.0pF - 10pF	1.0, 1.3, 1.5, 1.7, 1.9, 2.0, 2.2, 2.7, 3.0, 3.9, 4.7, 5.6, 6.8, 7.5, 8.2pF,	16	+/.1pF
		10pF		+/-5%
DKD0201N03	0201N 10 - 100pF	10, 13, 15, 18, 20, 22, 27, 30, 39, 47, 56, 68, 75, 82, 91, 100pF	16	+/-5%
DKD0402N01	0402N .1pF - 2.0pF	0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.2, 1.5, 1.6, 1.8, 2.0pF	15	+/-.1pF
DKD0402N02	0402N 1.0pF - 10pF	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7, 3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2pF,	16	+/-.1pF
		10pF		+/-5%
DKD0402N03	0402N 10pF - 33pF	10 12, 13, 15, 16. 18, 20, 22, 24, 27, 30, 33pF	12	+/-5%
DKD0603N01	0603N .1pF - 2.0pF	0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.5, 1.6, 1.8, 2.0pF	16	+/-.1pF
DKD0603N02	0603N 1.0pF - 10pF	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7, 3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2pF,	16	+/-.1pF
		10pF		+/-5%
DKD0603N03	0603N 10pF - 100pF	10, 12, 15, 18, 20, 22, 24, 27, 30, 33, 39, 47, 56, 68, 82, 100pF	16	+/-5%
DKD0805N01	0805N .1pF - 2.0pF	0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.2, 1.5, 1.6, 1.8, 2.0pF	15	+/-.1pF
DKD0805N02	0805N 1.0pF - 10pF	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7, 3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2pF,	16	+/-.1pF
		10pF		+/-5%
DKD0805N03	0805N 10pF - 100pF	10, 12, 15, 18, 20, 22, 24, 27, 30, 33, 39, 47, 56, 68, 82, 100pF	16	+/-5%
DKD0805N04	0805N 10pF - 220pF	10, 15, 18, 20, 24, 27, 30, 39, 47, 56, 68, 82, 100, 120, 150, 180, 220pF	17	+/-5%
Design Kit	Description	Values (pF)	# of values	Tolerance
DKD1111N01	1111N 0.2pF - 10pF	0.2, 0.5, 0.7, 0.8, 1.0, 1.2, 1.5, 1.8, 2.0, 2.4, 2.7, 3.0, 3.3,	19	+/-.1pF
		3.9, 4.7, 5.6, 6.8, 8.2pF,		
		10pF		+/-5%
DKD1111N02	1111N 10-100pF	10, 12, 15, 18, 20, 22, 24, 27, 30, 33, 39, 47, 56, 68, 82, 100pF	16	+/-5%
DKD1111N03	1111N 100-1000pF	100, 120, 150, 180, 200, 220, 240, 270, 300, 390, 470,	15	+/-5%
		560, 680, 820, 1000pF		

◆ Engineer Adjustment Stick Kits

Adjustment Stick Kits for engineers for their in-circuit tuning prove to be valuable tools for the engineer enabling them to precisely tune a circuit board without running the risk of damaging the board while changing out capacitors. Now, engineers can “tweak” their boards using these adjustment sticks to determine the better values needed for their projects.

Series: 0505C - (.055 x .055) Traditional High-Q Low ESR (NPO TC)

Design Kit	Range (pF)	Capacitance (pF)	Values	Tolerance
TSD0505C01	.1 - 2.0	0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.5, 1.6, 1.8, 2.0	16	± .1 ± .25
TSD0505C02	1.0 - 10	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7, 3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2 10	- 16	± .25 ± 5%
TSD0505C03	10 - 100	10, 12, 15, 18, 20, 22, 24, 27, 30, 33, 39, 47, 56, 68, 82, 100	16	± 5%
TSD0505C04	100 - 1000	100, 120, 150, 180, 200, 220, 240, 270, 300, 330, 390, 470, 560, 680, 820, 1000	16	± 5%

Series: 1111C - (.110 x .110) Traditional High-Q Low ESR (NPO TC)

Design Kit	Range (pF)	Capacitance (pF)	Values	Tolerance
TSD1111C01	0.1 - 1.0	0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 & 1.0	- 10	± .1 ± .25
TSD1111C02	1.0 - 10	1.0, 1.2, 1.5, 1.8, 2.0, 2.2, 2.4, 2.7, 3.0, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2 10	- 16	± .25 ± 5%
TSD1111C03	10 - 100	10, 12, 15, 18, 20, 22, 24, 27, 30, 33, 39, 47, 56, 68, 82 & 100	16	± 5%
TSD1111C04	100 - 1000	100, 120, 150, 180, 200, 220, 240, 270, 300, 330, 390, 470, 560, 680, 820, 1000	16	± 5%

Series: 2225C - (.220 x .250) Traditional High-Q Low ESR (NPO TC)

Design Kit	Range (pF)	Capacitance (pF)	Values	Tolerance
TSD2225C01	1.0 - 100	1.0, 1.5, 2.2, 3.3, 4.7, 5.6, 6.8, 8.2, 10, 15, 22, 33, 47, 56, 68, 82 & 100	- - 17	± .1 ± .25 ± 5%
TSD2225C02	100 - 2700	100, 150, 220, 330, 470, 560, 680, 820, 1000, 1500, 2200, 2700	12	± 5%

Values in the TSD0505C kits have a 150V.
Values in the TSD1111C kits have a 500V.
Voltages for the values in the TSD2225C kits will vary depending on value.

Custom Kits

According to the customer's demand, PPI can provide many kinds of tool kits for engineers to design and debug the circuit. All of our products satisfy the requirement of RoHS instruction.

Passive Plus will develop a custom kit using the engineer's specific requirements for the engineer's projects (case size, temperature coefficient, value range, tolerances, voltages, and quantities per value). Once these requirements are determined, PPI will then provide customer with a price. Please contact PPI directly to start this process.

All kits are RoHS Compliant.

Custom Kits


Passive Plus Inc.
RF & Microwave Capacitors


Passive Plus Inc.
RF & Microwave Capacitors
www.passiveplus.com
+(631) 425-0938
sales@passiveplus.com


sales@passiveplus.com
+(631)-425-0938
>67GHZ
P/N 01005BB104MW4R0
Qty 50
Value 0.1µF
Tol ±20%
Voltage 4V
>65GHZ
P/N 0201BB104KW160
Qty 50
Value 1µF
Tol ±10%
Voltage 16V
>16GHZ
P/N 0402BB103KW160
Qty 50
Value 10000pf
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Voltage 16V
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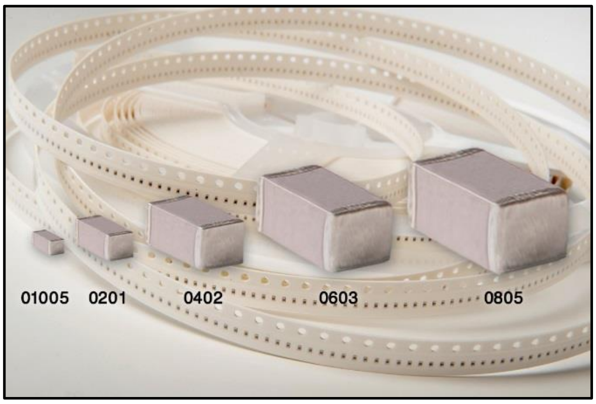
Tol ±10%
Voltage 25V
>50GHZ
P/N 0402BB104KW500
Qty 50
Value 1µF
Tol ±10%
Voltage 50V
Lot 140708-10
sales@passiveplus.com
+(631)-425-0938


01005
0201
0402
0603
0805

Broadband Capacitors

Broadband Capacitors

◆ Product Overview

Passive Plus, Inc. (PPI) has developed a series of Broadband Capacitors available in 5 different case sizes; 01005BB, 0201BB, 0402BB, 0603BB and the 0805BB. Values available are 10nF (103) and 100nF (104)

These capacitors are intended primarily for coupling RF signals or, occasionally, for bypassing them to ground, while blocking DC. The applications for which they are intended require small, surface-mountable devices that provide low RF impedances, i.e., low insertion losses and reflections, across extremely large RF bandwidths and temperatures typically ranging from -55 to +125° C.

Small, single layer capacitors, apart from not being surface-mountable, usually do not have sufficiently large capacitance values to cover the required frequency range, which may extend from the tens or hundreds of kilo-hertz to tens of gigahertz. Ordinary multi-layer capacitors, when operated over these ranges, display "parallel resonances," narrow frequency bands over which they have high impedances and insertion losses. The Passive Plus "BB" series overcomes these objections to achieve bandwidths as high as -- in the case of the 0201BB104 -- a remarkable 16 kHz to >40 GHz, Insertion Loss <1db, with a WVDC of 16V.

Applications for the Broadband series are primarily found in the so -called "signal integrity" market:

- Optoelectronics/high-speed data
- ROSA/TOSA (Transmit/Receive optical subassemblies)
- SONET(Synchronous Optical Networks)
- Broadband test equipment
- Broadband microwave and millimeter wave amplifiers and oscillators

In general, best results are achieved by capacitors that are close in width to that of the transmission line trace. Most trace widths on commonly used substrates that must function well above 12 GHz lie in the 8- to 24-mil range, and so 0402 and 0201 SMT devices are well suited to the applications.

To reiterate, customers requiring surface-mountable, 10 nF or 100 nF capacitors that provide resonance-free, low insertion loss, low reflection operation over extremely large RF bandwidths will be well served by Passive Plus's Broadband series.

For the most current Broadband Capacitors Data sheets, please visit our website http://www.passiveplus.com/broadbandcap.php

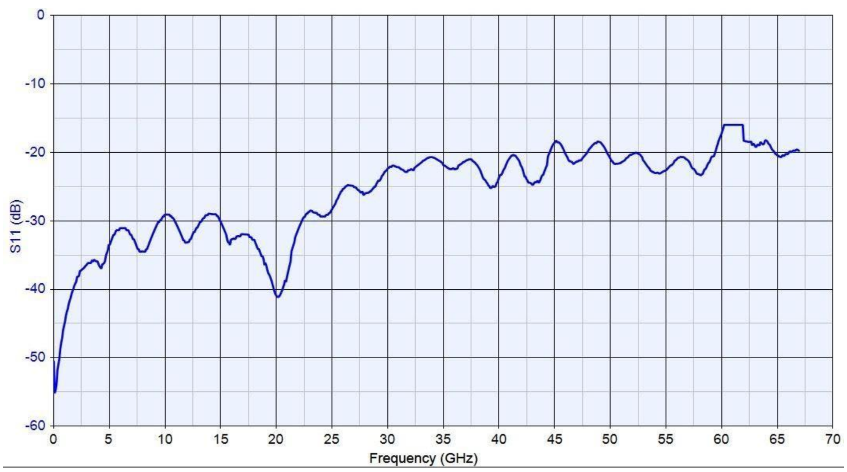
01005 (.010" x .005")

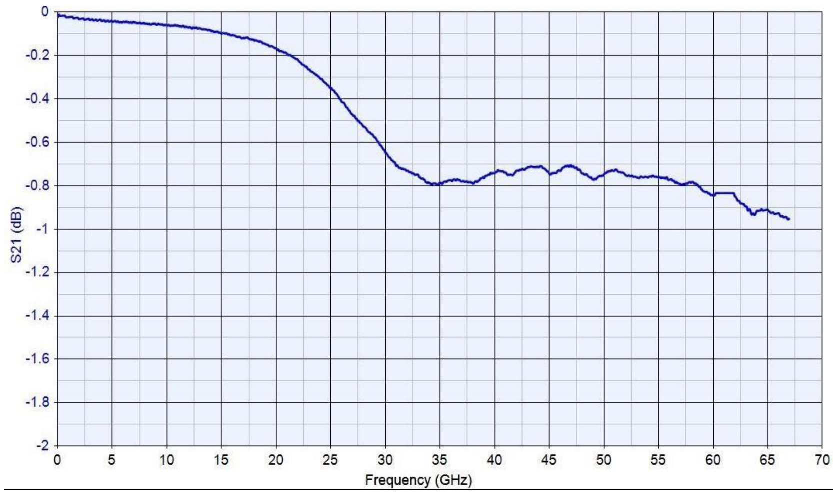
01005BB (.010" x .005") 100nF

◆ Product Features

- Typical operating frequency range: 16 KHz (- 3 dB point) to > **67 GHz**;
- Insertion Loss: < 1 db, typical; 4 WVDC;
- Available in 40K pcs/ reel; Lower quantities available in cut tape

◆ Performance Curves – Insertion and Return Loss Charts



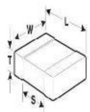


◆ Electrical Specifications

- Capacitance: 100 nF, nom.
- Operating Temperature Range: -55 C to +85 C
- Temperature Coefficient of Capacitance (TCC): (±15% , -55C to +85C)
- Rated Voltage: 4 WVDC
- Dielectric Withstanding Voltage (DWV): 250% of rated WVDC for 5 secs.
- Insulation Resistance: 10^11Ω min. @ +25C @ rated WVDC

◆ Mechanical Dimensions

L = 0.016 in. ±0.001 in. (0.4 mm ±0.02 mm)
W = 0.008 in. ±0.001 in. (0.2mm ±0.02 mm)
T = 0.008 in. ±0.001 in. (0.2mm ±0.02 mm)
S = 0.005 in., min. (0.13 mm, min.)



◆ Test Conditions

Typical responses for sample placed across a 0.127 mm (5.0 mil) gap between 0.29 mm (11.4 mil) wide, 0.21 mm (8.3 mil) long mounting pads on 4-mil Rogers RO4350B. Measured and modeled data are de-embedded to the mounting pad edges using TRL calibration procedures.

◆ Part Numbering

Modelithics®

01005 BB 104 M W 4R0

- WVDC
- Tin Plated over Nickel Barrier (RoHS) Compliant
- Capacitance Tolerance (M tolerance = ±20%)
- Indicates number of zeros following digits of capacitance in pF
- Capacitance Code – First 2 significant digits for capacitance
- Passive Plus Series
- Case Size

RoHS

0201BB (.020” x .010”) 100nF

◆ Product Features

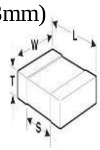
Typical operating frequency range: 16 KHz (- 3 dB point) to > 40 **GHz;**
Insertion Loss: < 1 db, typical; 16 WVDC; Available in Tin or Gold Terminations;
15K pcs/reels; lower quantities in cut tape; also available in Waffle Packs

◆ Electrical Specifications

- Capacitance: 100nF
- Operating Temperature Range: -55ºC to +125ºC
- Temperature Coefficient of Capacitance (TCC):
  ±15% (-55ºC to +125ºC)
- Rated Voltage: 16 WVDC
- Dielectric Withstanding Voltage (DWV):
  250% of rated WVDC for 5 secs.
- Insulation Resistance:
  10^11Ω min. @ +25ºC @ rated WVDC

◆ Mechanical Dimensions

L = 0.023 in. ±0.001 in. (0.58mm ±0.03mm)
W = 0.012 in. ±0.001 in. (0.3mm ±0.03mm)
T = 0.0118 in. MAX. (0.3mm)
S = 0.0078 in. MIN. (0.2mm MIN.)

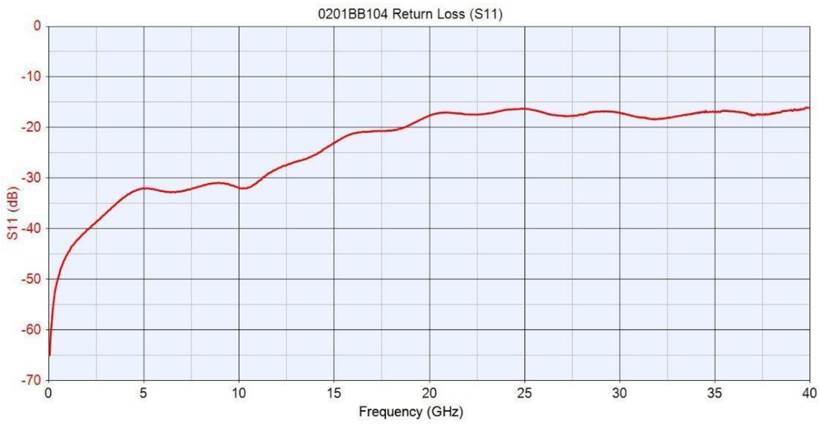


◆ Test Conditions

Typical responses for sample placed across a 3-mils gap in a 12.5-mil-wide trace, pad length 8.5 mils on 6.6mil RO4350B.

Measurements de-embedded to sample edges using TRL calibration procedures.

◆ Performance Curves -- Insertion and Return Loss Charts



◆ Modeling Data

- S-Parameters available on PPI website ([http://www.passiveplus.com/designsupp.php).](http://www.passiveplus.com/designsupp.php)
- Full models also available on Modelithics website at http://www.modelithics.com/mvp/PassivePlus/

◆ Part Numbering

0201 BB 10 4 K W 160

- 160 — WVDC
- W — **W** = Tin Plated over Nickel Barrier (RoHS) Compliant; **G** = Gold, Epoxy Mount only
- K — Capacitance Tolerance (K tolerance = +/-10%)
- 4 — Indicates number of zeroes following digits of capacitance in pF
- 10 — Capacitance Code – First 2 significant digits for capacitance
- BB — Passive Plus Series
- 0201 — Case Size

0201BB (.020” x .010”)

0201BB (.020” x .010”) 10nF

◆ Product Features

Typical operating frequency range: 160 KHz (- 3 dB point) to > 32 **GHz;**
Insertion Loss: < 1 db, typical; 25 WVDC; Available in Tin or Gold Terminations;
15K pcs/reels; lower quantities in cut tape; also available in Waffle Packs

◆ Electrical Specifications

- Capacitance: 10nF
- Operating Temperature Range: -55ºC to +125ºC
- Temperature Coefficient of Capacitance (TCC):

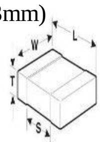
  ±15% (-55ºC to +125ºC)
- Rated Voltage: 25 WVDC
- Dielectric Withstanding Voltage (DWV):

  250% of rated WVDC for 5 secs.
- Insulation Resistance:

  10^11Ω min. @ +25ºC @ rated WVDC

◆ Mechanical Dimensions

L = 0.023 in. ±0.001 in. (0.58mm ±0.03mm)
W = 0.012 in. ±0.001 in. (0.3mm ±0.03mm)
T = 0.0118 in. MAX. (0.3mm)
S = 0.0078 in. MIN. (0.2mm MIN.)



◆ Test Conditions

Typical responses for sample placed across a 3-mils gap in a 12.5-mil-wide trace, pad length 8.5 mils on 6.6mil RO4350B.

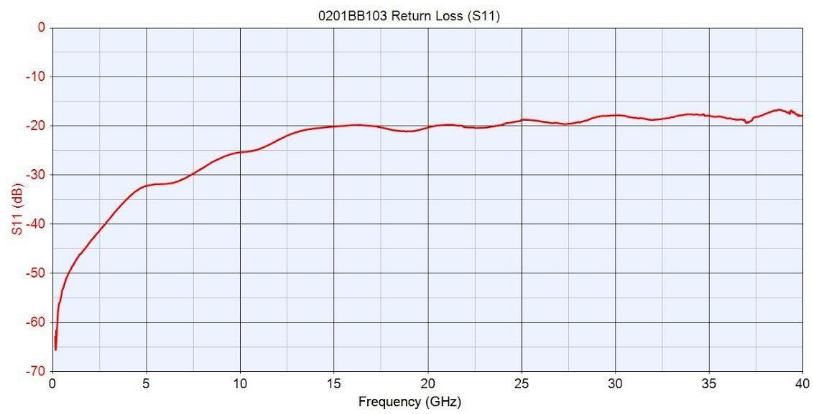
Measurements de-embedded to sample edges using TRL calibration procedures.

◆ Modeling Data

- S-Parameters available on PPI website (http://www.passiveplus.com/designsupp.php).

- Full models also available on Modelithics website at http://www.modelithics.com/mvp/PassivePlus/

◆ Performance Curves -- Insertion and Return Loss Charts



Modelithics®

◆ Part Numbering

0201 BB 103 K W 250

- 250 — WVDC
- W — **W** = Tin Plated over Nickel Barrier (RoHS) Compliant; **G** = Gold, Epoxy Mount only
- K — Capacitance Tolerance (K tolerance = +/-10%)
- 3 — Indicates number of zeroes following digits of capacitance in pF
- 10 — Capacitance Code – First 2 significant digits for capacitance
- BB — Passive Plus Series
- 0201 — Case Size

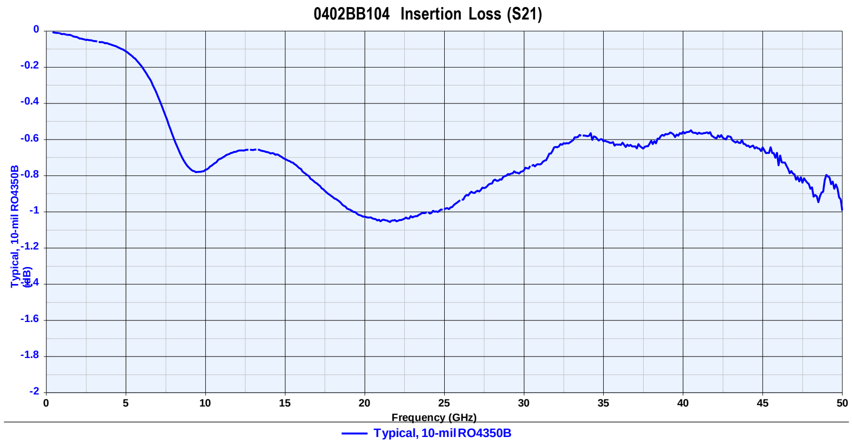
RoHS

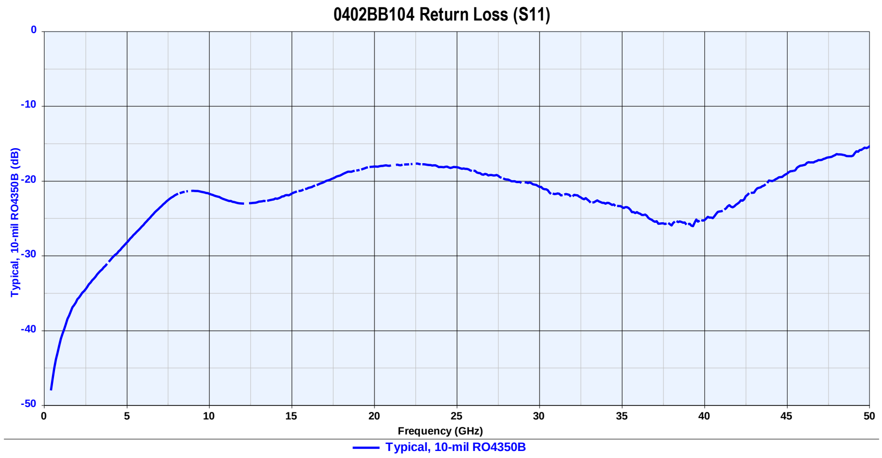
0402BB (.040" x .020") 100nF

◆ Product Features

- Typical operating frequency range:16 KHz (-3 dB point) to **50 GHz**;
- Insertion Loss: < 1.2 db, typical; **50 WVDC;**
- Available in **Tin and Gold Terminations**
- 10K pcs/reel; Lower quantities available in cut tape

◆ Performance Curves – Insertion and Return Loss Charts



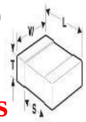


◆ Electrical Specifications

- Capacitance: 100 nF
- Operating Temperature Range:
  -55 C to +125 C
- Temperature Coefficient of Capacitance (TCC): ±15% (-55 C to +125 C)
- Rated Voltage: **50 WVDC**
- Dielectric Withstanding Voltage (DWV):
  250% of rated WVDC for 5 secs.
- Insulation Resistance:
  10^11Ω min. @ +25 C @ rated WVDC

◆ Mechanical Dimensions

L = 0.040 in. ±0.004 in. (1.016mm ±0.102mm)
W = 0.020 in. ±0.004 in. (0.508 mm ±0.102 mm)
T = 0.024 in. MAX. (0.610 mm MAX.)
S = 0.016 in. MIN. (0.406 mm MIN.)



◆ Electrical Specifications

Typical responses for sample places across a 15.5 mil gap in a 21-mil-wide trace, pad length 12.3 mils on 10-mil RO43508.

Measurements de-embedded to sample edge using TRL calibration procedures.

Modelithics®

◆ Part Numbering

0402 BB 10 4 K W 500

- 500: WVDC
- W: **W** = Tin Plated over Nickel Barrier (RoHS) Compliant; **G** = Gold, Epoxy Mount only
- K: Capacitance Tolerance (K tolerance = ±10%)
- 4: Indicates number of zeros following digits of capacitance in pF
- 10: Capacitance Code - First 2 significant digits for capacitance
- BB: Passive Plus Series
- 0402: Case Size

RoHS

0402BB (.040” x .020”) 10nF

0402 (.040” x .020”)

◆ Product Features

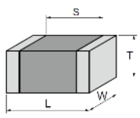
- Typical operating frequency range: 160 KHz (- 3 dB point) to 40 GHz;
- Insertion Loss: < 1 db, typical; 50WVDC;
- Available in 10K pcs/ reel; lower quantities available in cut tape.

◆ Electrical Specifications

- Capacitance: 10 nF.
- Operating Temperature Range:
  -55℃ to +125 ℃
- Temperature Coefficient of Capacitance
  TCC: ±15% (-55℃ to +125 ℃)
- Rated Voltage: 50 WVDC
- Dielectric Withstanding Voltage (DWV):
  250% of rated WVDC for 5 secs.
- Insulation Resistance:
  $10^{11}\Omega$ min. @ +25℃ @ rated WVDC

◆ Mechanical Dimensions

L = 0.040 in. ±0.004 in. (1.016mm ±0.102mm)
W = 0.020 in. ±0.004 in. (0.508 mm ±0.102 mm)
T = 0.024 in. MAX. (0.610 mm MAX.)
S = 0.016 in. MIN. (0.406 mm MIN.)

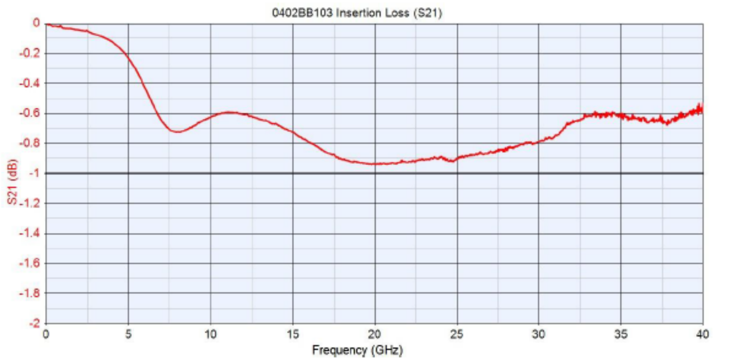


◆ Test Conditions

Typical responses for sample placed across a 10-mil-thick Rogers 4350B microstrip board, sample spanning a 15.5-mil gap in the 20-mil-wide center trace. All measurements made using TRL de-embedding procedures.

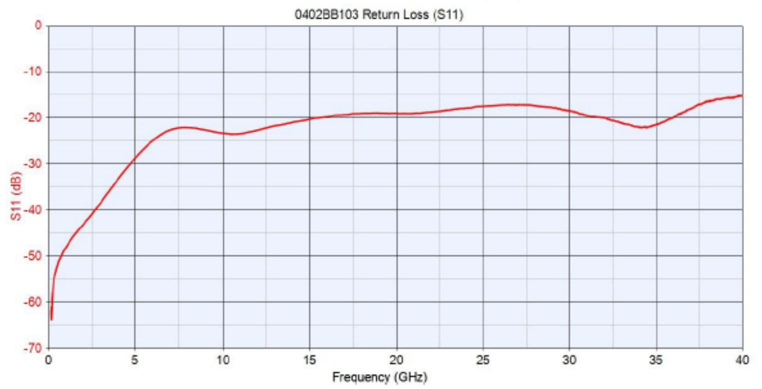
◆ Performance Curves – Insertion and Return Loss Charts

0402BB103 Insertion Loss (S21)



S[2,1]

0402BB103 Return Loss (S11)



S[2,1]

◆ Part Numbering

0402 BB 10 3 K W 500

- WVDC
- Tin Plated over Nickel Barrier (RoHS) Compliant
- Capacitance Tolerance (K tolerance = ±10%)
- Indicates number of zeros following digits of capacitance in pF
- Capacitance Code - First 2 significant digits for capacitance
- Passive Plus Series
- Case Size

Modelithics®

0805BB (.080” x .050”)

0805BB (.080” x .050”) 10nF

◆ Product Features

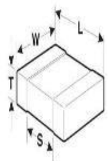
Typical operating frequency range: 160 KHz (- 3 dB point) to > 3 **GHz;**
Insertion Loss: < 0.25db, typical; 100 WVDC; Available in Tin Termination

◆ Electrical Specifications

- Capacitance: 10nF
- Operating Temperature Range: _55ºC to +125ºC
- Temperature Coefficient of Capacitance (TCC):
  ±15% (_55ºC to +125ºC)
- Rated Voltage: 100 WVDC
- Dielectric Withstanding Voltage (DWV):
  250% of rated WVDC for 5 secs.
- Insulation Resistance:
  10^11Ω min. @ +25ºC @ rated WVDC

◆ Mechanical Dimensions

L = 0.080in. ±0.006 in. (2.03mm ±0.15mm)
W = 0.050 in. ±0.006 in. (1.27mm ±0.15mm)
T = 0.040 in. MAX. (1.02mm)
S = 0.044 in. MIN. (1.12mm)

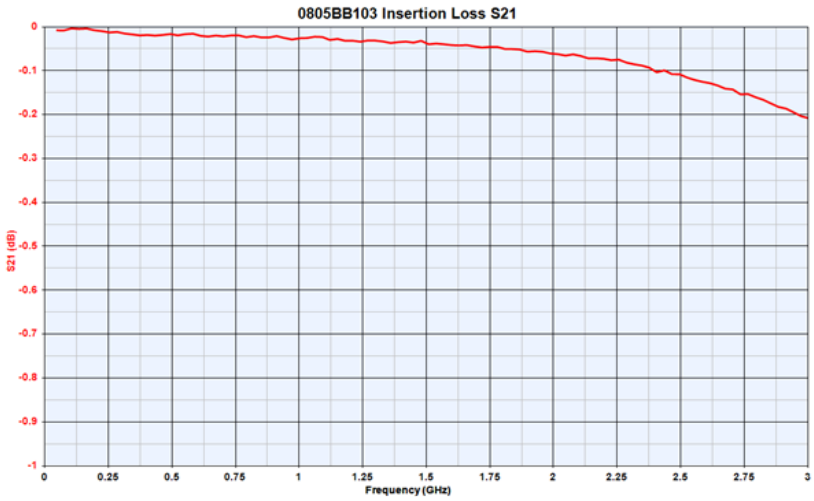


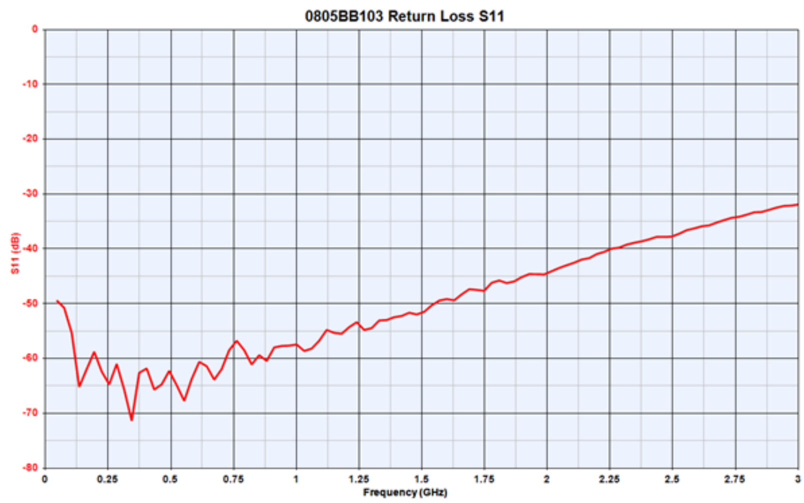
◆ Test Conditions

Typical responses for a horizontally oriented sample (electrodes parallel to plane of substrate) placed across a 25.5-mil gap in a 42.5-mil-wide trace on 20-mil Rogers 4003C.

Measurements are de-embedded to sample edge using TRL calibration procedures.

◆ Performance Curves -- Insertion and Return Loss Charts





◆ Part Numbering

0805 BB 10 3 K W 101

- 101 – WVDC
- **W** = Tin Plated over Nickel Barrier (RoHS) Compliant
- K – Capacitance Tolerance (K tolerance = +/-10%)
- 3 – Indicates number of zeroes following digits of capacitance in pF
- 10 – Capacitance Code – First 2 significant digits for capacitance
- BB – Passive Plus Series
- 0805 – Case Size

Modelithics®

Application Note: Broadband Capacitors

Introduction

There are a number of circuits that require coupling RF signals or bypassing them to ground while blocking DC over extraordinarily large RF bandwidths. The applications for which they are intended typically require small, surface-mountable (SMT) units with low insertion losses, reflections, and impedances across RF frequencies extending from the tens of KHz to the tens of GHz, and temperatures typically ranging from -55 to +85 ^{0}C. This note focuses on a particular implementation of these devices -- multilayer ceramic capacitors (MLCCs) – and how to obtain the best performance when they're used on various substrates.

Broadband capacitors are used in the "signal integrity" market -- optoelectronics/high-speed data; ROSA/TOSA (Transmit/Receive optical subassemblies); SONET(Synchronous Optical Networks); broadband test equipment – as well as in broadband microwave and millimeter wave amplifiers (MMICs, GaN transistors) and oscillators. The basic requirement in the former is to produce an output waveform that closely replicates an input waveform, typically a train of digital pulses, as shown in **Fig. 1**.

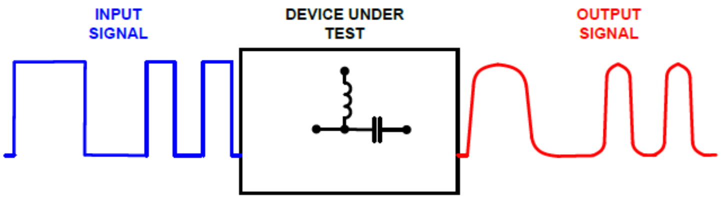


Fig. 1 "Signal Integrity" – output replication of input

While RF and microwave devices are typically measured in the frequency domain, digital systems are usually characterized in the time domain, and so it is necessary to make a connection between the two (**Fig. 2**).

- FREQUENCY DOMAIN
  - Insertion loss
  - Reflection

- TIME DOMAIN
  - Rise and fall times
  - Eye opening
  - Jitter

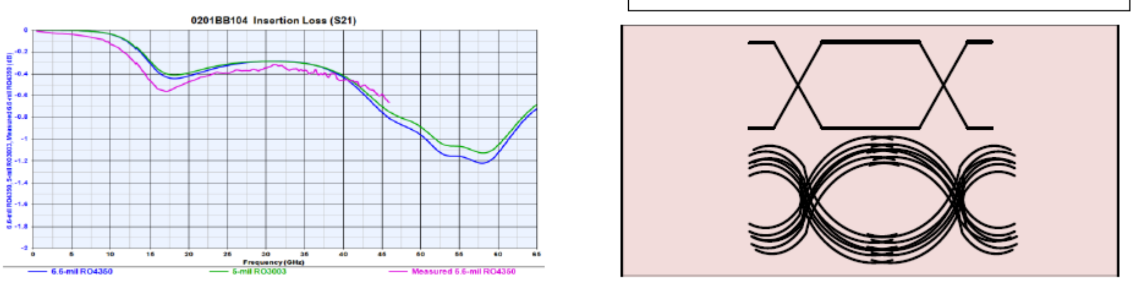
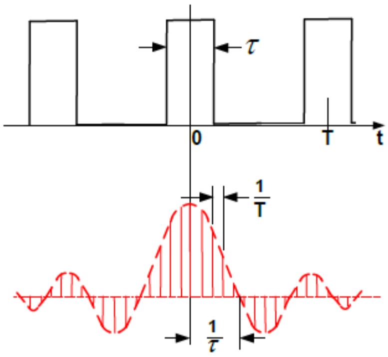


Fig. 2 Frequency domain and time domain parameters

Fortunately, all electrical engineers are familiar with the Fourier and Laplace transforms that do precisely that. The low-frequency and high-frequency responses required to reproduce a train of rectangular pulses with reasonable fidelity are shown in **Fig. 3**.



Rules of thumb:
If F_L is the lowest frequency needed to reproduce the longest pulse (string of "ones"),

$F_L \approx 1/\tau$

If $R \equiv$ pulse rate in GB/sec, and F_H is the upper frequency needed to reproduce pulses,
$F_H(GHz) \approx (R/2)*5$

Fig. 3 "Rules of thumb" for reproducing a rectangular pulse train

In general, systems that transmit all frequencies with equal velocity and minimal attenuation and reflection, will accurately reproduce input signal waveforms at their outputs. Conversely, systems that are dispersive, i.e., where signals at different frequencies travel at different speeds or have unequal attenuations or reflections, create distortions in the output waveform.

Broadband Capacitors

In considering "broadband capacitors," perhaps the first question that arises is precisely what distinguishes these devices from any other capacitors. One property is alluded to above: When used to RF couple/DC block, the capacitor should have minimal attenuation and reflection. **Fig. 4** compares the insertion loss vs. frequency plot of a typical high-Q ceramic microwave capacitor with that of a broadband capacitor.

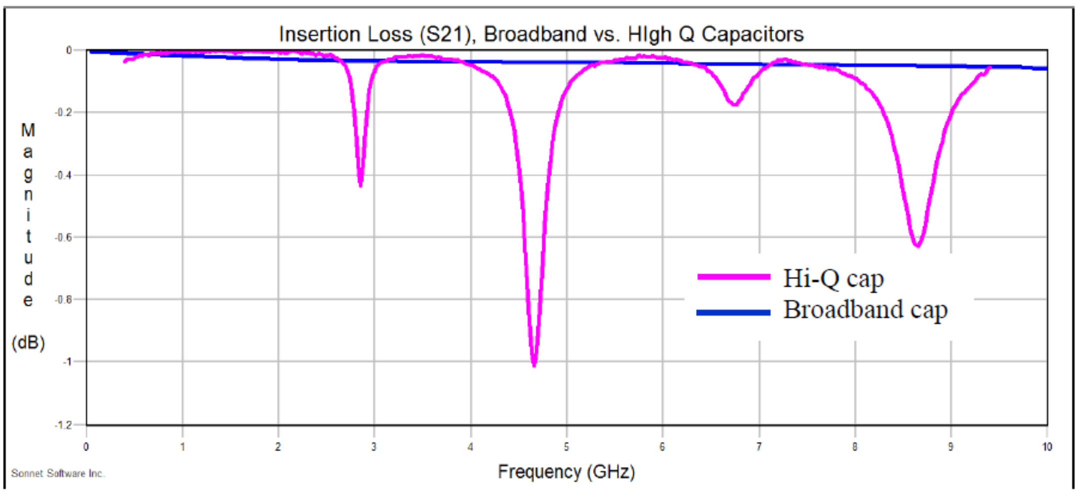


Fig. 4 Insertion loss of a broadband capacitor compared to that of a high-Q capacitor

The salient feature of the plots is that the high-Q capacitor exhibits a number of "parallel resonances" that create regions of high insertion loss, which is not the case with the broadband device.

A Lumped-Element Electrical Model

To understand the electrical behavior of an MLCC, one place to begin is with an equivalent circuit that produces the same performance, including interaction with a microstrip or coplanar waveguide transmission line. One such circuit, using lumped elements, is shown in **Fig. 5.**

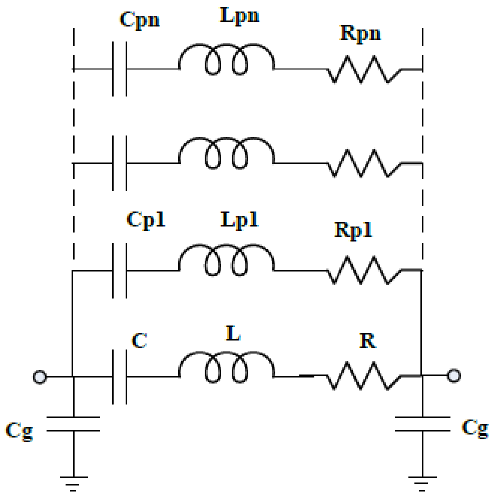


Fig. 5 A lumped element equivalent circuit for an MLCC on microstrip

If we consider a reduction of this circuit to only the first (lowest order) branch, Cg can be considered to represent capacitance of the MLCC body to the groundplane; C, the capacitor's value; L, its net inductance in the presence of the groundplane; and R, the equivalent series resistance (ESR). Note that to more closely reflect actual performance, L and R are both frequency varying to accommodate skin and proximity effects.

The addition of a second branch consisting of another inductor, Lp1, in series with another capacitor, Cp1, and resistor, Rp1, enables modeling the lowest-frequency parallel resonance; addition of additional Lpn-Cpn-Rpn branches capture higher-order parallel resonances. There are, however, constraints on these higher order element values beyond yielding the correct resonant frequencies, e.g., the model's low-frequency capacitance value (all inductive reactances negligible) must equal the true low-frequency value of the device and the high-frequency inductance value (all capacitive reactances negligible) must also equal that of the device.

Both broadband and high-Q MLCCs have the same physical structure: interleaved metallic electrodes embedded in a ceramic brick. From whence, then, comes the difference in behavior? Examination of Figs. 4 and 5 suggests at least one answer: The broadband capacitor is lossy. Specifically, in Fig. 5, resistances Rp1 through Rpn, must be high enough that only exceedingly low-Q parallel resonances are created when their reactances are capacitive and those of the lower branches are inductive. If this is the case, then at frequencies high enough that the reactance of C is negligible compared to that of L, the circuit reduces to the simple one in **Fig. 6**. It may be observed that this is a lumped element (low-pass filter) approximation of a transmission line section and, as such, best performance should be achieved by having the characteristic impedance of that section, $(Ls/Cg)^{1/2}$, about equal to 50 Ohms.

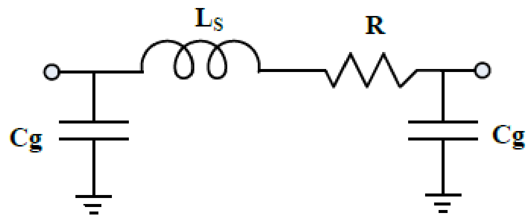


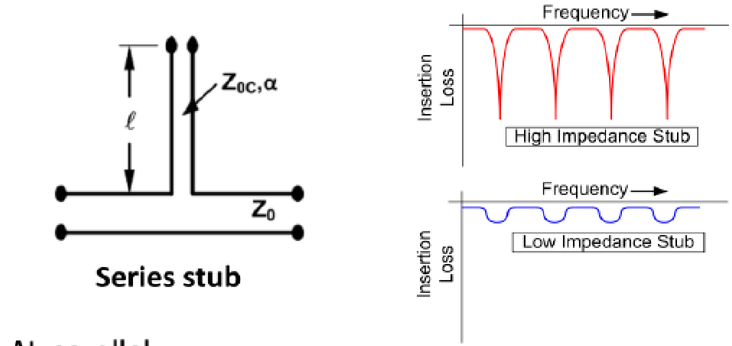
Fig. 6 Simplified lumped-element high-frequency equivalent circuit for microstrip-mounted MLCC with very low-Q parallel resonances

While lumped-element models are quite flexible, particularly where element values can incorporate arbitrary variation with frequency, there is at least one reason to be wary in applying them to broadband capacitors: The models are ad hoc, heuristic representations, derived from a combination of experimental observations and "common sense" circuit theory (there must be some series inductance, there must be some shunt capacitance to ground, etcetera), rather than more fundamental principles. Nowhere is this clearer than in the addition of the Lp-Cp branches to create parallel resonances. As lumped elements, they have no obvious physical origin and are attached ad hoc purely to simulate observed electrical manifestations.

We should, in fact, be cautious about any lumped-element representation of capacitors that operate at sufficiently high frequencies – but let's consider where "sufficiently high" might begin. Typical X7R dielectrics for these devices have relative dielectric constants in the 2500 – 3000 range. This implies quarter wavelengths on the order of 60 mils or less at 1 GHz. Thus, an 0402 device of length 40 mils would reach a quarter wavelength at 1.5 GHz; a 20-mil-long 0201 device would reach a quarter wavelength at 3 GHz. It therefore seems evident that, to characterize these devices to 50 GHz and beyond, we'd really like a distributed model.

Distributed Electrical Models

Fig. 7 depicts how an idealized, lossy, open-circuit series stub can function as a broadband coupling device. Note the resolution of the apparent paradox: How can the stub itself be quite lossy and yet have only minimal effect on the main line? The answer is that as long as the stub characteristic impedance is low relative to the main line characteristic impedance, the main line insertion loss will also be low. In fact, if the stub loss is sufficiently gradual and large, the stub input impedance will approach its characteristic impedance.



At parallel resonances: $IL = 20\log_{10}\left|1 + \tfrac{1}{2}\cdot\dfrac{Y_0}{Y_{0C}}\cdot\dfrac{1}{\tanh \alpha\ell}\right|$

For low insertion loss at parallel resonances:

* Low Z_{0C}
* High αL

Fig. 7 How to make a broadband series coupling stub

Turning now to distributed capacitor models, one such was proposed many years ago by Gordon Kent and Mark Engels [1], [2]. Using a procedure involving "unfolding" the interleaved electrode structure of the capacitor, they arrived at an equivalent section of open-circuited parallel-plate transmission line that exhibited periodic series and parallel resonances. This model had, however, a number of drawbacks: (1) It considered a capacitor only in isolation, not including interaction with the substrate it was mounted on; (2) it did not account for the fact that observed parallel resonances do not occur at uniformly spaced frequencies (again, ad hoc reactances or line sections were added in an attempt to model the latter behavior); and (3) it required the currents in each electrode to flow in opposite directions on each surface, something impossible at frequencies below those where significant skin effect occurs – and yet where parallel resonances are nevertheless observed.

Alternative distributed models consider the Lpn-Cpn-Rpn branch circuits of Fig. 5 as the capacitances, inductances, and resistances of individual overlapping electrode pairs, all loading an open-circuited parallel-plate stub transmission line formed by the MLCC terminations. **Fig. 8** is an example of one such model. In this case, the interleaved electrodes also have quasi-distributed representations (open circuit stubs instead of lumped capacitors) in accordance with models of metal-insulator-metal (MIM) capacitors [3]. Referring back to our discussion of open-circuited series stubs, it may be observed that **if** the characteristic stub impedance $Z0_M$ is << 50 Ohms, the internal distributed losses can be large and yet the overall insertion loss as a series-connected device will be low. (The impedance at the input to stub M will simply approach a $Z0_M$-Ohm resistor.) Therefore, another part of making a capacitor broadband is reducing L_T and L_{En} as much as possible, while maintaining high capacitance.

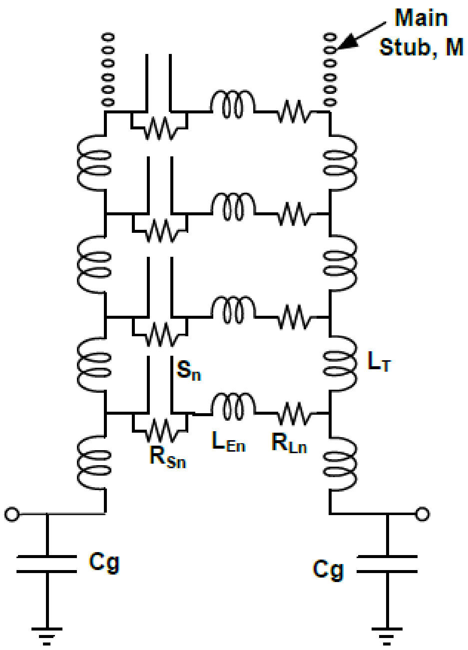


Fig. 8 A distributed MLCC model

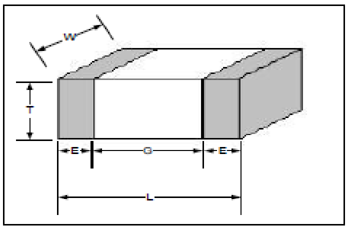
Unfortunately, neither lumped nor distributed theoretical models are able to capture the full range of real-world complexity: the presence of three different dielectrics (capacitor, air, substrate) and consequent TEM propagation modes [4], [5]; the mutual inductance and resistance effects of the electrodes; the discontinuity reactances of the microstrip-to-MLCC transitions (including solder joints); mounting pad dimensions that exceed those of the device's termination footprints; higher (non-TEM) mode generation; radiation; etc.

However, there is a combined experimental/theoretical approach, e.g., [6], that does yield good agreement with real-world behavior: It is that taken by Modelithics, Inc., a vendor that creates electrical models based on extensive (soldered on) device measurements performed on a variety of substrates having different dielectric constants, thicknesses, and pad dimensions. PPI has commissioned Modelithics to measure and model a number of its broadband capacitors; in the following section, by investigating the behavior of one such model under several different conditions, we can arrive at some fundamental conclusions on how to achieve good performance.

Optimizing Performance as a Coupling/Blocking Device

We will use the Modelithics model of the PPI 0201BB104 broadband MLCC to derive some general principles as to how best to achieve our objective. Two circumstances must be addressed: (1) The user has the freedom to select a substrate best suited for a broadband capacitor; or (2) the user already has a substrate and wants to optimize performance with a broadband capacitor. In each case, the user must know the highest operating frequency; this will determine the required characteristics of both substrate and broadband capacitor.

To achieve our objective, we modeled performance – insertion loss and return loss -- of the PPI 0201BB104 on microstrip substrates having three different dielectric constants. Three thicknesses of each substrate were chosen to create the following conditions with respect to the trace width necessary for a 50-Ohm characteristic impedance transmission line (at 10 GHz): Equal to the part width, less than the part width, greater than the part width. **Fig. 9** shows the basic dimensions of the part; while **Table 1** provides specifics on the substrates.



L = 24 ± 1
W = 12 ± 1
T = 12 ± 1
E = 6 ± 2
G = 8, Min.

All dimensions in mils

Fig. 9 Dimensions of the PPI 0201BB104

Closest Substrate	Dielectric Constant	Substrate Thickness (Mils)	Trace Thickness (Mils)	Linewidth for 50Ω Zo @ 10 GHz (Mils)
Rogers	3.9	6.6	0.71	13.1
RO4350B		10		20.1
		4		7.7
Rogers	6.5	10	0.71	13.4
RO3006		13.5		18.3
		7		9.2
Alumina	9.6	13	0.1	12.8
		20		19.8
		5		4.8

For the study,
W_{PART} = 13 mils

Table 1 Substrates used in investigation

Figs. 10 - **12** show insertion and return losses for the various substrates and thicknesses.

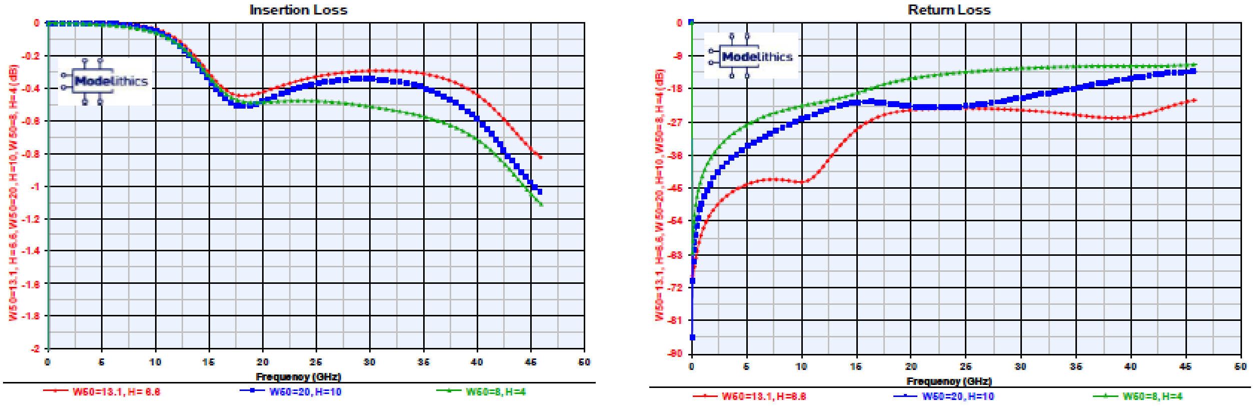


Fig. 10 Insertion and Return loss, 0201BB104, three K=3.9 substrate thicknesses, three 50-Ω linewidths

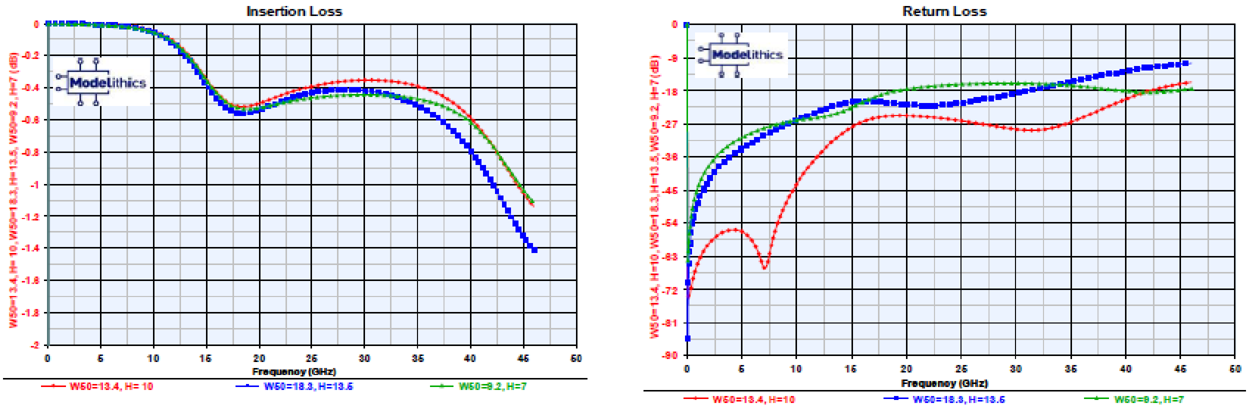


Fig. 11 Insertion and Return loss, 0201BB104, three K=6.5 substrate thicknesses, three 50-Ω linewidths

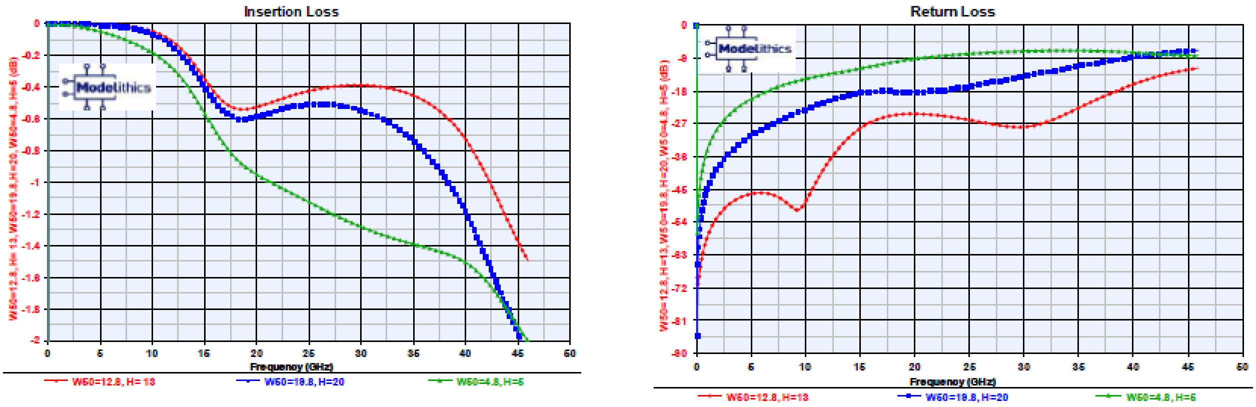


Fig. 12 Insertion loss, 0201BB104 three K=9.6 (alumina) substrate thicknesses, three 50-Ω linewidths

It is seen that, in all cases, best performance (red curves) is achieved when the part width is about the same as W50, the 50-Ohm characteristic impedance trace width. If the part width is either significantly greater than W50 (blue curves) or less than W50 (green curves), performance is degraded. Note that this is roughly consistent with the very simple circuit of Fig. 6 and the seemingly naïve observation above it that best performance would be obtained when $(Ls/Cg)^{1/2}$ was about equal to 50 Ohms. (The caveats, however, still apply: The Fig. 6 circuit does not predict details of the frequency response.)

Mounting Pads and Impedance Matching

In light of the above, there is no one-size-fits-all prescription for mounting pad dimensions because there are too many variables involved: PC board dielectric constant and thickness, customer pick-and-place capabilities, PC trace tolerances, performance desired over frequency range, etc. In general, for good (but not necessarily optimum) performance, one wants the width of the part and mounting pad to be about equal to the width of a 50-Ohm trace on the substrate, and the lengths of the lands to extend only minimally beyond the length of the part. As for the gap, 5-mils nominal is a good starting point for the 0201BB104 and 01005BB104 -- although (again) not necessarily the absolute optimum – while a 10-mil gap is a good starting point for the 0402BB103 and 0402BB104 . **Fig. 13** illustrates these suggestions.

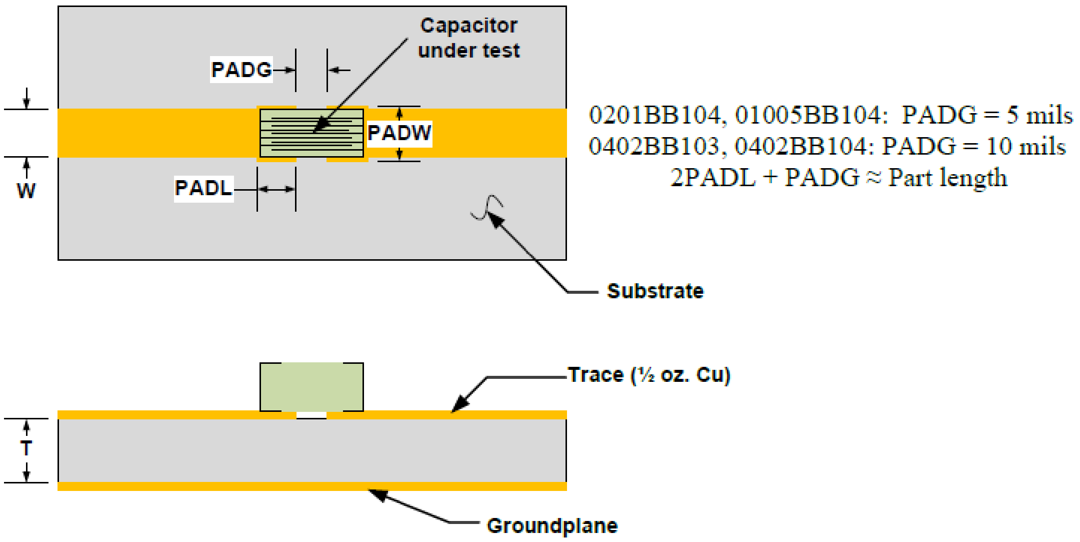


Fig. 13 Mounting pad layout

It may be of interest that the 0201BB104 Modelithics model has a pad scalability feature, meaning that the landing pad dimensions can be changed within prescribed limits and the consequent electrical behavior characterized. Note that the min. and max. dimensions on the Modelithics pads -- PADL, PADW, PADG – are simply the ranges over which the model is valid, not recommended tolerances. Keep in mind, too, that the part itself has the tolerances shown in Fig. 9.

Determining final pad tolerances often devolves to a struggle between RF engineers, who want the pad width and tolerance to match as closely as possible the part width and tolerance, and production processing engineers, who'd like the largest pad dimensions and tolerances possible to facilitate pick-and-place operation. Fortunately, performance over most frequency ranges through about 40 GHz seems relatively insensitive to small deviations of pad dimensions.

If the substrate thickness and trace width are determined before the broadband capacitor is selected, then it's best to choose a capacitor whose width is closest to that of the 50-Ohm trace. There is also the possibility of improvement if additional impedance matching is done. In general, when the part width exceeds the trace width, the imaginary part of the input impedance is capacitive, and the creation of additional series inductance by a short section of reduced trace width can help. Alternatively, removal of a portion of the dielectric beneath the capacitor (reducing the shunt capacitance to ground) can also be effective. Similarly, when the part width is less than the 50-Ohm trace width, the input impedance is inductive, and the creation of additional shunt capacitance by widening a section of trace width adjacent to one or both mounting pads, or the mounting pad widths (PADW) themselves, can improve performance.

An example of impedance matching is shown in **Fig. 14**, which applies to PPI model 01005BB104, a 100 nF EIA size 01005 part mounted on a 6.6 mil thick substrate of dielectric constant 3.9. The part itself is 8 mils wide and the trace it was mounted on was 12 mils wide. (The 50-Ohm trace width on the substrate at 10 GHz is 13.1 mils.) Using a scattering matrix for the part measured by Modelithics, return loss was plotted in Agilent Inc. Genesys software for (a) the part alone, and (b) a circuit that adds 5-mil-long sections of widened traces at input and output. Using Genesys's optimization function, dimensions of the traces were adjusted for best input and output return loss over the 0.05 to 46 GHz measurement range. It should be cautioned that, because of the part's insertion loss, input reflection after impedance matching at only one port is not necessarily equal to output reflection; one could improve return loss at one of the ports beyond that shown, but the improvement would come at the expense of the other port's reflection.

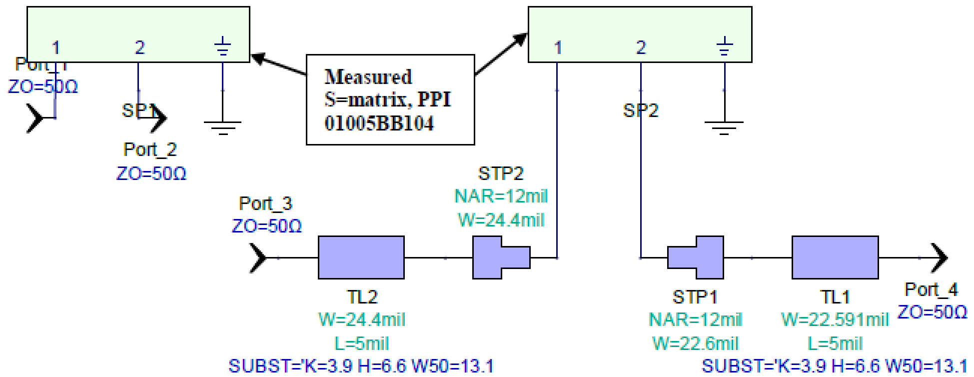


Fig. 14a Circuit layout for PPI 01005BB104 (a) as measured on K=3.9 H=6.6 mil trace, and (b) with simple added impedance matching

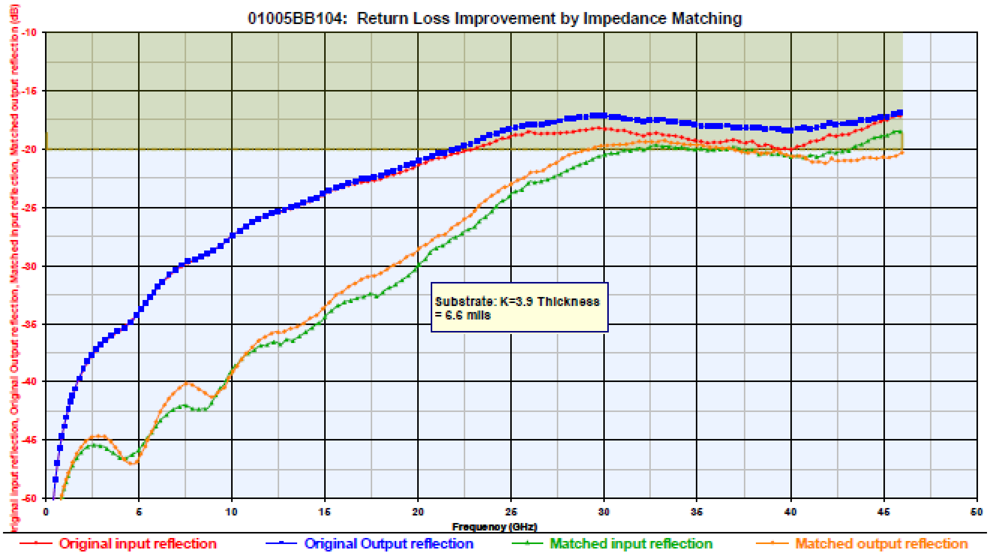


Fig. 14b Input and Output Return loss, PPI 01005BB104 (red, blue) as measured on K=3.9 H=6.6 mil trace, and (orange, green) with added impedance matching

Non-linear Behavior – VCC, Temperature, Aging

Thus far, we've discussed only the basic electrical performance of broadband capacitors as linear devices but, particularly where so-called "signal integrity" is important, e.g. in accurately reproducing a stream of (rectangular waveform) bits from input to output, a number of non-linear parameters are involved. Let's define the major ones before proceeding to some of the tradeoffs involved:

- **The voltage coefficient of capacitance, VCC**, is the change of capacitance – usually a decrease **--** with applied voltage. In general, VCC depends on the electric field (volts/mil) across the dielectric, and the higher the dielectric constant, the greater the VCC. Any decrease in capacitance is likely to impact the low-frequency range of performance. **Fig. 15** shows the capacitance change with DC voltage for three PPI broadband MLCCs.

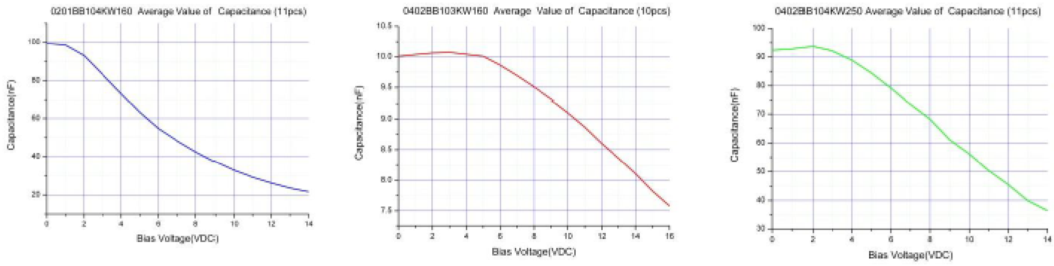


Fig. 15 Capacitance change with DC voltage for three PPI broadband MLCCs

Capacitance will also change with AC voltage and frequency, sometimes rising with the latter before falling off.

- **The Temperature coefficient of capacitance, TCC**, is the change of capacitance with temperature. In general, the higher the dielectric constant, the greater will be its change with temperature. Most broadband capacitors have dielectrics rated as either X7R, signifying a ± 15% maximum capacitance change with temperature from - 55^0 to +125^{0}C or X5R, signifying a ± 15% maximum capacitance change with temperature from - 55^0 to +85^{0}C. Again, any decrease in capacitance will impact the low-frequency range of performance.

- **Aging** is the tendency of non-linear dielectrics, e.g. the X7R type, to exhibit a reduction in dielectric constant as time passes. It is usually given in "percent capacitance loss per decade hour," implying that, on logarithmic graph paper where time is the "X" variable and capacitance is the "Y" variable, there is a straight line characteristic with a negative slope. Aging is typically measured starting from 10 to 24 hours after a capacitor emerges from an oven set at a temperature above that of the dielectric's Curie temperature. Thus, a capacitor will lose capacitance by the same percentage from 10 hours to 100 hours as it will from100 to 1000 or 1000 to 10,000. In order to be sure that customers receive a stable part, most manufacturers wait till the fourth decade, so that the part's age is between 1000 and 10,000 hours before shipping. Nevertheless, when thinking about performance over shelf time at the factory and subsequent field life, customers should be cognizant that over 10,000 hours – about 14 months – capacitance values may, in the worst case (original shipment after 1000 hours), decrease by the aging specified maximum percentage.

Table 2 indicates some of the tradeoffs in design and selection of a broadband capacitor. The left-hand column contains independent parameters; the boxes show the results if any one parameter is changed as shown while the others are held constant.

Parameter	Parameter Change	Capacitance/ Low-freq. response	High Freq. Response	Voltage Rating (WVDC)	VCC	TCC	Aging
Case size	Smaller	Lower for same WVDC/Worse	Better	Lower for same capacitance	----	----	----
Dielectric constant	Higher	Higher/Better	----	----	Worse	Worse	Worse
Dielectric thickness	Lower	Higher/Better	----	Lower	Worse	----	----

Table 2 Broadband capacitor tradeoffs with case size, dielectric constant, and dielectric thickness

In general, larger capacitance values enable operation down to lower frequencies. To extend the upper operating frequency, smaller case sizes are needed, since these are commensurate with the smaller substrate thicknesses and narrower line widths required for higher-mode-free, high-frequency operation. Therefore, to extend both ends of the spectrum, one must squeeze equal or greater capacitance into smaller case sizes, and the only ways to accomplish this are to either decrease the inter-electrode dielectric spacing and/or use a dielectric with a higher dielectric constant. The first reduces the voltage rating (WVDC), and either approach exacerbates the non-linear effects – and thus the tradeoffs.

Performance as a Bypass Device

It is often desired to bypass some point to ground over a large frequency range, that is, provide a path having very low impedance to RF signals while still blocking DC. In the past, this was typically accomplished by an array of capacitors having different values, as shown in **Fig. 16**.

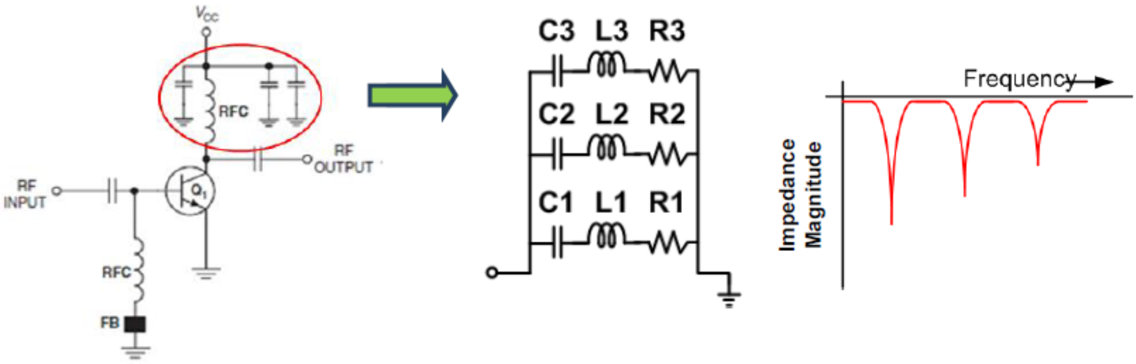


Fig. 16 Capacitor array used as bypass to ground

Here, C1 might be perhaps 100 pF, C2 might be 1 nF, and C3 might be 10 nF. There were two problems with this arrangement: (1) Above the series resonance of C3 [= $(2\pi)^{-1}(L3C3)^{-0.5}$)], its impedance was inductive and would create a parallel resonance with C1 and C2; and (2), the individual capacitors had their own built-in parallel resonances. Either problem led to an impedance magnitude vs. frequency characteristic similar to that shown on the right of Fig. 16. To reduce the magnitude of the resonances, additional loss would need to be introduced in the form of low-value resistors connecting the capacitors or ferrite beads surrounding the connecting leads. **In contrast, broadband capacitors offer a simple, cost effective way to replace these arrays with a single capacitor.**

Again using the Modelithics model of the PPI 0201BB104 on a 6.6 mil thick, K = 3.9 substrate, this time with a grounded output, **Fig. 17** shows the real and reactive parts of the input impedance.

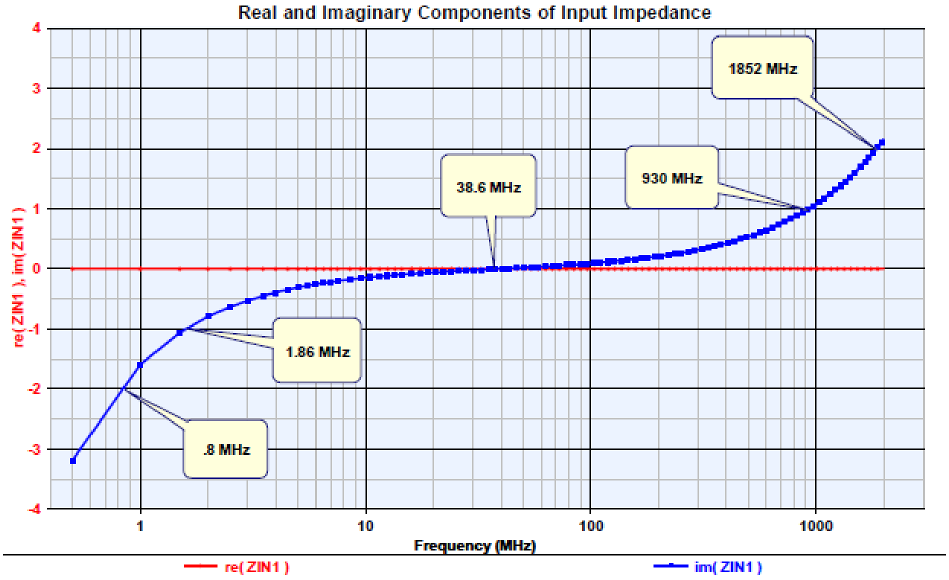


Fig. 17 PPI 0201BB104 in bypass mode: Real and Imaginary parts of input impedance

It is seen that the reactance is inductive above 38.6 MHz and capacitive below that frequency; it is the magnitudes of these components that will determine the operational range. For example, if the absolute value of the impedance to ground needs to be < 1 Ohm, the frequency range over which this is achieved is 1.86 – 930 MHz; if the value can be extended to < 2 Ohms, the frequency range can be commensurately widened to cover 0.8 – 1852 MHz. Note that the plots do not include the inductive contribution of a via to the groundplane, which is likely required in many practical situations.

The inductive reactance could be reduced by decreasing spacing to the groundplane (although 6.6 mils is already quite thin), and total reactance can be reduced by paralleling two or more devices, but the latter may not be practical for reasons of space or economics. In summary, in a bypass mode, a broadband capacitor can effectively replace an array of capacitors to cover frequencies ranging from the high KHz/low MHz region to the low GHz region, depending on the requirements of the particular circuit.

Conclusions

The principal "take-aways" from the discussion are listed below:

- Used as DC blocking/RF coupling devices, SMT broadband ceramic capacitors can operate free of parallel resonances over a very wide frequency range. Resonances are suppressed by losses within the device.
- Circuit models, whether lumped or distributed, cannot adequately capture the effect of all the electrical phenomena involved in practical devices: mutual inductance and resistance of the electrodes; discontinuity reactances of microstrip-to-MLCC transitions (including solder joints); mounting pad

dimensions that exceed those of the device's termination footprints; higher (non-TEM) mode generation; radiation; etc.

- Good experimental/theoretical combination models, such as those available from Modelithics Inc., enable performance simulation on a variety of substrate thicknesses and dielectric constants. Impedance matching can often be used to improve insertion loss and return loss performance.
- Non-linear effects – capacitance change with applied voltage, temperature, and time passage – can negatively affect performance. Tradeoffs can be made that impact maximum working voltage and case size.
- In a bypass mode, a single SMT ceramic capacitor can replace an array of various-value capacitors to effectively cover frequencies ranging from the high KHz/low MHz region to the low GHz region.

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[4] V.K. Tripathi, "Assymetric coupled Transmission Lines in an Inhomogeneous Medium," *IEEE Trans. Microwave Theory Tech.*, pp. 734-739, Sept.., 1975
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[6] B. Lakshminarayanan, et al, "A Substrate-Dependent CAD Model for Ceramic Multilayer Capacitors," *IEEE Trans. Microwave Theory Tech.*, vol. MTT-48, pp. 1687-1693, October, 2000


PPI
470pF±5%
3KV
PPI
160pF±2%
5KV
PPI
500pF±5%
8KV
DLC180
0505
1111
2225
3838
6040
7676
1313

Notes

◆ Storage

① The chip capacitors shall be packaged in carrier tapes or bulk cases.

② Keep storage facility temperatures from +5C to +35C, humidity from 45 to 70% RH.

③ The storage atmosphere must be free of gas containing sulfur and chlorine. Also, avoid exposing the product to saline moisture. If the product is exposed to such atmospheres, the terminations will oxidize and solderability will be affected.

④ If the above storage condition is followed, Then the solderability is assured for 12 months from our final inspection date.

◆ Circuit Design

① Once application and assembly environments have been checked, the capacitor may be used in conformance with the rating and performance, provided in both the catalog and the specifications. Exceeding the specifications listed may result in inferior performance. It may also cause a short, open or smoking to occur, etc.

② Please use the capacitors in conformance with the operating temperature provided in both the catalog and the specifications. Be especially cautious not to exceed the maximum temperature. If the maximum temperature set forth in both the catalog and specifications is exceeded, the capacitor's insulation resistance may deteriorate. Power may suddenly surge and short-circuit may occur. The capacitor has a loss, and may self-heat due to equivalent series resistance when alternating electric current is passed through. As this effect becomes especially pronounced in high frequency circuits, please exercise caution. When using the capacitor in a (self-heating) circuit, please make sure the surface of the capacitor remains under the maximum temperature for usage. Also, please make certain temperature rise remains below 20°C.

③ Please keep voltage under the Rated Voltage, which is applied to the capacitor. Also, please make certain the Peak Voltage remains below the Rated Voltage when AC or voltage is super-imposed to the DC voltage. In the situation where AC or pulse voltage is employed, ensure average peak voltage does not exceed the Rated Voltage. Exceeding the Rated Voltage provided in both the catalog and specifications may lead to defect with standing voltage. In worse case situations, It may cause the capacitor to smoke or flame.

◆ Handling

Chip capacitors should be handled with care to avoid contamination or damage. The use of vacuum pick-up or plastic tweezers is recommended for manual placement. Tape and reeled packages are suitable for automatic pick and placement machines.

◆ Flux

① An excessive amount of flux or too rapid temperature rise causes solvent burst, and solder can generate a large quantity of gas. The gas spreads small solder particles which can cause a solder balling effect or bridging problem.

② Flux containing too high a percentage of halide may cause corrosion of termination unless sufficiently cleaned.

③ Use rosin-type flux, and do not use a highly acidic flux (halide content less than 0.2 wt%).

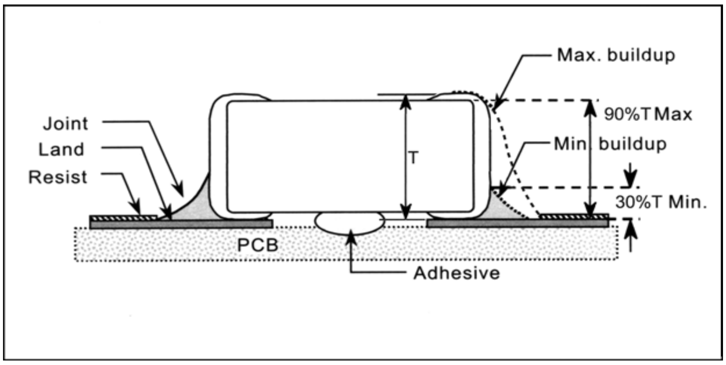
④ The water soluble flux causes deteriorated insulation resistance between outer termination unless sufficiently cleaned.

◆ Component Spacing

For wave soldering components, the spacing must be sufficiently far apart to prevent bridging or shadowing. This is not so important for the reflow process, but sufficient space for rework should be considered. The suggested spacing for reflow soldering and wave soldering is 0.5mm and 1.0mm, respectively.

◆ Solder Fillet

Too much solder amount may increase solder stress and cause cracking risks. Insufficient solder amount may PCB. When soldering, confirm that the solder is 30%T to reduce adhesive strength and cause parts to fall off 90%T.



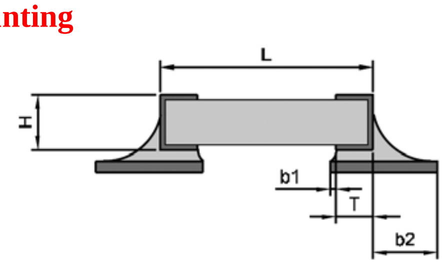
◆ Recommended Land Pattern Dimensions

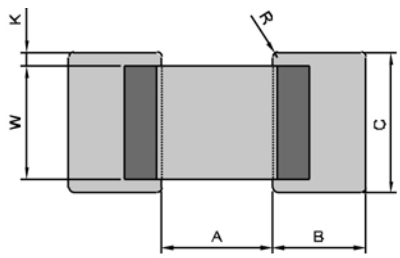
When mounting the capacitor to substrate, it's important to carefully consider that the amount of solder (size of fillet) used has a direct effect upon the capacitor once it's mounted.

① The greater the amount of solder, the greater the stress to the elements. This may cause the substrate to break or crack.

② In the situation where two or more devices are mounted onto a common land, be sure to separate the device into exclusive pads by using soldering resist.

● Horizontal Mounting

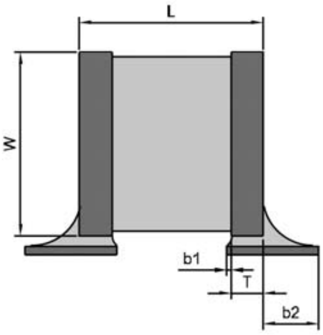


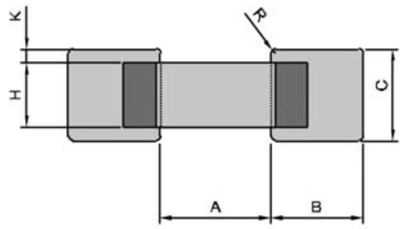


Horizontal Mounting – Recommended Land Pattern Dimensions of Reflow soldering (unit: millimeter)											
	0201	0402	0603	0505	0805	0708N	1111	2225	3838	6040	7676
A	0.28	0.41	0.70	0.70	1.10	0.90	1.90	3.90	7.10	13.00	16.00
B	0.28	0.41	0.90	0.90	1.10	1.00	1.70	2.50	3.00	3.30	3.30
C	0.37	0.54	0.90	1.40	1.40	2.90	2.90	7.00	10.20	11.30	19.60
T	-	-	0.40	0.40	0.50	-	0.70	1.00	1.30	1.30	1.30
b1	-	-	0.05	0.05	0.10	-	0.10	0.10	0.10	0.10	0.10
b2	-	-	0.50	0.50	0.60	-	1.00	1.50	1.70	2.00	2.00
K	-	-	0.00	0.00	0.10	-	0.10	0.10	0.10	0.10	0.10
R	-	-	0.00	0.00	0.30	-	0.50	0.80	0.80	1.00	1.00

Horizontal Mounting – Recommended Land Pattern Dimensions of Iron soldering (unit: millimeter)							
	0603	0505	0805	0708	1111	2225	3838
A	0.70	0.70	1.10	0.90	1.90	3.90	7.10
B	2.00	2.00	2.00	2.00	2.50	4.00	5.00
C	0.90	1.40	1.40	2.90	2.90	7.00	10.20
T	0.40	0.40	0.50	-	0.70	1.00	1.30
b1	0.05	0.05	0.10	-	0.10	0.10	0.10
b2	0.50	0.50	0.60	-	1.00	1.50	1.70
K	0.00	0.00	0.10	-	0.10	0.10	0.10
R	0.00	0.00	0.30	-	0.50	0.80	0.80

● Vertical Mounting



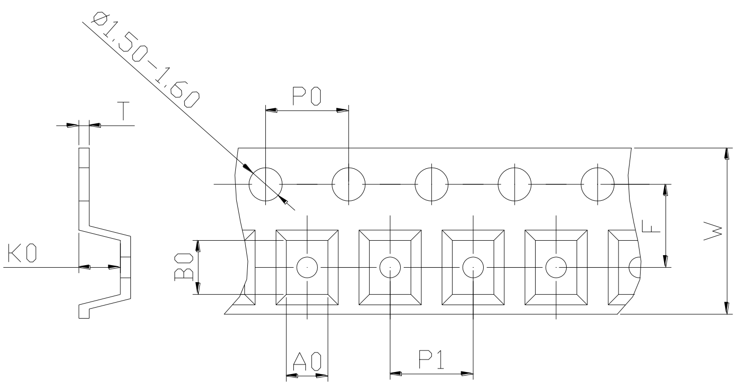


Vertical Mounting – Recommended Land Pattern Dimensions of Reflow soldering (unit: millimeter)					
	0505	0805	1111	2225	3838
A	0.70	1.10	1.90	3.90	7.10
B	0.90	1.10	1.70	2.50	3.00
C	1.40	1.40	2.50	4.00	5.00
T	0.40	0.50	0.70	1.00	1.30
b1	0.05	0.10	0.10	0.10	0.10
b2	0.50	0.60	1.00	1.50	1.70
K	0.00	0.10	0.10	0.10	0.10
R	0.00	0.30	0.50	0.80	0.80

Vertical Mounting – Recommended Land Pattern Dimensions of Iron soldering (unit: millimeter)					
	0505	0805	1111	2225	3838
A	0.70	1.10	1.90	3.90	7.10
B	2.00	2.00	2.50	4.00	5.00
C	1.40	1.40	2.50	4.00	5.00
T	0.40	0.50	0.70	1.00	1.30
b1	0.05	0.10	0.10	0.10	0.10
b2	0.50	0.60	1.00	1.50	1.70
K	0.00	0.10	0.10	0.10	0.10
R	0.00	0.30	0.50	0.80	0.80

● Tape & Reel Specifications

	A0	B0	K0	W	P0	P1	T	F	MIN /REEL	QTY/ REEL	TAPE Material
0201N - H	0.406	0.749	0.422	8.00	4.00	2.00	0.42	3.50	500	500	Paper
0402N - H	0.60	1.10	1.00	8.00	4.00	2.00	0.20	3.50	500	500	Paper
0603N - H	0.95	1.80	0.85	8.00	4.00	4.00	0.20	3.50	500	500	Paper
0805N - H	1.60	1.60	2.40	8.00	4.00	4.00	0.20	3.50	500	500	Paper
0708N - H	2.30	3.60	2.70	8.00	4.00	4.00	0.254	3.50	500	500	Plastic
1111N - H	2.92	3.51	2.34	8.00	4.00	4.00	0.254	3.50	500	500	Embossed
1111N - V	2.92	3.51	2.34	8.00	4.00	4.00	0.254	3.50	500	500	Embossed
0505C/P - H	1.38	1.68	0.98	8.00	4.00	4.00	0.22	3.50	500	3000	Plastic
0505C/P - V	1.10	1.60	1.40	12.00	4.00	4.00	0.30	5.50	500	2000	Plastic
1111C/P - H	2.85	3.50	1.95	8.00	4.00	4.00	0.22	3.50	500	2000	Plastic
1111C/P - V	2.00	3.50	2.70	12.00	4.00	4.00	0.40	5.50	500	1500	Plastic
2225C/P	6.70	6.20	3.40	16.00	4.00	12.00	0.30	7.50	500	500	Plastic
3838C/P	10.10	10.10	3.30	16.00	4.00	16.00	0.30	7.50	50	200	Plastic
0505X- H	0.042	0.065	0.054	8.00	4.00	4.00			500	4000	Plastic
1111X - H	0.109	0.131	0.091	8.00	4.00	4.00	0.220	3.50	500	2000	Plastic
2225 - H	0.270	0.235	0.128	12.00	4.00	4.00			500	500	Plastic
0603CG	1.05	1.80	0.90	8.00	4.00	4.00	0.90	3.50	1000	4000	Paper
0805CG	1.40	2.20	1.20	8.00	4.00	4.00	0.22	3.50	1000	3000	Plastic
1206CG	1.91	3.51	1.30	8.00	4.00	4.00	0.25	3.50	1000	3000	Plastic
1210CG	2.85	3.50	1.95	8.00	4.00	4.00	0.25	3.50	1000	3000	Plastic



◆ Resin Mold

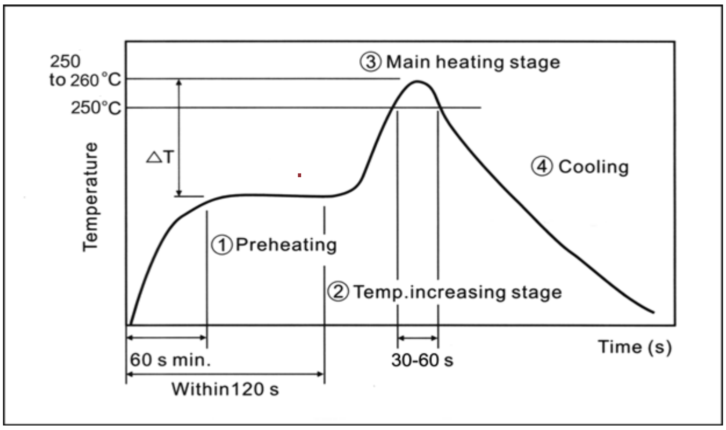
If a large amount of resin is used for molding the chip, cracks may occur due to contraction stress during curing. To avoid such cracks, use a low shrinkage resin. The insulation resistance of the chip will degrade due to moisture absorption. Use a low moisture absorption resin. Check carefully that the resin does not generate a decomposition gas or reaction gas during the curing process or during normal storage. Such gases may crack the chip capacitor or damage the device itself.

◆ Soldering For Chip Capacitors

● Reflow Soldering

When sudden heat is applied to the elements, the mechanical strength of the components decrease because change can cause deformity of components inside. In order to avoid mechanical damage in the elements, preheating should be requested for both of components and the PCB board. Preheating conditions are given in the table below, It is requested to keep the temperature gap between the soldering and the elements surface (ΔT) as small as possible.

When elements are submerged in solvent after mounting, be sure to maintain the temperature gas (ΔT) between the element and solvent within the range shown in the table below.



Chip Capacitor	0402/0603/0505/0805/1111	2225/3838
Preheating	ΔT≤190℃	ΔT≤150℃

PPI

Soldering Guide

<u>Soldering iron</u>. A temperature controlled iron of suitable wattage is strongly recommended. The iron temperature should typically be set 20-30 ^{0}C above the solder liquids temperature. Tip size is important; it should be about the same size as the part. Too small a tip (corresponding to an iron of insufficient wattage) will take too long to heat the printed circuit board land and part, while too large a tip (too high a wattage iron) may damage the board or component.

<u>Soldering Procedure</u>. The initial consideration is which end of the capacitor to solder first. The choice can generally be decided by recognizing that it is desirable to minimize the heat flowing directly through the component. Thus, it is best to start from the end that has the poorest heat conduction (equals highest thermal resistance) to a heat sink. (Were one to start from the opposite end, a good heat path would have been created <u>through</u> the capacitor to the heat sink when one soldered the second joint.) If it is not apparent which land has the poorer connection to a heat sink, begin with the one having the smallest area.

Follow these steps in soldering:

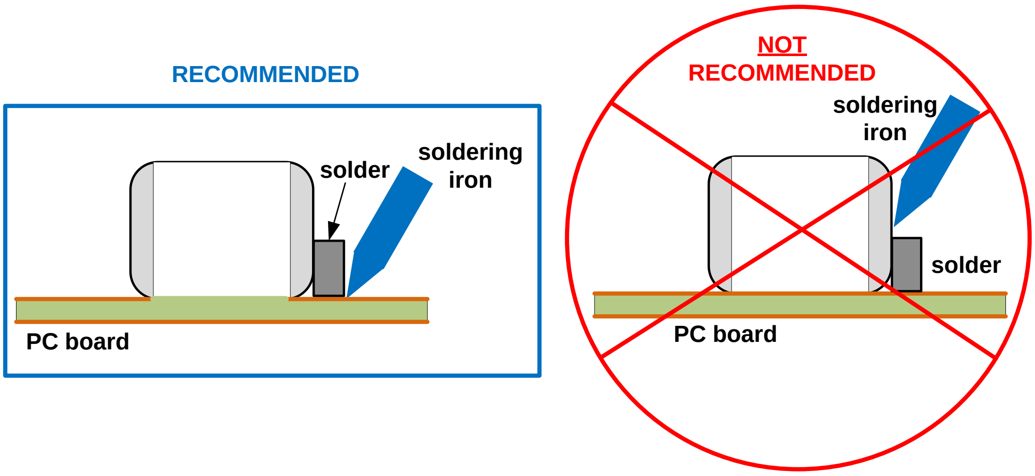
1. <u>Pre-heat the substrate</u>. Where possible, it is very desirable to gradually pre-heat the substrate, e.g. on a hotplate, to about 30 ^{0}C below the solder liquids temperature. Two steps are usually sufficient: Start the hotplate at a temperature about halfway to the desired pre-heat temperature, place the board on it and wait till the board temperature stabilizes, then increase the hotplate temperature to the desired final pre-heat value.

2. <u>Pre-“tin” the traces.</u> Select one of the PC board lands and clean it with isopropyl alcohol. If the solder you are using does not contain its own flux, place a small quantity of flux on the land, and a small amount of solder into the flux. (A razor may be used to cut a tiny custom preform from solid wire.) Place the iron on the printed circuit trace adjacent to the flux (but not touching) and heat the land until the solder melts into a flat, shallow pool. Remove the iron, then clean off any remaining flux with isopropyl alcohol. Repeat the procedure for the second land, then add fresh flux and a fresh solder preform (if not using flux-core solder) to each tinned land. (The preform should have sufficient mass to create a proper fillet – see step 5 – on the component.)

3. Pick up the component with either a hand tweezer or vacuum tweezer. (Stainless steel or ceramic-tipped tweezers are preferred.)

4. Place the component so that it straddles the circuit board lands, and make sure it lies flat on the board. As shown in **Fig. 1**, **<u>Do not touch the component directly with the soldering iron</u>**. Rather, touch the iron to the land adjacent to the capacitor until the solder begins to flow; then move the iron slowly toward the component.

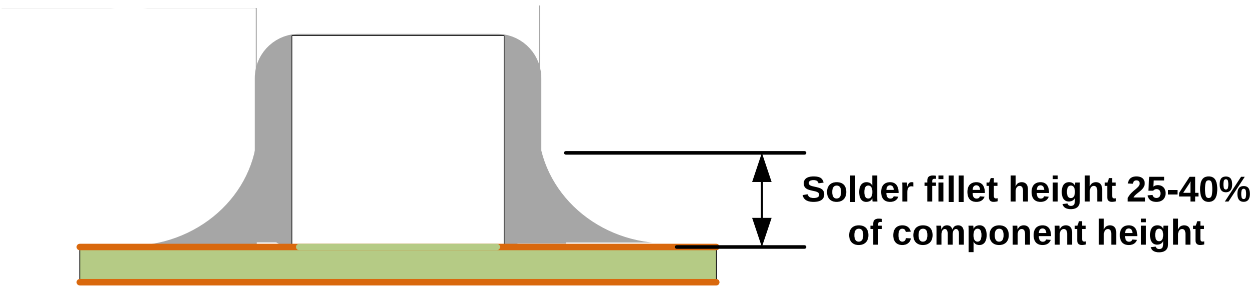
Fig. 1



5. When a fillet forms, remove the iron. As shown in **Fig. 2**, solder fillets should occupy about 25-40% of the component's height, have a concave profile, and be free of peaks and voids.

6. Repeat steps 1-5 for the second joint, then let the board cool gradually to room temperature. Use isopropyl alcohol to remove any residual flux from each joint.

Fig. 2



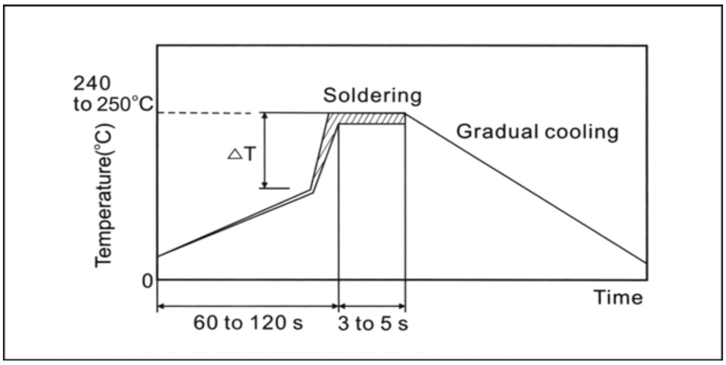
Wave Soldering

When sudden heat is applied to the elements, the mechanical strength of the components should decrease because remarkable temperature change can cause deformity of components inside. Also long soldering time or high soldering temperatures, result in leaching by the external electrodes, causing poor adhesion or a reduction in capacitance value due to loss of contact between electrodes and end termination.

In order to avoid mechanical damage in the elements, preheating should be requested for both of the components and the PCB board. Preheating conditions are given in the table below. It is requested to keep the temperature gap between the soldering and the elements surface (.T) as small as possible.

When elements are submerged in solvent after mounting, be sure to maintain the temperature gas (.T) between the element and solvent within the range shown in the table below.

Do not apply the flow soldering to capacitors not listed in the table below.

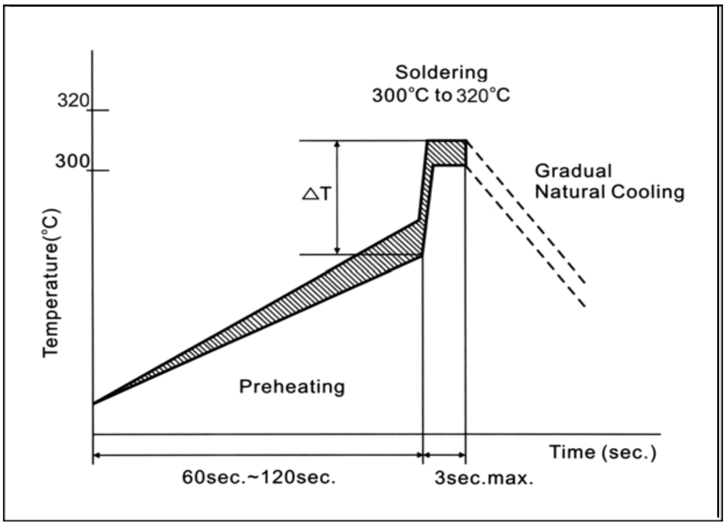


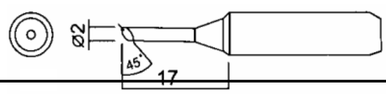
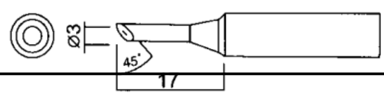
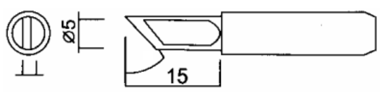
Chip Capacitor	0402/0603/0505/0805
Preheating	$\Delta T \leq 150$℃

Passive Plus does not recommend flow soldering for its 1111P/1111C, 2225P/2225C, 3838P/3838C.

● Soldering Iron

When sudden heat is given to the elements by soldering iron, the mechanical strength of the components should weaken because sharp temperature change can cause deformity of components inside. In order to avoid mechanical damage in the elements, preheating should be requested for both of the components and the PCB board. Preheating conditions are given in the below table. It is requested to keep the temperature gap between the soldering and the elements surface (ΔT) as small as possible. After the soldering, it should not be allowed to cool down suddenly.



Size	Soldering Iron	Temperature	Soldering Iron head Size	Solder
0505/0805	70W Thermostat Iron	330℃		63Sn/37Pb, 95.5Sn/3.8Ag /0.7Cu
1111		350℃		
2225		370℃		
3838		370℃		

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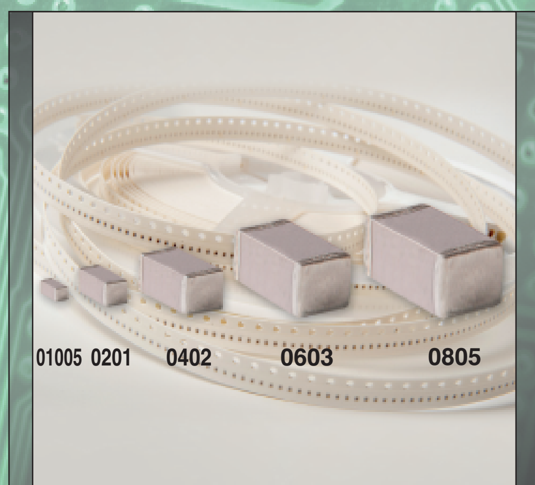

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