Introduction

RGA Multilayer Ceramic Capacitors are constructed by screen printing alternative layers of internal metallic electrodes onto ceramic dielectric materials and firing into a concrete monolithic body. Secondly, they are applied with metal end terminations which are fired to assure permanent bonding with the individual internal electrodes. Reliable performance is built-in through fine formulation of dielectric materials, preparation of conductive pastes, automatic manufacturing and strict process control. This assures excellent control in dielectric thickness, electrode integrity, electrode to termination continuity, termination to lead connection and coating insulation.

Dielectric formulations are identified and classified by the capacitance temperature coefficient of materials. NPO, X7R, Z5U and Y5V are the four most common for industrial use. The internal electrodes and end termination pastes are made of extremely precious metals; such as palladium, and silver, which result in a lower dissipation factor. The inherent high resistivity of ceramic dielectrics yields very high values of insulation resistance. A safety factor is also added up in thickness design to withstand undesired transient voltage surges. The final construction has excellent frequency characteristics.

Since the soldering period of the SMT process takes a much longer time than the conventional assembly process, a special treatment of MLC chip end termination is required to prevent silver electrode from leaching during soldering. Nickel barrier is electroplated on the top of the silver layer which is suitable for this purpose, along with a solder layer which is electroplated consequently to enhance the solderability.

This type of capacitor is especially produced for SMT or hybrid assembly, which use reflow, vapor phase, wave or any other kind of soldering systems.

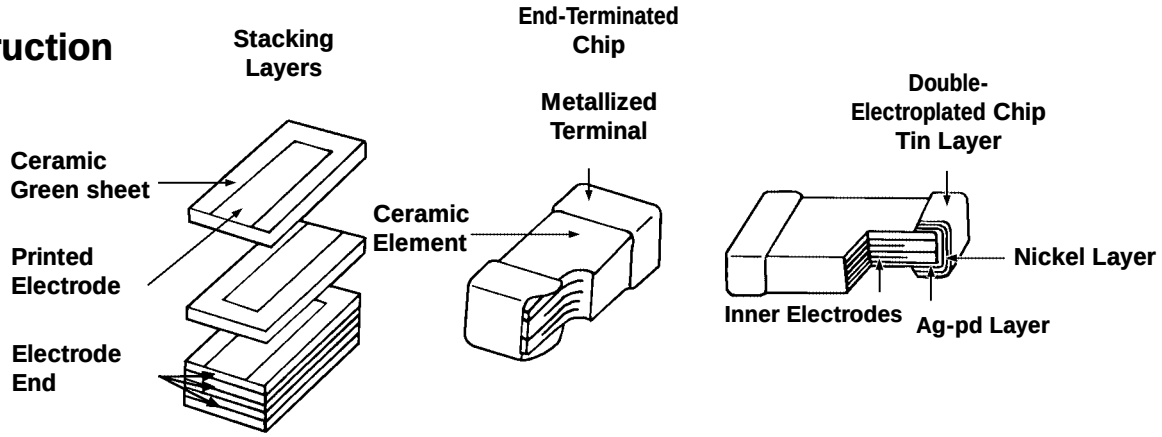
Features

- Small in size and large in capacitance.
- Superior humidity characteristic and long life due to complete sealing of inner electrodes.
- Low inductance and excellent frequency characteristics.
- Excellent solderability and resistance to soldering heat due to solder plating.
- Reduction of assembly costs and matching with auto placement machines.

Application

- Hybrid thick and thin film integrated circuits
- Telecommunication equipment
- Computers
- Electronic wrist watches and cameras
- TV tuners
- Video cameras
- Radio and Tape Recorders

Construction



Rated Voltage

Code	1A	1C	1E	1H	2A	2D	2E	2H	2O	3A
Voltage (VDC)	10	16	25	50	100	200	250	500	630	1000

*For voltages above 100V, please consult factory

Part Dimension

EIA Size	Part Dimension (mm)		
	Length (L)	Width (W)	Thickness (T)
0402	1.0±0.05	.5±0.05	0.5±0.05
0603	1.6±0.1	0.8±0.1	0.8±0.1
0805	2.0±0.2	$1.2^{+0.2}_{-0.15}$	1.4 Max.
1206	3.2±0.2	1.6±0.2	1.52 Max.

* For larger case sizes, please consult factory.

* For 0201 specifications, please consult factory.

Temperature Characteristic Code

	N(NPO)	W(X7R)	Z(Z5U)	Y(Y5V)
Temperature Coeff.	0±30 ppm/°C	±15%	+22% -56%	+22%~-82%
Operating Temperature	-55°C~+125°C	-55°C~+125°C	+10°C~+85°C	-30°C~+85°C

Capacitance Code

Code	Capacitance(pF)	Code	Capacitance(pF)
1R0	1	102	1000
1R5	1.5	222	2200
100	10	472	4700
101	100	103	10000

Tolerance Code

Code	Tolerance
B	±.1pF
C	±0.25pF
D	±0.50pF
F	±1%
G	±2%

Code	Tolerance
J	±5%
K	±10%
M	±20%
Z	+80 – 20%

Termination Code

Code	S	P (Pd-Ag)	N
Termination Type	Silver	Paladium Silver	Nickel Barrier

Packaging Code

Packaging Code	Quality Per Reel	Size of Reel
Paper = P	01 = 1000	7”
Plastic = E	2 = 2000	10”
	3 = 3000	13”
	4 = 4000	
	5 = 5000	
	1 = 10,000	

* For Taping Specification, please see Page B15

Part Numbering System

S	0805	N	101	J	1H	R	N	_	P47
Chip Cap.	Size	T.C.	Capacitance Code	Tolerance	Voltage	Package	Termination		Packaging Code
	0402 0603 0805 1206	N= NP0 W= X7R Z= Z5U Y= Y5V	Two Significant digits + No. of zeros. Example: 10PF=100 100PF=101 1,000PF=102 22,000PF=223 100,000PF=104	J = ±5% K = ±10% M =±20% Z = +80% -20%	1A = 10V 1C = 16V 1E = 25V 1H = 50V 2A = 100V 2E = 250V	B: Bulk R: Tape & Reel	N= Ni-Barrier P= Pd-Ag S= Silver		See Box Above

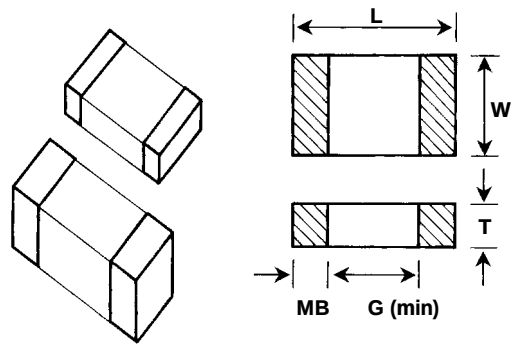
NPO Dielectric

Introduction:

The NPO (COG) is a high Q, low K temperature compensating type of dielectric with stable electrical properties under varying voltage, temperature, frequency and time. It's suitable for circuits that require low loss, as well as timing and tuning applications.

Features:

- Very low temperature coefficient
- Stable electrical characteristics
- Small size with high capacitance values
- Consistent dimension and finish surface
- Engineered for automatic handling and insertion



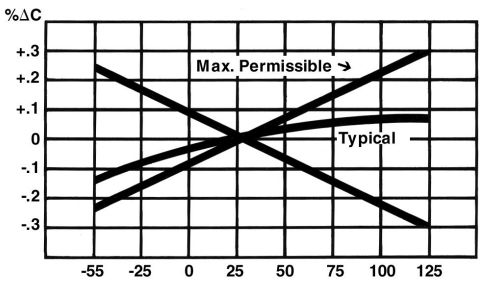
(in mm)

General Specifications

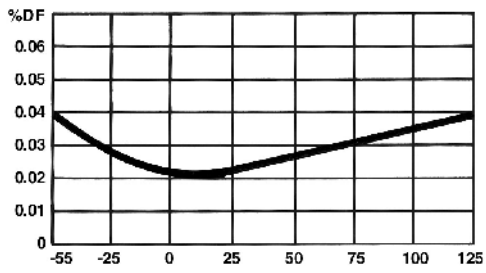
Capacitance Range	0.5pF to 4,700pF
Capacitance Tolerance	± .1pF, ±0.25pF, ±0.5pF, ±2%, ±5%, ±10%
Operating Temperature Range	-55°C ~+125°C
Temperature Coefficient (C Max.)	0±30 ppm
Rated Voltage	25, 50, 100VDC
Dissipation Factor (tan)	0.1% Max, 0.04% typical
Insulation Resistance (IR), @25 @125	Lesser of 100G or 1000M μF Lesser of 1G or 10M μF
Aging Rate	0% per Decade hour
Dielectric Strength	2.5 times the rated WVDC
Testing Parameters	For Values ≤ 1000pF MHz@1.0±0.2Vrms For Values > 1000pF KHz@ 1.0±0.2Vrms

NPO Dielectric

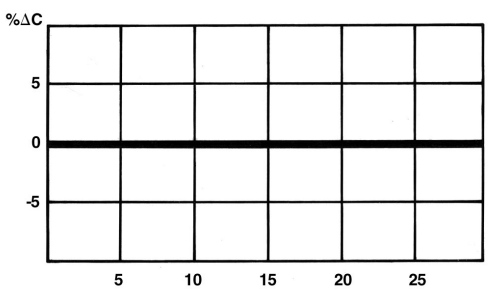
Typical Characteristic Curves



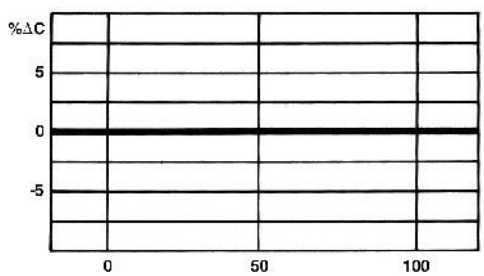
Temperature Coefficient



D.F. vs. Temperature



Capacitance vs. AC Testing Voltage

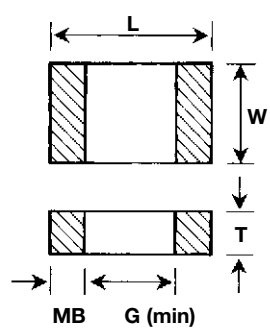


Capacitance vs. DC-Bias Voltage

Capacitance Chart (NPO)

Case Size	Rated Voltage	Temp. Chart	Capacitance		Dimension (mm)				
			Range	Tolerance	L	W	T(max)	MB(min)	G(min)
0402	1H=50V 1E=25V	0±30 PPM	1pF~220pF 270pF~330pF	J,K	1.0±0.05	0.5±0.05	0.5±0.05	0.10	0.30
0603	1H=50V/2A=100V 1H=50V/2A=100V		.5pF~9.9pF	C,D	1.6±0.10	0.8±0.10	0.8±0.10	0.20	0.30
			10pF~680pF	J, K					
0805	1H=50V/2A=100V 1H=50V/2A=100V		.5pF~9.9pF	C,D	2.0±0.20	1.2+0.2-0.15	1.4	0.25	0.70
			10pF~1800pF	J, K					
1206	1H=50V/2A=100V 1H=50V 2A-100V		.5pF~9.9pF	C,D	3.2±0.20	1.6±0.20	1.52	0.25	1.40
			10pF~4700pF	G,J,K					
			10pF~3300pF	J					

* Additional capacitances and voltages available upon request.
* For 0201 specifications, please consult factory.



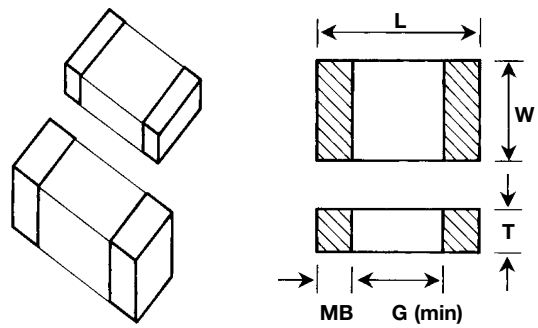
X7R Dielectric

Introduction:

The X7R has a moderate K value and is temperature stable. It shows moderate change in electrical properties under changing temperature, voltage and frequency. It's suitable for by-passing, coupling, and frequency discrimination circuits applications.

Features:

- Stable electrical characteristics
- Small size with high capacitance values
- Consistent dimension and finish surface
- Engineered for automatic handling and insertion



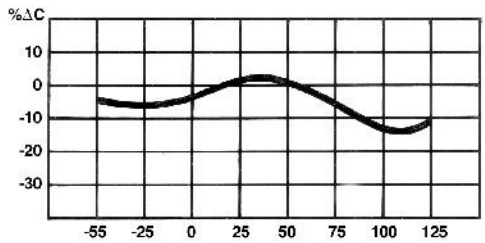
(in mm)

General Specifications

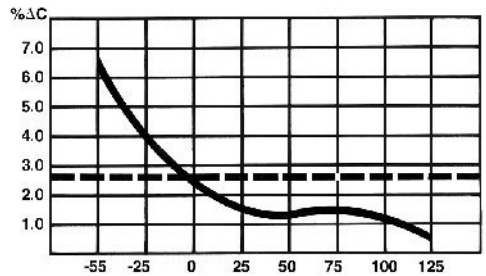
Capacitance Range	180pF to .1μF
Capacitance Tolerance	±5%, ±10%, ±20%
Operating Temperature Range	-55°C ~+125°C
Temperature Coefficient (C Max.)	±15% ppm
Voltage Rating	16, 25, 50, 100 VDC
Dissipation Factor (tan)	2.5% Max, 1.6% typical (16V, 3.5%, Max.)
Insulation Resistance (IR), @25 @125	Lesser of 10G or 1000M μF Lesser of 1G or 10M μF
Aging Rate	-1.5% per Decade hour
Dielectric Strength	2.5 times the rated WVDC
Testing Parameters	1KHz±50Hz, 1.0Vrms±0.2Vrms @25, 0 Volts Bias

X7R Dielectric

Typical Characteristic Curves

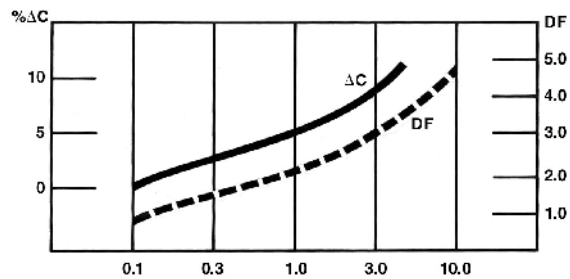


Temperature Coefficient



D.F. vs. Temperature

D.C. Voltage - Coefficient
VDC/MIL Dielectric

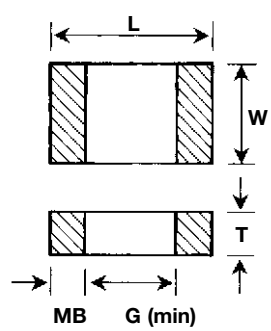


A.C. Voltage - Coefficient
Testing Voltage - VRMS/MIL Dielectric

Capacitance Chart (X7R)

Case Size	Rated Voltage	Temp. Chart	Capacitance		Dimension (mm)				
			Range	Tolerance	L	W	T(max)	MB(min)	G(min)
0402	1H=50V 1E=25V 1C=16V	±15%	220pF~2200pF	K,M	1.0±0.05	0.5±0.05	0.5±0.05	0.10	0.30
			3300pF						
			3900pF~.033μF						
0603	2A=100V 1H=50V 1C=16V		180pF~.01μF	K	1.6±0.10	0.8±0.10	0.8±0.10	0.20	0.30
			180pF~.022μF	J,K,M					
			.047μF~.1μF	K,M					
0805	2A=100V 1H=50V		180pF~.022μF	K	2.0±0.20	1.2 $^{+0.2}_{-0.15}$	1.4	0.25	0.70
			180pf~.1μF	J,K,M					
1206	2A=100V 1H=50V		470pF~.1μF	K	3.2±0.20	1.6±0.20	1.52	0.25	1.40
			470pF~.1μF	J,K,M					

* Additional capacitances and voltages available upon request.
* For 0201 specifications, please consult factory.



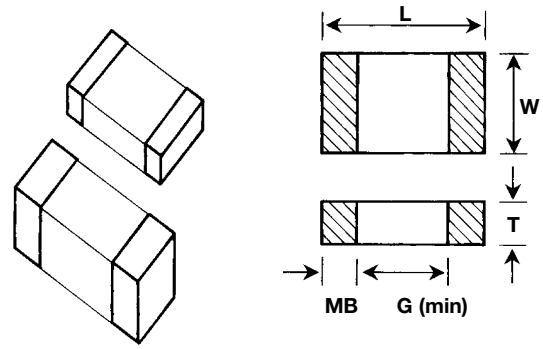
Z5U Dielectric

Introduction:

The Z5U has a moderate K value and is temperature stable. It shows moderate change in electrical properties under changing temperature, voltage and frequency. It's suitable for by-passing, coupling, and frequency discrimination circuits applications.

Features:

- Stable electrical characteristics
- Small size with high capacitance values
- Consistent dimension and finish surface
- Engineered for automatic handling and insertion



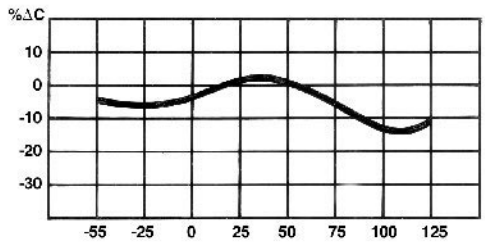
(in mm)

General Specifications

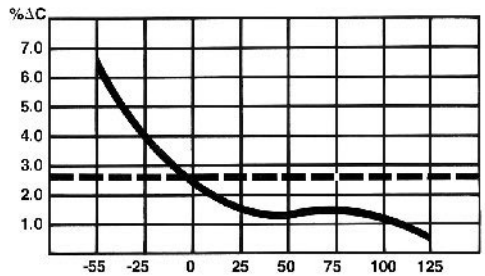
Capacitance Range	.01μF to 1.0μF
Capacitance Tolerance	±20%, +80 - 20%
Operating Temperature Range	+10°C～+85°C
Temperature Coefficient (C Max.)	+22%～-56%
Voltage Rating	16, 25, 50 VDC
Dissipation Factor (tan)	4% Max.
Insulation Resistance (IR), @25	Lesser of 10G or 1000M μF
Aging Rate	-7% per Decade hour
Dielectric Strength	250% of rated voltage for 5 sec. at 50m amp max.
Testing Parameters	1KHz±50Hz, 1.0Vrms±0.2Vrms @25, 0 Volts Bias

Z5U Dielectric

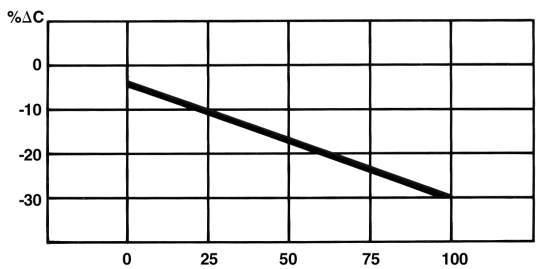
Typical Characteristic Curves



Temperature Coefficient

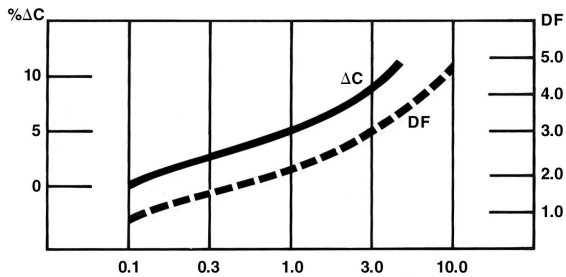


D.F. vs. Temperature



D.C. Voltage - Coefficient

VDC/MIL Dielectric



A.C. Voltage - Coefficient

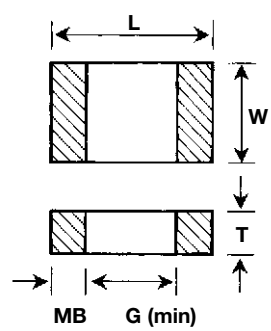
Testing Voltage - VRMS/MIL Dielectric

Capacitance Chart (Z5U)

Case Size	Rated Voltage	Temp. Chart	Capacitance		Dimension (mm)				
			Range	Tolerance	L	W	T(max)	MB(min)	G(min)
0402	1H=50V 1E=25V 1C=16V	+22% -56%	.01μF~.015μF	M,Z	1.0±0.05	0.5±0.05	0.5±0.05	0.10	0.30
			.018μF~.022μF						
			.027μF~.1μF						
0603	1H=50V 1C=16V		.01μF~.15μF	M,Z	1.6±0.10	0.8±0.10	0.8±0.10	0.20	0.30
			.22μF	Z					
0805	1H=50V 1E=25V 1C=16V		.01μF~.33μF	M,Z	2.0±0.20	1.2 $^{+0.2}_{-0.15}$	1.4	0.25	0.70
			.47μF						
			1.0μF						
1206	1H=50V 1E=25V		.01μF~.47μF	M,Z	3.2±0.20	1.6±0.20	1.52	0.25	1.40
			1.0μF						

* Additional capacitances and voltages available upon request.

* For 0201 specifications, please consult factory.



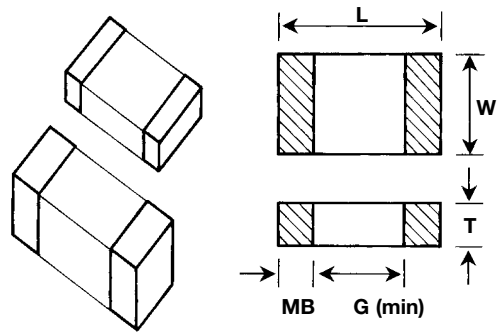
Y5V Dielectric

Introduction:

The Y5V has a high K value. Its electrical properties vary considerably under changing voltage, temperature and time. It's suitable for all general purpose applications where high capacitance values are required. and are ideal for room temperature applications with low DC bias.

Features:

- Small size with high capacitance values
- Consistent dimension and finish surface
- Engineered for automatic handling and insertion



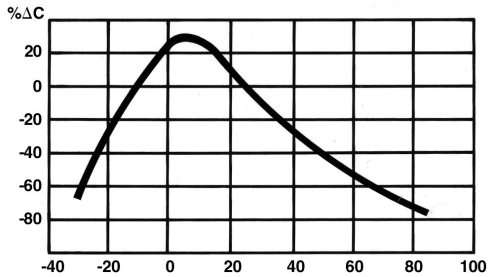
(in mm)

General Specifications

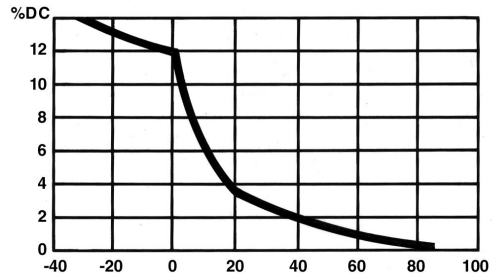
Capacitance Range	.01μF to 1.0μF
Capacitance Tolerance	±20%, +80 - 20%
Operating Temperature Range	-30°C~+85°C
Temperature Coefficient (C Max.)	+22%~-82%
Voltage Rating	16, 25, 50 VDC
Dissipation Factor (tan)	7% Max. (12.5% Max. for 10V)
Insulation Resistance (IR), @25	Lesser of 10G or 1000M μF
Aging Rate	-7% per Decade hour
Dielectric Strength	2.5 times the rated WVDC
Testing Parameters	1KHz±50Hz, 1.0Vrms±0.2Vrms @25, 0 Volts Bias

Y5V Dielectric

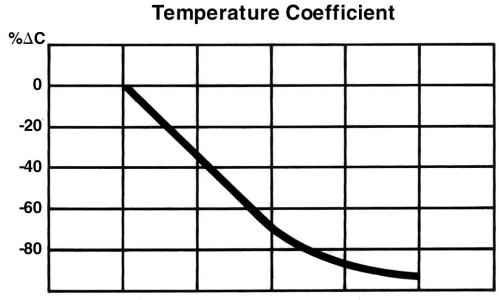
Typical Characteristic Curves



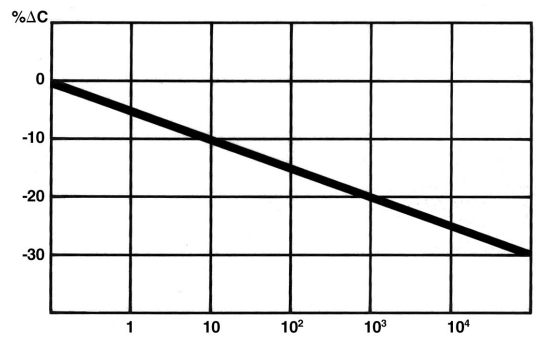
Temperature Coefficient



D.F. vs. Temperature



D.C. Voltage Coefficient

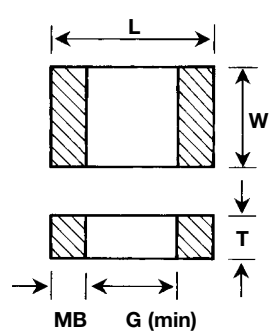


Capacitance vs. Decade Hours

Capacitance Chart (Y5V)

Case Size	Rated Voltage	Temp. Chart	Capacitance		Dimension (mm)				
			Range	Tolerance	L	W	T(max)	MB(min)	G(min)
0402	1H=50V 1E=25V 1C=16V	+22% -82%	.01μF~.015μF	M,Z	1.0±0.05	0.5±0.05	0.5±0.05	0.10	0.30
			.018μF~.022μF						
			.027μF~.1μF						
0603	1H=50V 1C=16V		.01μF~.15μF	M,Z	1.6±0.10	0.8±0.10	0.8±0.10	0.20	0.30
			.22μF	Z					
0805	1H=50V 1E=25V 1C=16V		.01μF~.33μF	M,Z	2.0±0.20	1.2 $^{+0.2}_{-0.15}$	1.4	0.25	0.70
			.47μF						
			1.0μF						
1206	1H=50V 1E=25V		.01μF~.47μF	M,Z	3.2±0.20	1.6±0.20	1.52	0.25	1.40
			1.0μF						

* Additional capacitances and voltages available upon request.
* For 0201 specifications, please consult factory.



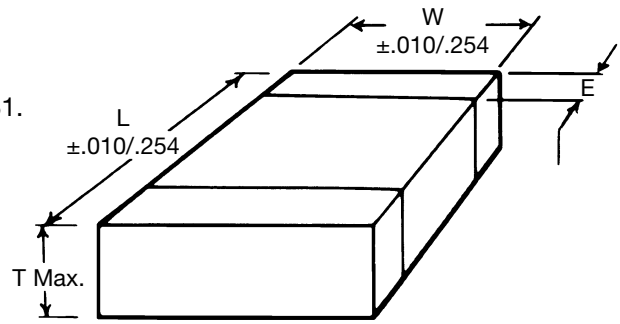
Ceramic Chip Capacitors

High Voltage
General Specifications
NPO (COG) and X7R, Temperature Coefficients
500 to 5,000 Volts

Tape and Reel Quantities
All tape and reel specifications are in compliance with RS481.

Sizes	Standard Electrodes	
	1206, 1210, 1808	1812, 1825, 2225
Embossed Carrier	8mm	12mm
Pieces/7" Reel	3000-5000(1)	1000-1500
Pieces/13" Reel	10,000	4,000-10,000

Dimensions: Inches / Millimeters



Size And Capacitance Specifications

Dimensions: Inches (Millimeters)

EIA:	1206	1210	1808	1812	1825	2225
Length (L)	.125 (3.18)	.125 (3.18)	.180 (4.57)	.175 (4.45)	.180 (4.57)	.225 (5.72)
Width (W)	.062 (1.58)	.095 (2.41)	.080 (2.03)	.125 (3.18)	.250 (6.35)	.250 (6.35)
Thickness Max. (T)	.050 (1.27)	.065 (1.65)	.065 (1.65)	.065 (1.65)	.062 (1.57)	.065 (1.65)
Endband Min. (E)	.020 (.508)	.020 (.508)	.020 (.508)	.020 (.508)	.020 (.508)	.020 (.508)

Max. Capacitance (EIA)							
	Case	1206	1210	1808	1812	1825	2225
NPO	500v	102	222	332	472	103	183
	1000v	471	102	152	222	562	822
	2000v	680	181	221	331	102	122
	3000v	–	–	121	221	471	102
	4000v	–	–	470	101	271	471
	5000v	–	–	–	–	101	181
X7R	500v	223	473	683	124	224	394
	1000v	472	153	183	273	473	104
	2000v	471	152	182	332	562	103
	3000v	–	–	102	182	222	392
	4000v	–	–	471	681	821	152
	5000v	–	–	–	–	391	681

Tol.	±0.1pf	±.25pf	±.50pf	±1.0%	±2.0%	±5%	±10%	±20%	-0+100%	20%–+80%
Code	B	C	D	F	G	J	K	M	P (GMV)	Z

Part Numbering System

S	1206	N	101	J	3A	R	N	_	P47
Chip Cap.	Size: 0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2225	T.C.: N=NPO, W=X7R	Capacitance Code: Two significant digits + No. of zeros. Example: 10PF = 100, 100PF = 101, 1,000PF = 102, 22,000PF = 223, 100,000PF = 104	Tolerance: J = ± 5%, K = ± 10%, M = ± 20%, Z = + 80 - 20%	Voltage: 2H = 500V, 3A = 1000V, 3D = 2000V, 3F = 3000V, 3G = 4000V, 3H = 5000V	Packaging: B Bulk, R Tape & Reel	Termination: N = Ni-Barrier, P = Pd-Ag, S = Silver		Packaging Code: See Page B4

High Voltage

NPO ceramics, Class 1, offer one of the most stable capacitor dielectrics available. Typical capacitance change with life is less than ±0.1% for NPO's, one-fifth that shown by most other dielectrics.

The NPO formulation usually has Qs (Quality Factor) in excess of 1000 and shows little capacitance or Q changes with frequency.

The inherent stability of these devices makes them ideally suited for use in precision applications such as oscillator, filtering, and timing circuits.

Temperature Coefficient: 0±30ppm/°C from -55°C to +125°C

Dissipation Factor: ≤0.1%@25°C/1KHz

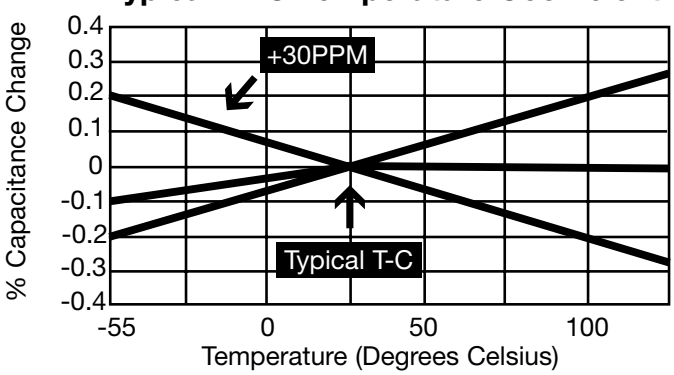
Insulation Resistance: 100,000MΩ min. or 1000ΩxF whichever is less @WVDC, 25°C
10,000MΩ min. or 100ΩxF whichever is less @WVDC, 125°C

Dielectric Strength: >1.2 times WVDC, 50 mA Max.

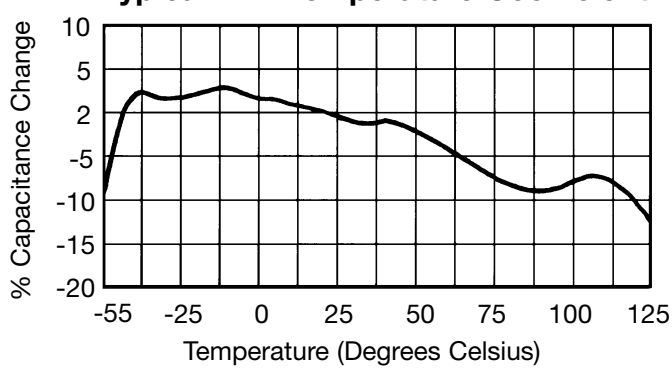
Testing Conditions: 1MHz ±50KHz@1.0±.20Vrms@25°C for values ≤1000pF
1KHz ±50Hz@1.0±.20Vrms@25°C for values >1000pF

Capacitance Tolerance: Values<10pF: B(±0.1pF), C(±0.25pF) and D(±0.50pF)
Values≥10pF: F(±1%), J(±5%) and K(±10%)

Typical NPO Temperature Coefficient



Typical X7R Temperature Coefficient



X7R ceramics, Class II, are the most temperature-stable ceramics in their class. Capacitance for X7R varies under the influence of electrical operating conditions such as voltage and frequency. It also varies with time, approximately 2.5% ΔC per decade hour, representing about 12.5% change in ten years.

These devices are suited for bypass and de-coupling applications, filtering, frequency discrimination, DC blocking, and voltage suppression.

Temperature Coefficient: ±15%Δ°C Max. from -55°C to+125°C

Dissipation Factor: ≤2.5%@1KHz,1.0 Vrms, 25°C

Insulation Resistance: 100,000MΩ min. or 1000ΩxF whichever is less @WVDC, 25°C
10,000MΩ min. or 100ΩxF whichever is less @WVDC, 125°C

Dielectric Strength: >1.2 times WVDC, 50 mA Max.

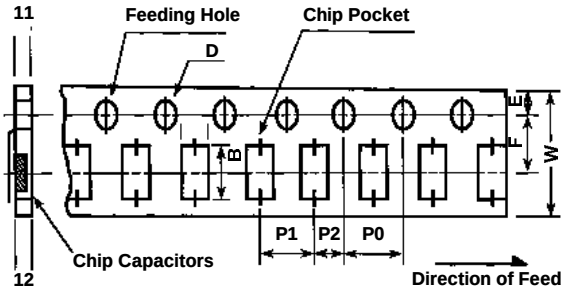
Testing Conditions: 1KHz ±50KHz@1.0±.20 Vrms @25°C

Capacitance Tolerance: J(±5%), K(±10%), and M(±20%)

Termination	– Nickel Barrier, Palladium Silver
Packaging	– Embossed Plastic Tape 8mm (1206 and 1210)
	12mm (1808, 1812, 1825 and 2225)
	– Bulk
Application	– For High Voltage Capacitors Above 1000 Volts, A Surface Coating May Be Required After Assembly To Prevent External Arcing.

Packaging & Dimensions

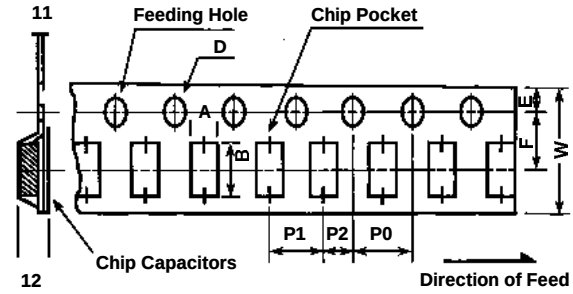
1. Cardboard Tape Dimensions



Cardboard Tape

Symbol / Size Code	A	B	W	F	E	P1	P2	P0	D	t1	t2
0402	0.65	1.15	8.0 ±0.3	3.5 ±0.06	1.75 ±0.1	2.0 ±0.05	0.00 ±0.05	4.0 ±0.1	1.5 +0.1/-0	1.1max	
0603	1.05 ±0.1	1.85 ±0.1	8.0 ±0.2	3.5 ±0.05	1.75 ±0.1	4.0 ±0.1	2.0 ±0.05	4.0 ±0.1	1.5 +0.1/-0	1.1max	
0805	1.55 ±0.15	2.3 ±0.15								1.1 max	1.4 max
1206	2.0 ±0.2	3.6 ±0.2									

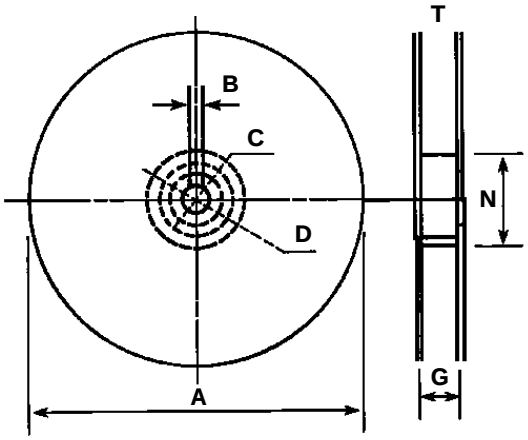
2. Embossed Tape Dimensions



Unit: mm

Embossed Tape

Symbol / Size Code	A	B	W	F	E	P1	P2	P0	D	t1	t2
0805	1.6 ±0.2	2.4 ±0.2	8.0	3.5	1.75	4.0	2.0	4.0	1.5 +0.1	0.4 max	2.5 max
1206	2.0 ±0.2	3.6 ±0.2									



Unit mm

Symbol	A	N	C	D	B	G	T
Dimension	178±2.0	50	13.0±0.5	21±0.8	2.0±0.5	10.0±1.5	12±2.0

Quantity Per Reel

Chip Size	Tape	D
0402	8mm	10,000 pcs.
0603		3,000/4,000 pcs
0805		
1206		3,000/4000 pcs.

Quantity per reel may vary due to voltage/ capacitance.

* Chip sizes available on different reel quantity.
* For larger case size tape & reel specifications, please consult factory.

Application & Handling Note

Storage:
Taped packaging of our MLCC Chip Capacitor is designed to endure long term storage under controlled environments. The product will degrade faster in the presence of high temperature and high humidity. It's recommended that the taped packaging MLCC Chip Capacitor be stored at ambient temperature of less than 40°C with a RH of less than 70% at all time. Also, the presence of corrosive gases such as sulfur and Chlorine might effect the termination's solderability, thus the MLCC Chip Capacitor should also be kept away from these gases.

Solder Land Design:
It's recommended that the solder land shape and size should be properly designed and taken into consideration during the PCB design process to ensure not to over stress the MLCC Chip capacitor during soldering because it might cause cracks on the chip body.

Adhesive:
Strong, good insulator, fast hardening, and non-toxic adhesive is recommended to avoid the MLCC Chip from falling during the soldering process, or resulting in improper electrical functioning and mechanical failures.

Mounting:
Excess Mounting force can easily cause the MLCC Chip Capacitor to crack, which will result in electrical and mechanical failures in many instances .

Soldering:
The MLCC Chip Capacitor comes into direct contact with melted solder paste during the soldering process, thus it can easily be exposed to high stress caused by sudden change in temperature. It might also be subjected to silver migration and contaminated flux, therefore, soldering technique is very important or critical to the MLCC chip capacitor.

Manual Soldering:
A Micro Crack can be easily formed on the MLCC Chip Capacitor body due to thermal shock, if the hot tip of the soldering iron comes into direct contact with the ceramic body of the chip capacitor. Therefore, proper use of the soldering iron tip, and temperature control, by an experienced operator is recommended when manual soldering is utilized.

Cooling:
After Soldering, natural air cooling is recommended. If solvent is used for assisted cooling, then the temperature difference should not exceed more than 100°C.

Cleaning:
Some modern fluxes will form residues after soldering process, thus it's necessary to use appropriate solvent for cleaning. Reflowed assemblies are easier to clean than wave soldered assemblies since the whole board is required to be fluxed and exposed to higher temperatures.

Note for separating multiple PCB:
Extra care should be taken during separation of multiple PCB to avoid damage to the MLCC Chip capacitor on board.