

Selection Guide

Main Characteristic	Model	Size range	Dielectric	Voltage range	Capacitance range	Temperature range	Coating					Leads				Mounting		Main Applications	Page
							Uncoated	Varnished	Conformal coated	Molded	Self protected	DIL	Ribbon	Axial	Radial	SMD	Through hole		
HIGH CAPACITANCE	R SERIES (CHIPS) High Capacitance Chips Capacitors 	2225 to 45107	X7R	50V to 500V	47nF to 27µF	-55°C to +125°C	•									•		Switch Mode Power Supply, filtering, smoothing, decoupling. • aerospace • space • defence	79
	R SERIES (LEADED) Radial Leaded Conformal Coated Capacitors 	-	X7R	50V to 500V	47nF to 27µF	-55°C to +125°C		•							•		•		83
	TEF SERIES Radial Leaded Conformal Coated Capacitors 	-	NPO	63V to 500V	10nF to 680nF	-55°C to +125°C			•						•		•		86
	SV / SC SERIES High Capacitance Stacked Capacitors 	2225 to 125205	X7R	50V to 500V	47nF to 390µF	-55°C to +125°C	•	•				•	•			•	•		87
	CNC3X SERIES High Capacitance Stacked Capacitors 	2220 to 4040	X7R	16V to 25V	1.2µF to 68µF	-55°C to +125°C	•	•				•				•	•		94
	CEC5X SERIES High Capacitance Stacked Capacitors 	3033 to 80150	NPO	63V to 500V	10nF to 6.8µF	-55°C to +125°C	•	•				•				•	•		96
	TEP / TEV SERIES High Capacitance Stacked Capacitors 	-	NPO	63V to 500V	10nF to 6.8µF	-55°C to +125°C		•							•		•		99
HIGH TEMPERATURE	TCN8X SERIES High Capacitance Molded Stacked Capacitors 	-	X7R	63V to 500V	0.47µF to 120µF	-55°C to +125°C				•					•		•	Oil drilling, motor control, braking systems.	101
	CE / CN SERIES High Temperature Chips Capacitors 	0402 to 3040	NPO X7R	16V to 100V	1pF to 8.2µF	-55°C to +250°C	•									•			106
	SCT SERIES High Temperature Stacked Capacitors 	2225 to 125205	X7R	50V to 500V	47nF to 390µF	-55°C to +215°C	•	•				•				•	•		108
	TCE / TCN MOLDED SERIES HT High Temperature Molded Capacitors 	-	NPO X7R	16V to 100V	1pF to 10µF	-55°C to +220°C				•				•	•		•		113
	TCE / TCN SELF-PROTECTED SERIES High Temperature Self-Protected Capacitors 	-	NPO X7R	25V to 500V	10pF to 3.9µF	-55°C to +250°C					•			•	•		•		115
FEED-THRU	TCH SERIES High Temperature High Voltage Capacitors 	-	NPO X7R	200V to 10kV	10pF to 15µF	-55°C to +250°C	•								•		•	Very low ESL	117
	TBC SERIES Discoidal Capacitors 	-	NPO X7R	25V to 1kV	10pF to 12µF	-55°C to +125°C	•									•			121
	BPM SERIES Planar Array 	-	X7R	25V to 200V	330pF to 68nF	-55°C to +125°C	•									•		Very low ESL, miniaturisation	123

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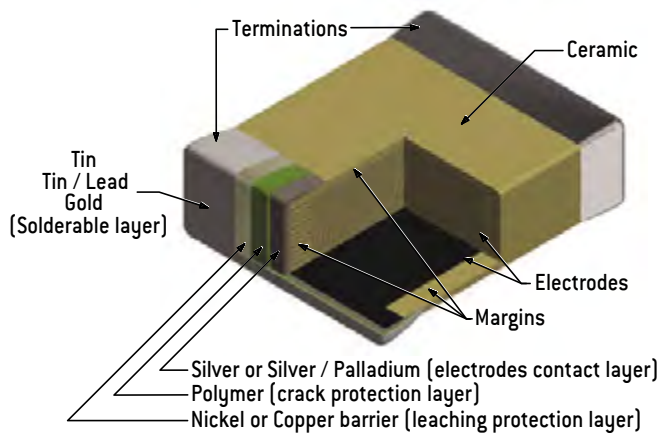
Main Characteristic	Model	Size range	Dielectric	Voltage range	Capacitance range	Temperature range	Coating					Leads				Mounting		Main Applications	Page
							Uncoated	Varnished	Conformal coated	Molded	Self protected	DIL	Ribbon	Axial	Radial	SMD	Through hole		
HIGH Q	XBL SERIES Broadband 	0402	X7R	16V	100nF	-55°C to +125°C	•									•		DC Blocking, Coupling, Bypassing	144
	UBL SERIES Broadband 	0402	X7R	16V	100nF	-55°C to +125°C	•									•			146
	UBZ SERIES Broadband 	0201	X5R X6T	10V	100nF	-55°C to +105°C	•									•			148
	CH SERIES Classic HiQ 	0505 1111	P100	50V to 1.5kV	0.1pF to 1nF	-55°C to +175°C	•						•		•	•		Cellular base station amplifier, MRI.	150
	SH SERIES Super HiQ 	0402 to 1210	NPO	25V to 1.5kV	0.2pF to 1nF	-55°C to +150°C	•						•		•	•		Cellular base station equipment Broadband Point to point/ multi-point radios RF generators	153
	SHD / SHR SERIES Reverse Geometry 	0709 0711	NPO	500V	0.5pF to 100pF	-55°C to +175°C	•									•			156
	NHB SERIES High Self Resonant Frequency 	1111	NPO	500V	0.3pF to 100pF	-55°C to +175°C	•									•			158
	CP SERIES High Power 	2225 4040	P100	200V to 7kV	1pF to 10nF	-55°C to +125°C	•		•				•	•	•	•	•	RF power amplifier Plasma chamber MRI coils	160
	CL SERIES High Power 	2225 to 7065	NPO	200V to 7kV	1pF to 10nF	-55°C to +125°C	•		•				•	•	•	•	•	RF power amplifier Plasma chamber MRI coils	164

ADDITIONAL AVAILABLE RANGES (consult our website)

STANDARD	TCE1X Series 	-	NPO	63V to 100V	0.5pF to 10nF	-55°C to +125°C				•						•		Precision, stability, decoupling	-
	TCN19 Series 	-	2C1	63V to 250V	10pF to 1μF	-55°C to +125°C				•						•		Decoupling	-
	TCN3X Series 	-	2C1	50V to 100V	100pF to 1.8μF	-55°C to +125°C				•						•			-
	LA6 Series 	-	2C1	25V to 63V	100pF to 1μF	-55°C to +125°C				•						•			-
HIGH VOLT.	H Series 	0805 to 6560	NPO X7R	1kV to 10kV	2pF to 390nF	-55°C to +125°C	•		•							•	•	Power supply, voltage multiplier, radars.	-
HIGH CAPACITANCE	CNC5X Series 	3033 to 80150	X7R	63V to 500V	0.1μF to 180μF	-55°C to +125°C	•	•				•				•	•	Switch Mode Power Supply, filtering, smoothing, decoupling. • aerospace • space • defence	-
	CNC8X Series (chips) 	3033 to 33110	X7R	63V to 400V	47nF to 27μF	-55°C to +125°C	•									•			-
	CNC8X Series (DIL) 	3333 to 80150	X7R	63V to 400V	47nF to 180μF	-55°C to +125°C	•	•				•				•	•		-
	TCP / TCV8X Series 	3333 to 80150	X7R	63V to 400V	47nF to 180μF	-55°C to +125°C		•							•		•		-
	TCP / TCV5X Series 	3033 to 80150	X7R	63V to 500V	0.1μF to 180μF	-55°C to +125°C		•							•		•		-
	TCF Series 	-	X7R	63V to 500V	0.1μF to 18μF	-55°C to +125°C			•							•	•		-
HIGH TEMP.	CNC25X Series 	3033 to 5550	X7R	50V	1μF to 33μF	-55°C to +200°C	•	•				•				•	•	Oil drilling, motor control, braking systems.	-
HIGH Q	CNW Series 	-	X7R	100V to 300V	10nF to 1μF	-55°C to +125°C	•						•	•		•	•	Power amplifier	-
	SPT519 / CAW CEW Series 	-	NPO	100V to 300V	10nF to 1μF	-55°C to +125°C	•	•					•	•		•	•		-

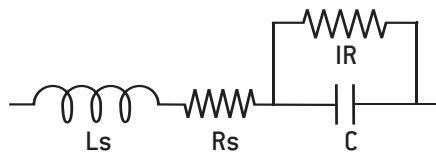
Ceramic Capacitors Technology

MLCC STRUCTURE



EQUIVALENT CIRCUIT

Capacitor is a complex component combining resistive, inductive and capacitive phenomena. A simplified schematic for the equivalent circuit is:



DIELECTRIC CHARACTERISTICS

Insulation Resistance (IR) is the resistance measured under DC voltage across the terminals of the capacitor and consists principally of the parallel resistance shown in the equivalent circuit. As capacitance values and hence the area of dielectric increases, the IR decreases and hence the product $[C \times IR]$ is often specified in $\Omega \cdot F$ or $M\Omega \cdot \mu F$.

The Equivalent Series Resistance (ESR) is the sum of the resistive terms which generate heating when capacitor is used under AC voltage at a given frequency $[f]$.

Dissipation factor (DF) is the ration of the apparent power input will turn to heat in the capacitor:

$$DF = 2\pi f C ESR$$

When a capacitor works under AC voltage, **heat power loss (P)**, expressed in Watt, is equal to:

$$P = 2\pi f C V_{rms}^2 DF$$

The series inductance (Ls) is due to the currents running through the electrodes. It can distort the operation of the capacitor at high frequency where the **impedance (Z)** is given as:

$$Z = R_s + j [L_s \omega - 1/(C \omega)] \text{ with } \omega = 2\pi f$$

When frequency rises, the capacitive component of capacitors is gradually canceled up to the resonance frequency, where :

$$Z = R_s \text{ and } L_s C \omega^2 = 1$$

Above this frequency the capacitor behaves like an inductor.

	P100	NPO	N2200 (C4xx)	BX	2C1	X7R
Dielectric material	Porcelain	Magnesium titanate or Neodymium baryum titanate	Barium zirconate titanate	Baryum titanate (BaTiO ₃)		
Dielectric constant	15 – 18	20 – 85	450	2,000 – 5,000		
Electrode technology	PME (Precious Metal Electrodes): Ag/Pd					
Capacitance variation between –55°C and +125/°C without DC voltage	{100±30}ppm/°C	{0±30}ppm/°C	{–2,200±500}ppm/°C	±15%	±20%	±15%
Capacitance variation between –55°C and +125/°C with DC rated voltage			0 -15%	15% –25%	20% –30%	Not applicable
Piezo-electric effect	None		None	Yes		
Dielectric absorption	None		Few %	Few %		
Thermal shock sensitive	+		+	++		

Ceramic Capacitors Technology

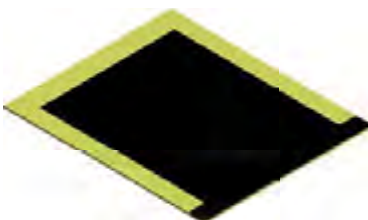
MANUFACTURING STEPS

SLIP CASTING



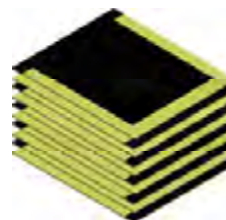
A slurry, a mix of ceramic powder, binder and solvents, is poured onto conveyor belt inside a drying oven, resulting in a dry ceramic sheet.

ELECTRODE SCREEN PRINTING



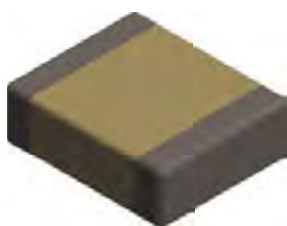
The electrode ink, made from a metal powder mixed with solvents, is printed onto the ceramic sheets using a screen printing process.

STACKING



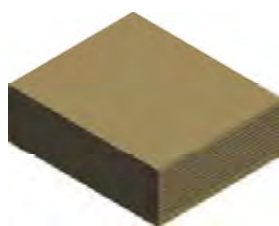
The sheets with electrode printed are stacked to create a multilayer structure.

TERMINATIONS



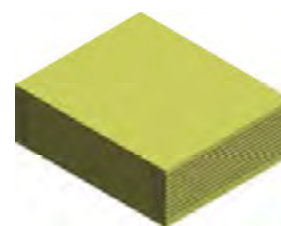
Each terminal of the capacitor is dipped in the termination ink, mix of metal powder, solvents and glass frit and the parts are fired in an oven.

SINTERING



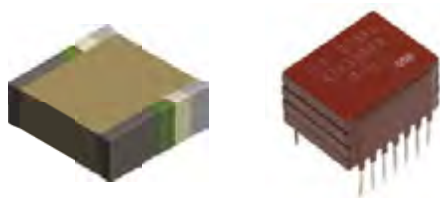
The parts are sintered in an oven with a precise temperature profile which is very important to the characteristics of the capacitors.

PRESSING



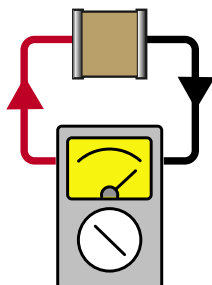
Pressure is applied to the stack to fuse all the separate layers, this created a monolithic structure.

TERMINATIONS PLATING



Stacking + leads soldering + encapsulation
[see pages 10-11]

FINAL TESTING



PACKAGING



User Guide

SMD TERMINATIONS

NON RoHS COMPLIANT	Code	RoHS COMPLIANT	Code	Recommended mounting process							Storage (months)*
Magnetic	Epoxy bonding	Iron soldering	Wave soldering	Vapor phase soldering	Infrared soldering	Wire bonding					
Ag	Q	Ag	QW / P	No	●	●	●	●			18
Ag/Pd/Pt	-	Ag/Pd/Pt	W / A	No	●	●	●				24
Ag/Pd/Pt + dipped Sn/Pb 60/40	H	Ag/Pd/Pt + dipped Sn	HW	No		●					24
Ag + Ni + electrolytic Sn/Pb 95/5	C	Ag + Ni + electrolytic Sn	CW / S	Yes		●	●	●	●		18
Ag + Ni + electrolytic Sn/Pb 60/40	D	-	-	Yes		●	●	●	●		18
-	-	Ag + Cu + electrolytic Sn	C**	No		●	●	●	●		18
Ag + Ni + dipped Sn/Pb 60/40	E	-	-	Yes		●	●				24
Ag + Ni + Au	G	Ag + Ni + Au	GW	Yes	●	●	●	●	●	●	36
Ag + Polymer + Ni + Sn/Pb 95/5	YC	Ag + Polymer + Ni + Sn	YCW	Yes		●	●	●	●		18
Ag + Polymer + Ni + Sn/Pb 60/40	YD	-	-	Yes		●	●	●	●		18
Ag + Polymer + Ni + Au	YG	Ag + Polymer + Ni + Au	YGW	Yes	●	●	●	●	●	●	36

Nickel (Ni) or Copper (Cu) barriers amplify thermal shock and are not recommended for chip sizes larger than 3030.

* Storage must be in a dry environment at a temperature of 20°C with a relative humidity below 50%, or preferably in a package enclosing a desiccant.

** Non magnetic chips series only.

SMD ENVIRONMENTAL TESTS

Ceramic chip capacitors for SMD are designed to meet test requirements of **CECC 32100** and **NF C 93133** standards as specified below in compliance with **NF C 20700** and **IEC 68** standards:

- Solderability: **NF C 20758**, 260°C, bath 62/36/2.
- Adherence: 5N force.
- Vibration fatigue test: **NF C 20706**, 20 g, 10 Hz to 2,000 Hz, 12 cycles of 20 minutes each.
- Rapid temperature change: **NF C 20714**, -55°C to + 125°C, 5 cycles.
- Combined climatic test: **IEC 68-2-38**.
- Damp heat: **NF C 20703**, 93 %, H.R., 40°C.
- Endurance test: 1,000 hours, 1.5 U_{RC}, 125°C.

STORAGE OF CHIP CAPACITORS

TINNED OR NON TINNED CHIP CAPACITORS

Storage must be in a dry environment at a temperature of 20°C with a relative humidity below 50 %, or preferably in a packaging enclosing a desiccant.

STORAGE IN INDUSTRIAL ENVIRONMENT:

- 2 years for tin dipped chip capacitors,
- 18 months for tin electroplated chip capacitors,
- 2 years for non tinned chip capacitors,
- 3 years for gold plated chip capacitors.

STORAGE IN CONTROLLED NEUTRAL NITROGEN ENVIRONMENT:

- 4 years for tin dipped or electroplated chip capacitors,
- 4 years for non tinned chip capacitors,
- 5 years for gold plated chip capacitors.

Storage duration should be considered from delivery date and not from batch manufacture date. The tests carried out at final acceptance stage (solderability, susceptibility to solder heat) enable to assess the compatibility to surface mounting of the chips.

User Guide

LEAD STYLES

SURFACE MOUNTING

DIL LEADS

P style



PL style



L style



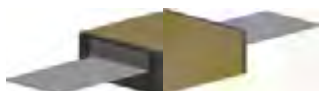
J style



RIBBON LEADS

Micro-strip (type 1)
Short Micro-strip (type 1S)

Axial (Type 2)



Radial (Type 3)



R style



RX style



RJ style



Please contact Exxelia sales for any lead configuration not shown.

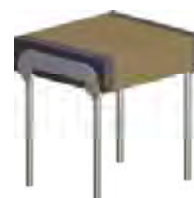
TROUGH-HOLE MOUNTING

AXIAL AND RADIAL

Radial leads (Type 6)



Radial leads (4 leads)



Axial leads (Type 7)



DIL leads: N style



ENCAPSULATION STYLES

Ceramic encapsulation
(selfprotected)

Varnish



Conformal coating

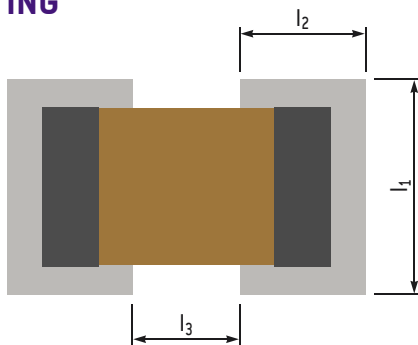


Molding



User Guide

SOLDERING ADVICES FOR REFLOW SOLDERING



Large chips above size 2225 are not recommended to be mounted on epoxy board due to thermal expansion coefficient mismatch between ceramic capacitor and epoxy. Where larger sizes are required, it is recommended to use components with ribbon or other adapted leads so as to absorb thermo-mechanical strains.

Dimensions in inches (in mm)	Reflow soldering						Wave soldering					
	l ₁		l ₂		l ₃		l ₁		l ₂		l ₃	
0402	0.043	(1.1)	0.035	(0.9)	0.012	(0.3)	0.043	(1.1)	0.047	(1.2)	0.012	(0.3)
0403	0.055	(1.4)	0.035	(0.9)	0.012	(0.3)	0.055	(1.4)	0.047	(1.2)	0.012	(0.3)
0504	0.063	(1.6)	0.051	(1.3)	0.016	(0.4)	0.063	(1.6)	0.063	(1.6)	0.016	(0.4)
0603	0.055	(1.4)	0.059	(1.5)	0.02	(0.5)	0.055	(1.4)	0.071	(1.8)	0.02	(0.5)
0805	0.073	(1.85)	0.065	(1.65)	0.024	(0.6)	0.073	(1.85)	0.077	(1.95)	0.024	(0.6)
0907	0.094	(2.4)	0.065	(1.65)	0.035	(0.9)	0.094	(2.4)	0.077	(1.95)	0.035	(0.9)
1005	0.073	(1.85)	0.067	(1.7)	0.039	(1)	0.073	(1.85)	0.079	(2)	0.039	(1)
1206	0.083	(2.1)	0.067	(1.7)	0.059	(1.5)	0.083	(2.1)	0.079	(2)	0.059	(1.5)
1210	0.118	(3)	0.069	(1.75)	0.059	(1.5)	0.118	(3)	0.081	(2.05)	0.059	(1.5)
1605	0.073	(1.85)	0.071	(1.8)	0.087	(2.2)	0.073	(1.85)	0.083	(2.1)	0.087	(2.2)
1806	0.087	(2.2)	0.073	(1.85)	0.102	(2.6)	0.087	(2.2)	0.085	(2.15)	0.102	(2.6)
1812	0.152	(3.85)	0.073	(1.85)	0.102	(2.6)	0.152	(3.85)	0.085	(2.15)	0.102	(2.6)
1825	0.281	(7.15)	0.073	(1.85)	0.102	(2.6)	0.281	(7.15)	0.085	(2.15)	0.102	(2.6)
2210	0.13	(3.3)	0.079	(2)	0.146	(3.7)	0.13	(3.3)	0.091	(2.3)	0.146	(3.7)
2220	0.228	(5.8)	0.079	(2)	0.146	(3.7)	0.228	(5.8)	0.091	(2.3)	0.146	(3.7)
2225	0.281	(7.15)	0.079	(2)	0.146	(3.7)	0.281	(7.15)	0.091	(2.3)	0.146	(3.7)

RECOMMENDED FOOTPRINT FOR SMD CAPACITORS

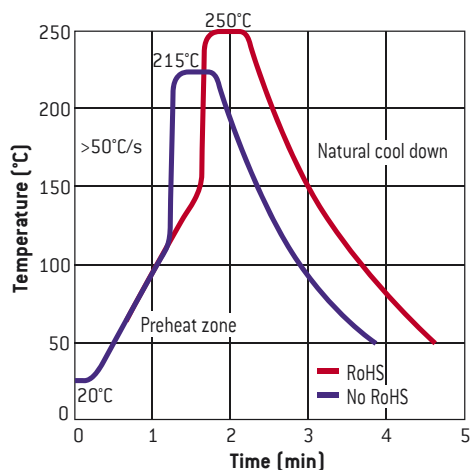
Ceramic is by nature a material which is sensitive both thermally and mechanically. Stresses caused by the physical and thermal properties of the capacitors, substrates and solders are attenuated by the leads.

Wave soldering is unsuitable for sizes larger than 2220 and for the higher ends of capacitance ranges due to possible thermal shock (capacitance values given upon request).

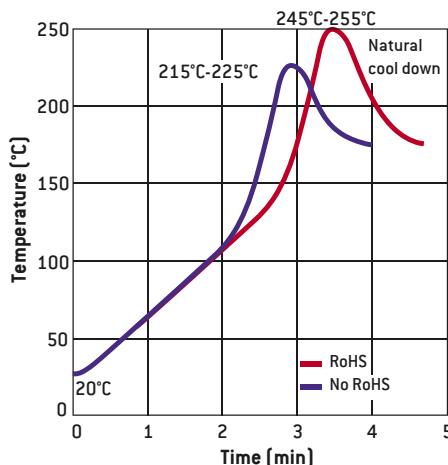
Infrared and vapor phase reflow, are preferred for high reliability applications as inherent thermo-mechanical strains are lower than those inherent to wave soldering.

Whatever the soldering process is, it is highly recommended to apply a thermal cycle, see hereafter our recommended soldering profile:

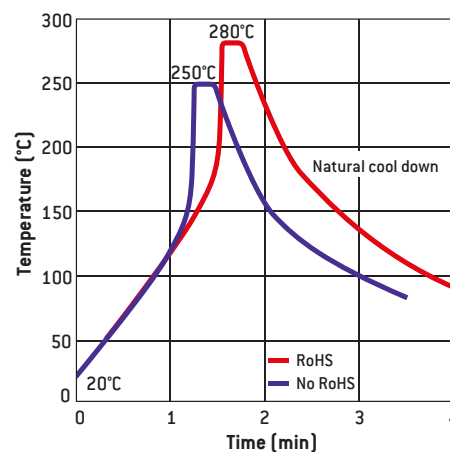
RECOMMENDED VAPOR PHASE REFLOW PROFILE



RECOMMENDED IR REFLOW PROFILE



RECOMMENDED WAVE SOLDERING PROFILE



SOLDERING ADVICES FOR IRON SOLDERING

Attachment with a soldering iron is discouraged due to ceramic brittleness and the process control limitations. In the event that a soldering iron must be used, the following precautions should be observed:

- Use a substrate with chip footprints big enough to allow putting side by side one end of the capacitor and the iron tip without any contact between this tip and the component,
- place the capacitor on this footprint,

- heat the substrate until the capacitor's temperature reaches 150°C minimum (preheating step, maximum 1°C per second),
- place the hot iron tip (a flat tip is preferred) on the footprint **without touching the capacitor**. Use a regulated iron with a 30 watts maximum power. The recommended temperature of the iron is 270 ±10°C. The temperature gap between the capacitor and the iron tip must not exceed 120°C,

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- leave the tip on the footprint for a few seconds in order to increase locally the footprint's temperature,
- use a cored wire solder and put it down on the iron tip. In a preferred way use Sn/Pb/Ag 62/36/2 alloy,
- wait until the solder fillet is formed on the capacitor's termination,
- take away iron and wire solder,
- wait a few minutes so that the substrate and capacitor come back down to

the preheating temperature,

- solder the second termination using the same procedure as the first,
- let the soldered component cool down slowly to avoid any thermal shock.

PACKAGING

TAPE AND REEL

The films used on the reels correspond to standard IEC 60286-3. Films are delivered on reels in compliance with document IEC 286-3 dated 1991.

Minimum quantity is 250 chips.

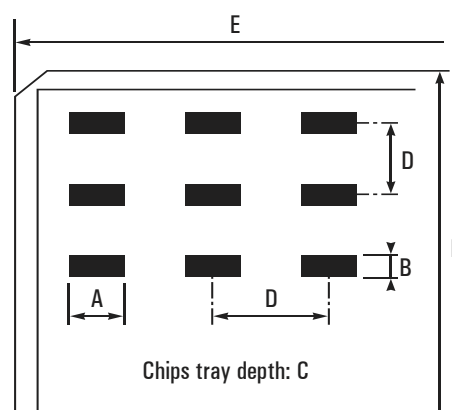
Maximum quantities per reel are as follows:

- Super 8 reel - Ø 180: 2,500 chips.
- Super 8 reel - Ø 330: 10,000 chips.
- Super 12 reel - Ø 180: 1,000 chips.

Reel marking complies with CECC 32100 standard:

- Model.
- Rated capacitance.
- Capacitance tolerance.
- Rated voltage.
- Batch number.

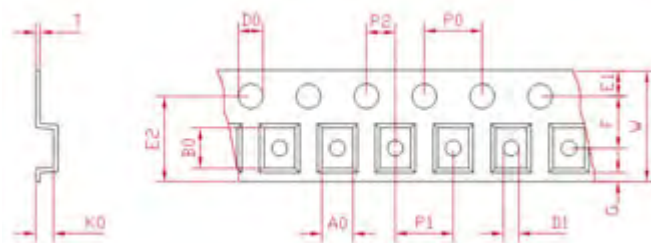
TRAY PACKAGES



DIMENSIONAL CHARACTERISTICS OF CHIPS TRAY PACKAGES

Sizes	Nr. of chips/ package	Oriented chips	Dimensions in inches (in mm)				
			A	B	C	D	E
0402	100	No	0.112 (0.302)		0.065 (1.65)	0.167 (4.24)	2 (50.8)
0403	100	No	0.112 (0.302)		0.065 (1.65)	0.167 (4.24)	2 (50.8)
0504	100	Yes	0.059 (1.5)	0.045 (1.14)	0.035 (0.89)	0.167 (4.24)	2 (50.8)
0603	340	Yes	0.1 (2.54)	0.06 (1.52)	0.045 (1.14)	0.167 (4.24)	2 (50.8)
0805	100	Yes	0.1 (2.54)	0.06 (1.52)	0.045 (1.14)	0.167 (4.24)	2 (50.8)
1206	100	No	0.14 (3.56)	0.14 (3.56)	0.06 (1.52)	0.167 (4.24)	2 (50.8)
1210	100	Yes	0.14 (3.56)	0.14 (3.56)	0.06 (1.52)	0.167 (4.24)	2 (50.8)
1812	100	No	0.25 (6.35)	0.25 (6.35)	0.13 (3.3)	0.345 (8.76)	4 (101.6)
2220	25	Yes	0.24 (6.1)	0.265 (6.73)	0.07 (1.78)	0.345 (8.76)	2 (50.8)
	100	Yes	0.25 (6.35)	0.25 (6.35)	0.13 (3.3)	0.345 (8.76)	4 (101.6)
	25	Yes	0.24 (6.1)	0.265 (6.73)	0.07 (1.78)	0.345 (8.76)	2 (50.8)

HIGH Q CAPACITORS TAPE AND REEL PACKAGING SPECIFICATIONS



Sizes	Type (1)	W±0.3 inches (mm)	F±0.05 inches (mm)	P1±0.1 inches (mm)	T max. inches (mm)	Reel Size inches (mm)	Quantity per Reel
A (0505)	H	0,315 (8)	0,138 (3.5)	0,157 (4)	0,010 (0,25)	7,087 (180)	3'000
A (0505)	V	0,315 (8)	0,138 (3.5)	0,157 (4)	0,010 (0,25)	7,087 (180)	3'000
S (0603)	H	0,315 (8)	0,138 (3.5)	0,157 (4)	0,016 (0,4)	7,087 (180)	4'000
F (0805)	H	0,315 (8)	0,138 (3.5)	0,157 (4)	0,016 (0,4)	7,087 (180)	4'000
B (1111)	H	0,315 (8)	0,138 (3.5)	0,157 (4)	0,012 (0,3)	7,087 (180)	1'000
B (1111)	V	0,315 (8)	0,138 (3.5)	0,157 (4)	0,010 (0,25)	7,087 (180)	1'000
X (2225)	H	0,472 (12)	0,138 (5.5)	0,472 (12)	0,018 (0,45)	12,992 (330)	500
E (4040)	H	0,945 (24)	0,453±0,004 (11.5±0.1)	0,630 (16)	0,018 (0,45)	12,992 (330)	700
E (4040)	V	1,260 (32)	0,559±0,004 (14.2±0.1)	0,945 (24)	0,022 (0,55)	15 (381)	350

(1): Horizontal (H) or Vertical (V) orientation in cavities.

User Guide

EIA STANDARD CAPACITANCE VALUES

Following EIA standard, the values and multiples that are indicated in the chart below can be ordered. E48, E96 series and intermediary values are available upon request.

E6 (± 20%)	E12 (± 10%)	E24 (± 5%)
10	10	10
		11
		12
15	12	13
		15
		16
22	15	18
		20
		22
33	18	24
		27
		30
47	22	33
		36
		39
68	27	43
		47
		51
100	33	56
		62
		68
150	39	75
		82
		91

Voltage (V)	Code	Letter code
25	250	A
40	400	B
50	500	C
63	630	D
100	101	E
200	201	G
250	251	H
400	401	K
500	501	L
1,000	102	M
2,000	202	P
3,000	302	R
4,000	402	S
5,000	502	T
7,500	752	U
10,000	103	W

EIA CAPACITANCE CODE

The capacitance is expressed in three digit codes and in units of pico Farads (pF). The first and second digits are significant figures of the capacitance value and the third digit identifies the multiplier.

For capacitance value < 10pF, R designates a decimal point.
See examples below:

EIA code	Capacitance value		
	in pF	in nF	in µF
2R2	2.2	0.0022	0.0000022
6R8	6.8	0.0068	0.0000068
220	22	0.022	0.000022
470	47	0.047	0.000047
181	180	0.18	0.00018
221	220	0.22	0.00022
102	1,000	1	0.001
272	2,700	2.7	0.0027
123	12,000	12	0.012
683	68,000	68	0.068
124	120,000	120	0.12
564	560,000	560	0.56
335	3,300,000	3,300	3.3
825	8,200,000	8,200	8.2
156	15,000,000	15,000	15
686	68,000,000	68,000	68
107	100,000,000	100,000	100
227	220,000,000	220,000	220

PART MARKING TOLERANCE CODES

Use the following tolerance code chart for part markings:

Tolerance	Letter code
±0.25pF	CU
±0.5pF	DU
±1pF	FU
±1%	F
±2%	G
±5%	J
±10%	K
±20%	M

PART MARKING VOLTAGE CODES

Use the following voltage code chart for part markings:

TCE/TCX/TCN/TXR Conformal Coated Series

Radial Dipped Capacitors



In accordance with the specifications of
CECC 30700 and NF C 83132 standards

FEATURES

- Radial conformal coated capacitors
- NPO, BX, 2C1, X7R dielectrics
- Capacitance range: 1pF to 6.8μF
- RoHS and Non RoHS compliant capacitors available

PHYSICAL CHARACTERISTICS

CONSTRUCTION

Leaded MLCC capacitors for through-hole mounting:
Epoxy molded capacitors

MARKING

Capacitance, tolerance, voltage, dielectric, date code.

ELECTRICAL SPECIFICATIONS

Description	NPO	BX	2C1	X7R
Dielectric code	CE	CX	CN	XR
Operating temperature	−55°C to +125°C			
Climatic category	55 / 125 / 56			
Rated voltage (U _{RC})	25V _{DC} to 500V _{DC}			
Max. ΔC/°C over temperature range without DC voltage applied	NA	±15%	±20%	±15%
Maximum ΔC/°C over temperature range with rated voltage applied	NA	+15% −25%	+20% −30%	NA
Temperature coefficient with or without DC voltage applied	(0±30)ppm/°C	NA	NA	NA
Dielectric withstanding voltage	2.5 U _{RC}			
Capacitance	at 1MHz for C ≤ 1,000pF at 1kHz for C > 1,000pF		at 1MHz for C ≤ 100pF at 1kHz for C > 100pF	
Dissipation factor at 25°C	≤ 0.015 (150/C + 7)% at 1MHz for C ≤ 50pF ≤ 0.15% at 1MHz for 50pF < C ≤ 1,000pF ≤ 0.15% at 1kHz for C > 1,000pF		≤ 2.5% at 1MHz for C ≤ 100pF ≤ 2.5% at 1kHz for C > 100pF	
Insulation resistance at 25°C	≥ 100,000 MΩ for C ≤ 10nF ≥ 1,000 MΩ.μF for C > 10nF			
Aging	None	≤ 2.5% per decade hour		

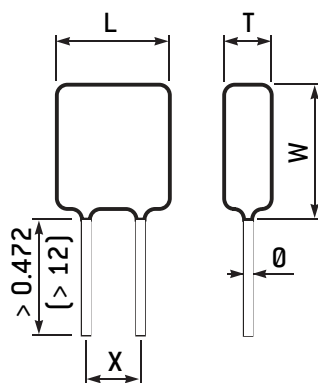
HOW TO ORDER

T	CE	77-1	W	F	2.7nF	10%	50V	B
Series	Dielectric	Size	RoHS compliant	Quality level	Capacitance	Tolerance	Rated voltage	Packaging
T = Radial leaded, conformal coated capacitor	CE = NPO CX = BX CN = 2C1 XR = X7R	77-1 77-5 78-1 78-5 79-5 80-5 76-5	- = No RoHS W = RoHS compliant	- = standard quality level F = Hi-Rel quality: screening in accordance with Exxelia specification	Capacitance value in clear	NPO: cap. value ≤ 12pF ±0.25pF cap. value ≤ 8.2pF ±0.5pF ±1pF cap. value > 22pF ±1% cap. value > 12pF ±2% cap. value > 8.2pF ±5% ±10% cap. value > 3.9pF ±20% Available for BX, 2C1 and X7R: ±5% ±10% ±20%	25V 50V 63V 100V 200V 250V 500V Intermediary and higher voltages available on request.	- = Exxelia packaging Available for quantity ≥ 500: B = reel

Radial Dipped Capacitors

TCE / TCX / TCN / TXR Conformal Coated Series

DIMENSIONS in inches (mm)



STANDARD RATINGS

Size		77-1		77-5		78-1		78-5	
Dimensions inches (mm)	L max.	0.150 (3.8)		0.150 (3.8)		0.197 (5)		0.197 (5)	
	W max.	0.229 (5.8)		0.209 (5.3)		0.276 (7)		0.256 (6.5)	
	T max.	0.099 (2.5)		0.099 (2.5)		0.123 (3.1)		0.123 (3.1)	
	X ± 0.008 (± 0.2)	0.2 (5.08)		0.1 (2.54)		0.2 (5.08)		0.1 (2.54)	
	Ø ± 10%	0.024 (0.6)		0.024 (0.6)		0.024 (0.6)		0.024 (0.6)	
Dielectric		NPO	BX	2C1	X7R	NPO	BX	2C1	X7R
Dielectric code		CE	CX	CN	XR	CE	CX	CN	XR
Min. Cap. value		1pF	22pF			1pF	22pF		
Rated voltage (U _{ric})	25V	5.6nF	150nF	180nF	180nF	33nF	820nF	1µF	1µF
	50V	2.7nF	39nF	56nF	82nF	15nF	220nF	390nF	470nF
	63V	2.2nF	27nF	39nF	56nF	12nF	150nF	220nF	330nF
	100V	1.2nF	10nF	18nF	33nF	6.8nF	56nF	120nF	180nF
	200V	390pF	2.2nF	3.9nF	8.2nF	2.2nF	12nF	27nF	47nF
	250V	220pF	1.2nF	2.8nF	4.7nF	1.2nF	8.2nF	18nF	33nF
	500V	82pF	-	-	820pF	470pF	-	2.7nF	4.7nF

Size		79-5				80-5				76-5			
Dimensions inches (mm)	L max.	0.299 (7.6)				0.398 (10.1)				0.5 (12.7)			
	W max.	0.378 (9.6)				0.477 (12.1)				0.56 (14.2)			
	T max.	0.15 (3.8)				0.15 (3.8)				0.197** (5)**			
	X ± 0.008 (± 0.2)	0.2 (5.08)				0.2 (5.08)				0.4 * (10.16) *			
	Ø ± 10%	0.024 (0.6)				0.024 (0.6)				0.024 (0.6)			
	Dielectric	NPO	BX	2C1	X7R	NPO	BX	2C1	X7R	NPO	BX	2C1	X7R
Dielectric code	CE	CX	CN	XR	CE	CX	CN	XR	CE	CX	CN	XR	
Min. Cap. value	1nF	4.7nF				3.9nF	12nF			8.2nF	33nF		
Rated voltage (U _{ric})	25V	82nF	2.2µF	2.2µF	2.2µF	150nF	3.9µF	3.9µF	3.9µF	270nF	6.8µF	6.8µF	6.8µF
	50V	56nF	1.2µF	1.5µF	1.5µF	100nF	2.7µF	2.7µF	2.7µF	180nF	4.7µF	4.7µF	4.7µF
	63V	47nF	820nF	1µF	1.2µF	100nF	1.5µF	2.2µF	2.2µF	150nF	2.7µF	4.7µF	3.9µF
	100V	27nF	270nF	560nF	820nF	56nF	560nF	1.2µF	1.2µF	100nF	1.2µF	2.2µF	2.2µF
	200V	10nF	82nF	150nF	220nF	27nF	180nF	330nF	390nF	56nF	390nF	680nF	820nF
	250V	6..8nF	47nF	100nF	150nF	15nF	100nF	220nF	220nF	39nF	270nF	470nF	560nF
	500V	3.3nF	6.8nF	18nF	33nF	6.8nF	15nF	39nF	56nF	15nF	47nF	100nF	120nF

* X = 0.2" (5.08mm) for Cr ≤ 1µF - 50V and Cr ≤ 680nF - 100V

** T max = 0.273" (6mm) for Cr ≥ 3.3µF - 50V

Available capacitance values:

NPO: E6, E12, E24, E48, E96 (see page 14). Specific values upon request.

X7R: E6, E12, E24 (see page 14). Specific values upon request.

The above table defines the standard products, other components may be built upon request.

Non Magnetic Conformal Coated Series

Radial Dipped Capacitors



FEATURES

- Case sizes: 1812 to 2220
- NPO and X7R dielectrics
- Capacitance range: 180pF to 1μF
- RoHS compliant capacitors

PHYSICAL CHARACTERISTICS

MLCC capacitors with:

- Radial leads for through-hole mounting.

ELECTRICAL SPECIFICATIONS

Description	NPO dielectric	X7R dielectric
Dielectric code	N	X
CECC class	1B / CG	2R1
EIA class	Class I	Class II
Temperature range	-55°C to +125°C	-55°C to +125°C
Temperature coefficient	(0±30) ppm/°C	NA
Maximum ΔC/°C over temperature range without DC voltage applied	NA	±15%
Rated voltage (U _R)	100V _{DC} to 500V _{DC}	63V _{DC} to 500V _{DC}
Dielectric withstanding voltage	250% rated voltage	250% rated voltage
Insulation resistance (I _R) at 25°C under U _R	100GΩ or 1,000Ω.F whichever is less	100GΩ or 1,000Ω.F whichever is less
Aging	None	≤ 2.5% per decade hour

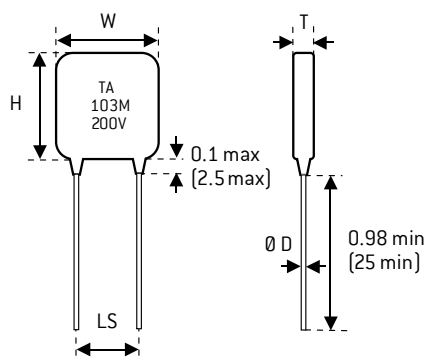
HOW TO ORDER

630	S43	X	394	K	R	E
Rated voltage	Exxelia size code	Dielectric code	Capacitance	Tolerance	Termination	Packaging
630 = 63V 101 = 100V 201 = 200V 501 = 500V	S43 = 1812 S47 = 2220	N = NPO X = X7R	Capacitance value in code. 1 st two digits represent significant figures; last digit specifies the number of zeros to follow. Examples: 101 = 100pF 472 = 4.7nF 683 = 68nF 564 = 0.56μF 105 = 1μF	NPO: F = ±1% G = ±2% J = ±5% K = ±10% M = ±20% X7R: K = ±10% M = ±20%	R = Radial two wires	- = Bulk E = tape & reel

Radial Dipped Capacitors

Non Magnetic Conformal Coated Series

DIMENSIONS in inches (mm)



STANDARD RATINGS

Size		1812		2220	
Excellia size code		S43		S47	
Dimensions inches (mm)	W	0.28 max. [7.1 max.]		0.327 max. [8.3 max.]	
	H	0.26 max. [6.6 max.]		0.335 max. [8.5 max.]	
	LS	0.2 ±0.02 [5.08 ±0.5]		0.2 ±0.02 [5.08 ±0.5]	
	Ø ±10%	0.024 [0.6]		0.024 [0.6]	
	T max.	0.146 [3.7]		0.146 [3.7]	
Dielectric		NPO	X7R	NPO	X7R
		N	X	N	X
Rated voltage (U _{rated})	63V	-		-	330nF to 1µF
	100V	1.8nF to 5.6nF	-	6.8nF to 10nF	-
	200V	180pF to 5.6nF	2.7nF to 100nF	680pF to 10nF	6.8nF to 220nF
	500V	180pF to 2.2nF	2.7nF to 47nF	680pF to 4.7nF	6.8nF to 100nF

Available capacitance values:

E6, E12 (see page 14). Specific values upon request.

Note: some capacitance values in these tables may not be proposed for small quantities. Please, contact us for confirmation.

For exact values regarding the thickness, please consult us.

CK Series

Radial Molded Capacitors



In accordance with MIL C 11015 D standards

CKR 05/06 : on request, High reliability types.

FEATURES

- Radial molded capacitors
- BX dielectric
- Capacitance range: 10pF to 1μF
- RoHS and Non RoHS compliant capacitors available

PHYSICAL CHARACTERISTICS

CONSTRUCTION

Leaded MLCC capacitors for through-hole mounting:
Epoxy molded capacitors

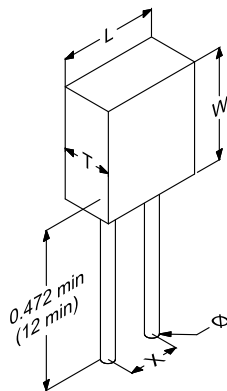
MARKING

Capacitance, tolerance, voltage, dielectric, date code.

ELECTRICAL SPECIFICATIONS

Description	BX
Operating temperature	-55°C to +125°C
Climatic category	55 / 125 / 56
Rated voltage (U_{RC})	25V _{DC} to 250V _{DC}
Max. $\Delta C/^{\circ}C$ over temperature range without DC voltage applied	$\pm 15\%$
Maximum $\Delta C/^{\circ}C$ over temperature range with rated voltage applied	+15% - 25%
Dielectric withstanding voltage	2.5 U_{RC}
Capacitance	at 1MHz for $C \leq 100pF$ at 1kHz for $C > 100pF$
Dissipation factor at 25°C	$\leq 2.5\%$ at 1MHz for $C \leq 100pF$ $\leq 2.5\%$ at 1kHz for $C > 100pF$
Insulation resistance at 25°C	$\geq 100,000 M\Omega$ for $C \leq 10nF$ $\geq 1,000 M\Omega \cdot \mu F$ for $C > 10nF$
Aging	$\leq 2.5\%$ per decade hour

DIMENSIONS in inches [mm]



Available capacitance values:

BX: E6, E12, E24 (see page 14). Specific values upon request.

The above table defines the standard products, other components may be built upon request.

STANDARD RATINGS

Size	05	06
Dimensions inches [mm]	L 0.189 $\pm$ 0.008 [4.8 $\pm$ 0.2]	0.291 $\pm$ 0.008 [7.4 $\pm$ 0.2]
	W 0.189 $\pm$ 0.008 [4.8 $\pm$ 0.2]	0.291 $\pm$ 0.008 [7.4 $\pm$ 0.2]
	T 0.091 $\pm$ 0.008 [2.3 $\pm$ 0.2]	0.091 $\pm$ 0.008 [2.3 $\pm$ 0.2]
	X 0.2 $\pm$ 0.008 [5.08 $\pm$ 0.2]	0.2 $\pm$ 0.008 [5.08 $\pm$ 0.2]
	$\emptyset \pm 10\%$ 0.024 [0.6]	0.024 [0.6]
Min. Cap. value	10pF	1.2 nF
Rated voltage [U_{RC}]	50V	100nF
	100V	10nF
	200V	1nF

HOW TO ORDER

CK	05	W	F	820nF	10%	25V	B	-
Series	Size	RoHS compliant	Quality level	Capacitance	Tolerance	Rated voltage	Packaging	Reliability level
CK = Radial leaded, molded capacitor	05 06	- = No RoHS W = RoHS compliant	- = standard quality level F = Hi-Rel quality: screening in accordance with Exxelia specification	Capacitance value in clear	$\pm 10\%$ $\pm 20\%$	25V 100V 50V 200V 63V 250V Intermediary and higher voltages available on request	- = Exxelia packaging Available for quantity ≥ 500 : B = reel	For F parts only, Acc. to Exxelia spec. - T5 T6 See page 15

HIGH VOLTAGE

GENERAL INFORMATION 46

C SERIES

High Voltage Chips Capacitors 51

TCF SERIES

High Voltage Conformal Coated Leaded Caps 54

TKD SERIES

High Voltage Conformal Coated Leaded Caps 57

TCL SERIES

High Voltage Molded & Varnished Leaded Caps 59

TCK SERIES

High Voltage Conformal Coated Leaded Caps 62

CF/CFS SERIES

High Voltage Conformal Coated Leaded Caps 65

CS SERIES

High Voltage Stacked Capacitors 70



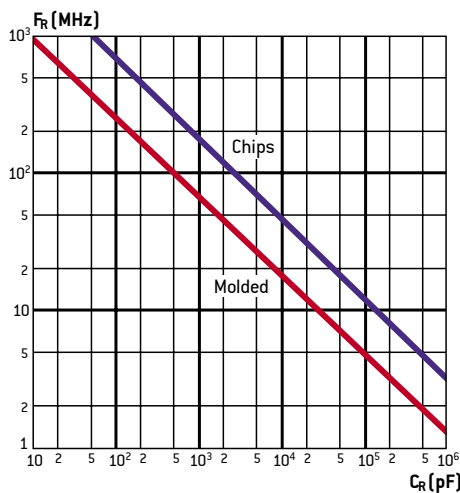
General Information

High voltage multilayer ceramic capacitors designed by EXXELIA are adapted to applications in electronics such as high voltage power supplies and high circuits. Their multilayer construction offers significant size and space saving advantages. They are available in class 1 (NP0), class 2 (X7R) and C4xx ($-2,200 \text{ ppm}/^{\circ}\text{C}$) dielectrics versions complying with the main requirements of applicable standards. They are suited for use in commercial, industrial and High-Rel military and space circuits.

As standard products can't meet all the specificities of all applications, special applications may require specific features (higher voltage, burn-in, dimensions, coating, leading, marking...) not described in this catalogue. Based on our state-of-the-art technologies and our expertise, our Engineers may study at your request all special components to meet your application.

Please, consult us for more information.

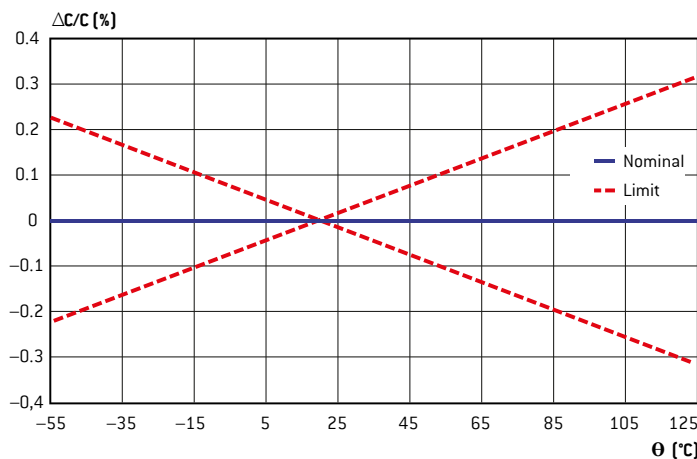
NP0, X7R, C4xx: SELF-RESONANCE FREQUENCY VS CAPACITANCE



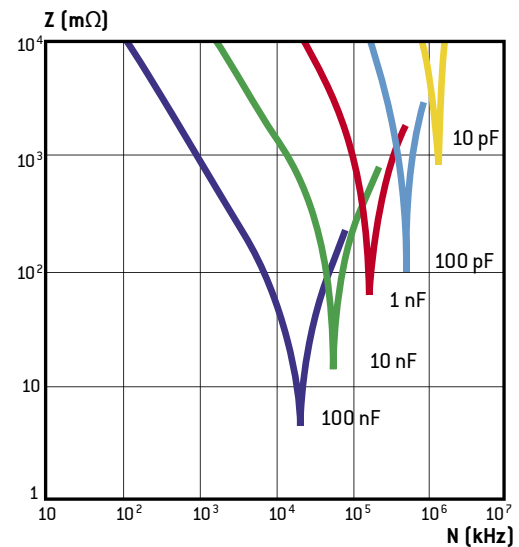
NP0/COG DIELECTRICS (CLASS 1)

Made of titanium oxide and other various selected oxides, they feature unique stability of all parameters under such constraints as operating time, temperature, voltage applied. For example, the quality factor remains very high over an extremely wide frequency range. As example, loss angle tangent value at 1MHz is typically in the order of 3.10^{-4} . These characteristics make them compatible with steep-edge impulse mode without noticeable temperature rise. The different parameters and related variations are illustrated in figures below:

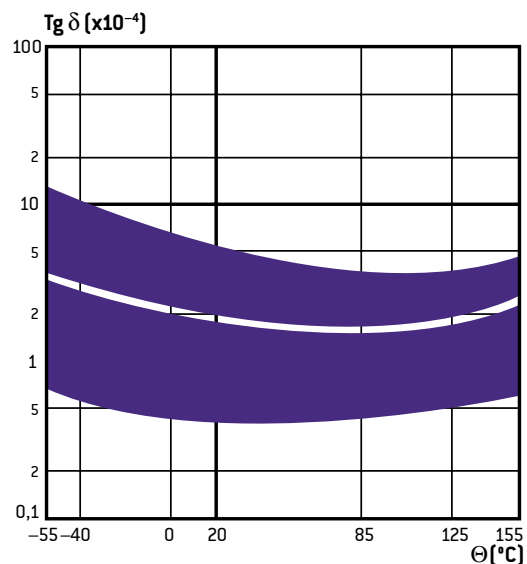
NP0: RELATIVE CAPACITANCE CHANGE VS TEMPERATURE



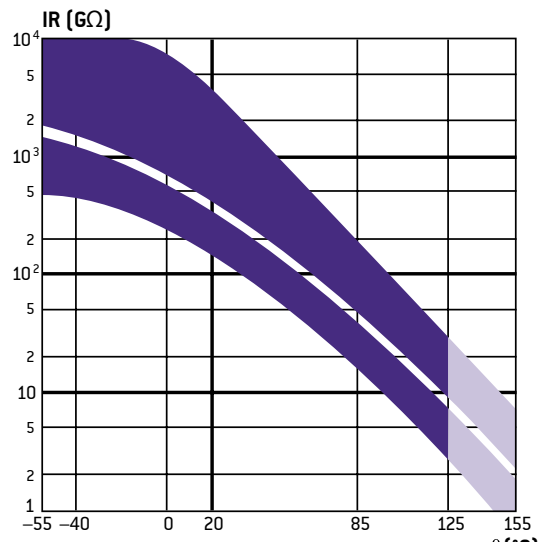
NP0: IMPEDANCE VS FREQUENCY



NP0: LOSS TANGENT VS TEMPERATURE



NP0: INSULATION RESISTANCE VS TEMPERATURE



General Information

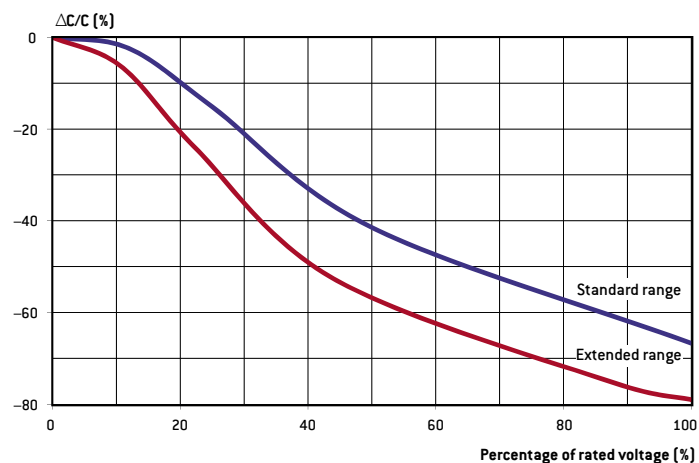
X7R DIELECTRICS (CLASS 2)

They are mainly made of barium titanate modified by various oxides to achieve the electrical properties required. A specific ceramic dielectric is used to achieve an excellent dielectric strength. High dielectric constant enables to achieve high capacitance values.

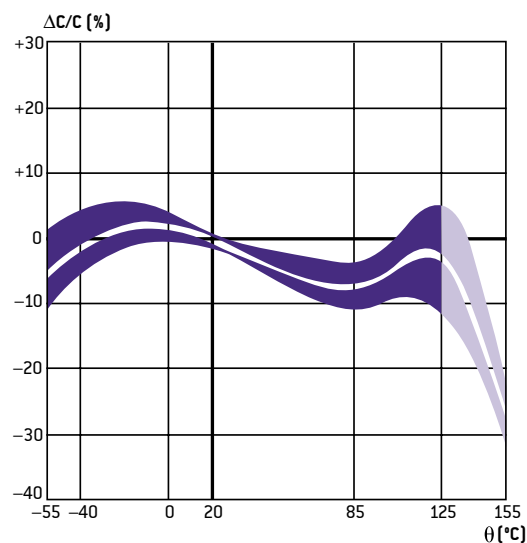
For optimum use, the specific properties of barium titanate in function of the different parameters must be taken into account.

See the variations illustrated in figures below:

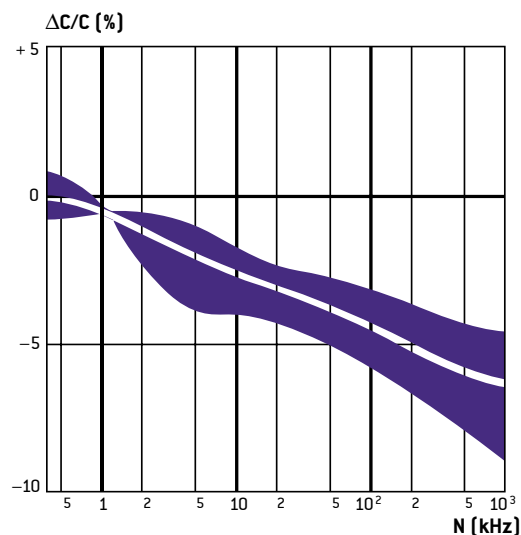
CHANGE VS PERCENTAGE OF RATED VOLTAGE APPLIED



X7R: CAPACITANCE CHANGE VS TEMPERATURE



X7R: CAPACITANCE CHANGE VS FREQUENCY



X7R: INSULATION RESISTANCE VS TEMPERATURE

