As the world's leading manufacturer of specific passive components, we stand apart through our ability to quickly evaluate the application specific engineering challenges and provide a cost-effective and efficient solutions.

For requirements that cannot be met by catalog products, we offer leading edge solutions in custom configuration: custom geometries, packaging, characteristics, all is possible thanks to our extensive experience and robust development process, while maintaining the highest level of reliability.

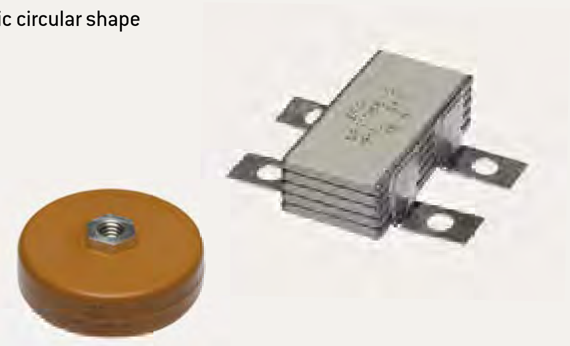
Where necessary, special testing is done to verify requirements, such as low dielectric absorption, ultra-high insulation resistance, low dissipation factor, stability under temperature cycling or under specified environmental conditions, etc.

HIGH CAPACITANCE

- High energy density
- Specific case sizes
- Specific shape of connections (high resistance to vibrations)

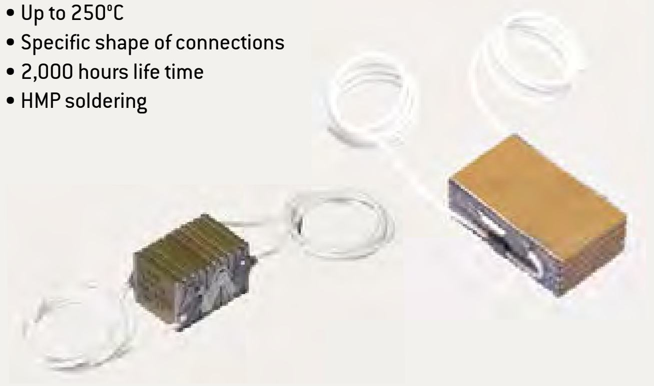
HIGH VOLTAGE

- Up to 50 kV
- Specific circular shape



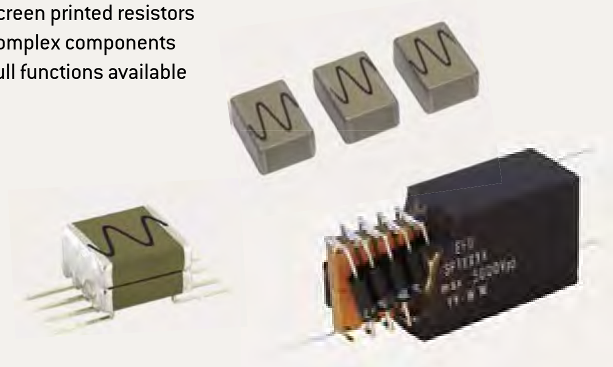
HIGH TEMPERATURE

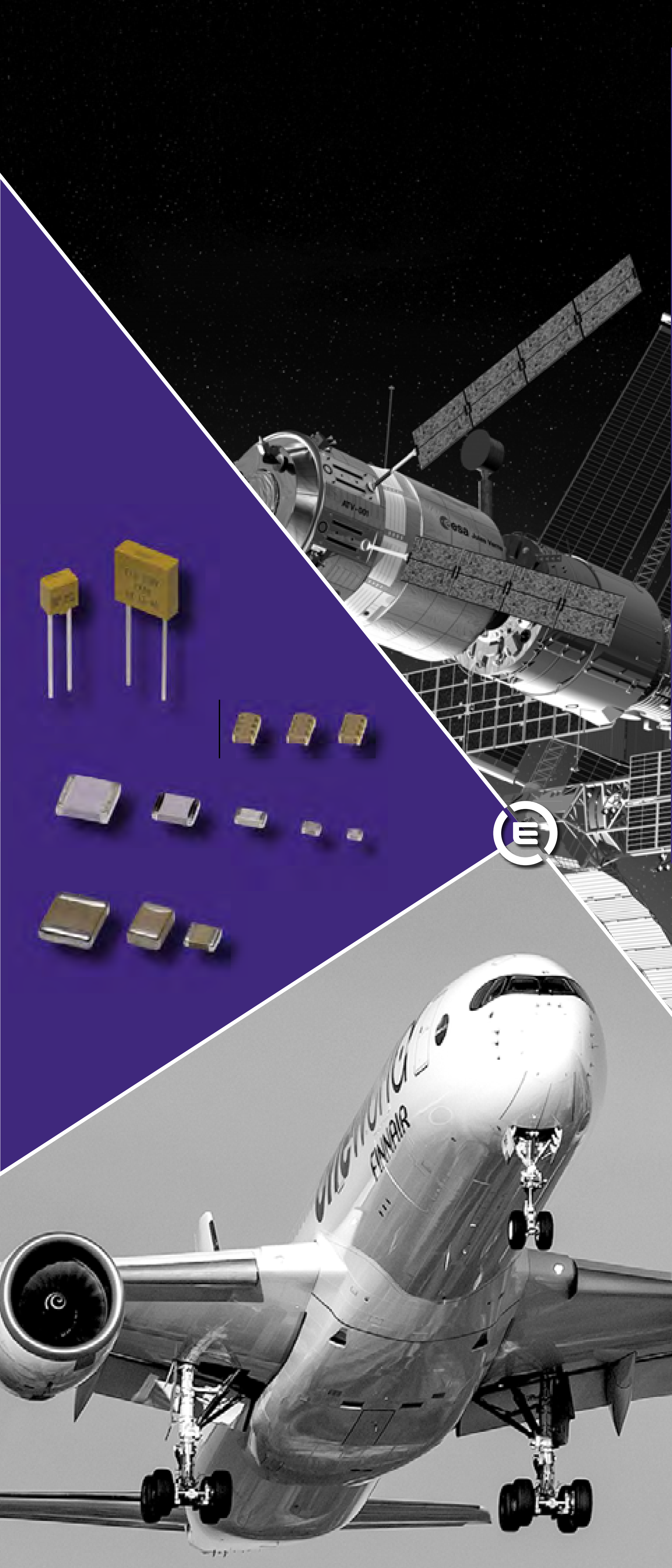
- Up to 250°C
- Specific shape of connections
- 2,000 hours life time
- HMP soldering



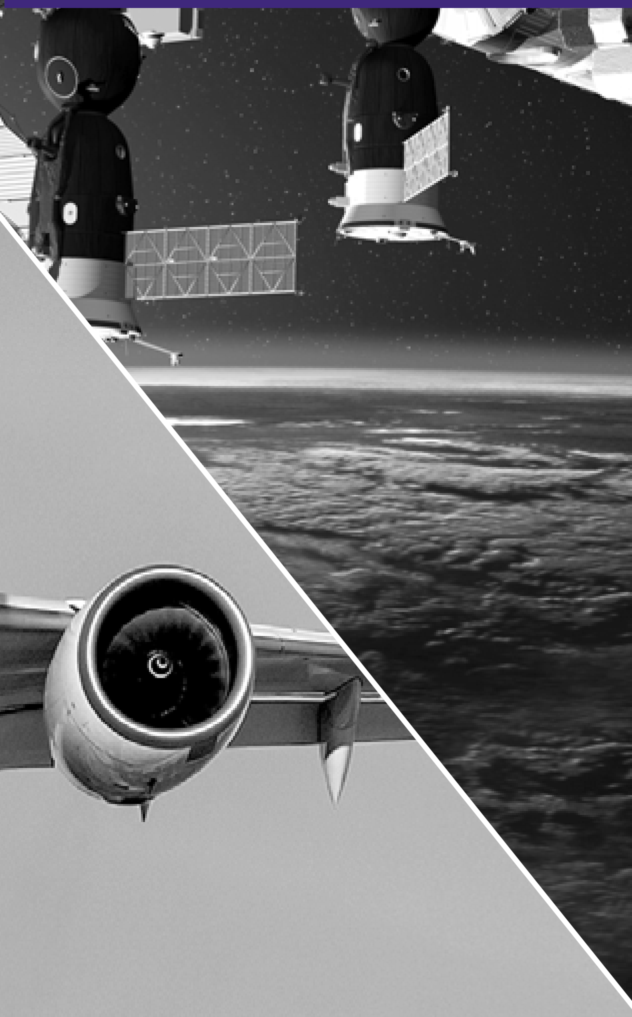
OTHERS

- Screen printed resistors
- Complex components
- Full functions available





STANDARD



General Information NPO/COG (Class 1)

COMPOSITION

NPO capacitors are produced by using a dielectric made of titanium dioxide ($Ti\ O_2$) modified by magnesium oxide Mg O (white ceramics) or a rare earth oxide, e.g. $Nd_2\ O_3$ (other NPO ceramics).

As a consequence, these ceramics are non ferro-electric materials with a low dielectric constant ($\varepsilon r \leq 110$).

Other additives are used to dope the dielectric constant up to 300. Though derogating from CG class, doped dielectric constant features a linear temperature drift and a matchless stability compared with class 2 ceramics.

The wide range of possible NPO dielectric compositions enables to use the material best suited to the application :

- standard applications,
- high voltage,
- high temperature,
- microwave,
- power capacitors.

«Temperature coefficient» compositions are particularly suitable for impedance matching. These ceramics usually enable to achieve temperature coefficients from 0 to –1 000 ppm/°C. For specific requirements, other coefficients can be achieved (e.g. –3 300 ppm/°C).

STABILITY

As εr is low, these dielectrics are extremely stable with only minor changes under such stresses as :

- temperature,
- voltage,
- frequency.

In addition, they are not affected by piezo-electric phenomena and their dielectric absorption coefficients are low and even non measurable for dielectrics with the lowest constants.

MECHANICAL PROPERTIES

Class 1 ceramics are the perfect match for metallic electrodes made of Pd or Ag-Pd alloy and have a high hardness and mechanical toughness making them resistant to thermal shocks (wave soldering for instance) and to thermal cycling after mounting on substrates having an expansion coefficient close to the capacitor one.

Ceramic chips meet CECC 32100 and NF C 93133 standards.

CLIMATIC CATEGORIES

Climatic categories are identified by three-digit codes as per NF C 20700 standard. Coding method is described in table 6.

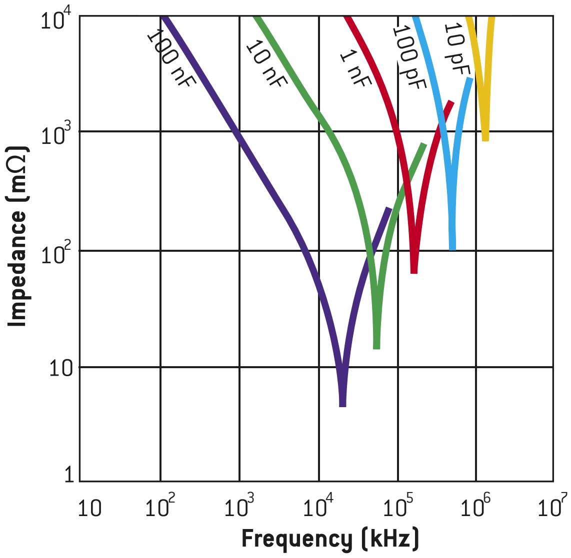
e.g. : – 55°C + 125°C / 56 days category is identified by code 434.

TEMPERATURE COEFFICIENT

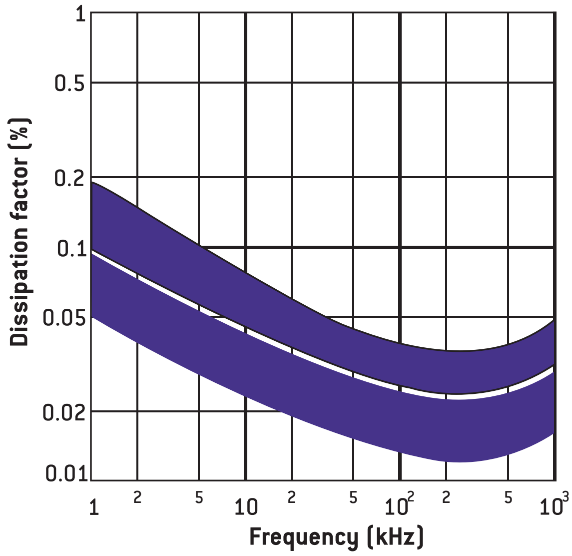
Temperature coefficient kθ (ppm/°C)		
kθ	Tolerances	Code letter
+ 100	± 30	AG
0	± 30	CG
– 33	± 30	HG
– 75	± 30	LG
– 150	± 30	PG
– 220	± 30	RG
– 330	± 60	SH
– 470	± 60	TH
– 750	± 120	UJ
– 1 000	± 250	QK

General Information NPO/COG (Class 1)

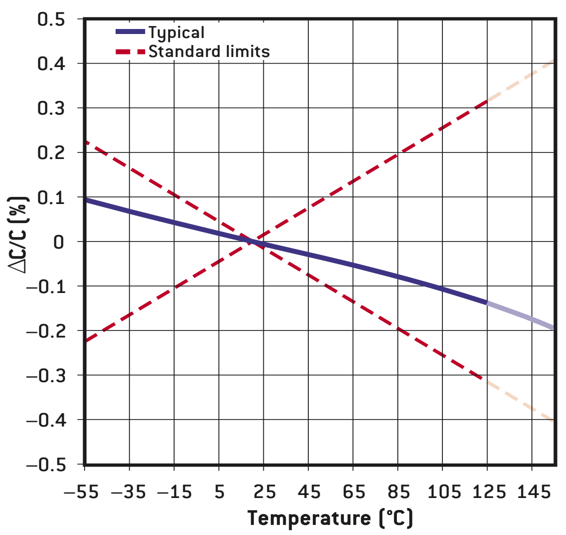
IMPEDANCE VERSUS FREQUENCY



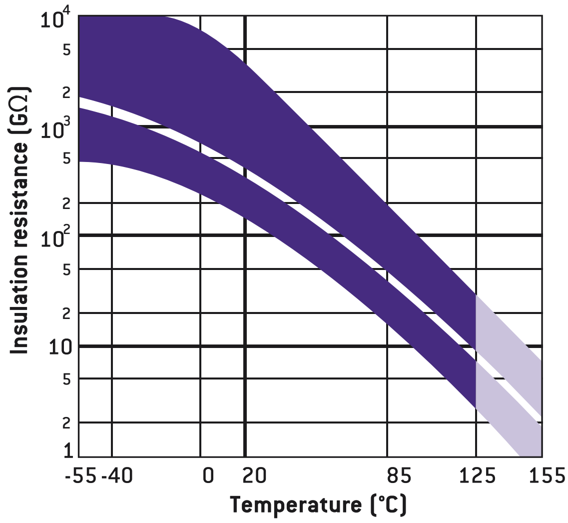
DISSIPATION FACTOR VERSUS FREQUENCY



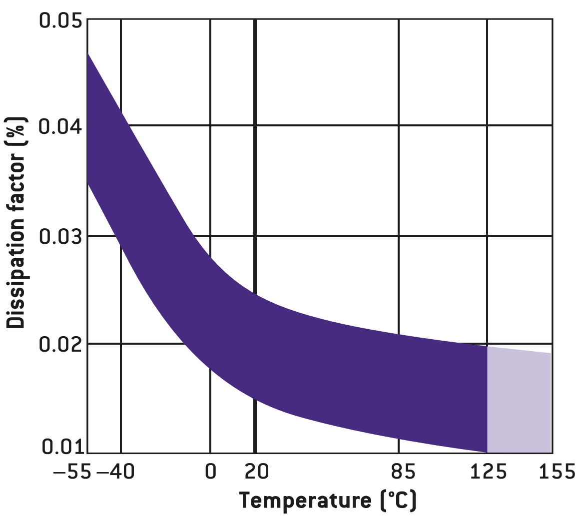
CAPACITANCE CHANGE VERSUS TEMPERATURE



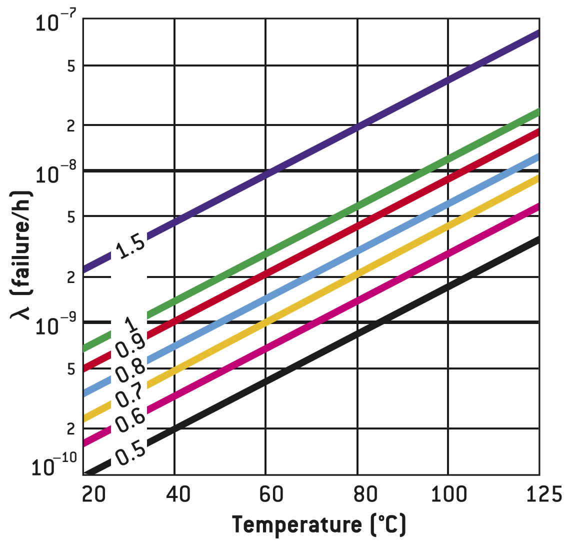
IR VERSUS TEMPERATURE



DISSIPATION FACTOR VERSUS TEMPERATURE



TYPICAL FAILURE RATE VERSUS TEMPERATURE



General Information X7R (Class 2)

COMPOSITION

Class 2 capacitors are produced by using a dielectric made of barium titanate (Ba Ti O_3). By nature, the dielectric is a ferroelectric compound with a high dielectric constant usually varying :

- from 1 000 to 5 000 - typical of capacitors meeting 2C1 type specifications (BX, X7R),
- from 5 000 to 15 000 - typical of capacitors meeting Z5U or Y5V type specifications.

Depending on whether the dielectric contains a flux additive, mainly bismuth or boron, electrodes are made of Ag-Pd alloys with high silver content or high palladium content, even pure palladium in some cases.

STABILITY

As the dielectric is a ferro-electric material, class 2 capacitors present significant variations under such stresses as :

- temperature,
- voltage,
- frequency.

In addition, the dielectric absorption coefficient can reach a few % and piezo-electric phenomena can affect the dielectric at critical frequencies (full information and specific documents available on request).

MECHANICAL PROPERTIES

Class 2 dielectrics are hard materials and are sensitive to thermo-mechanical stress. Stress should be limited when mounting and adequate substrates with an adapted expansion coefficient used.

BISMUTH OR BISMUTH FREE DIELECTRICS

Class 2 capacitors are made of ceramics capable to embed a flux element (e.g. bismuth or boron salt).Their eventual use will affect the choice of electrode alloys firing temperature used. Capacitor behavior under such constraints as temperature, voltage, frequency and even reliability, in some applications (further information available on request), is also different.

That is why French and European standard authorities have decided to differentiate bismuth from bismuth free ceramics by measuring tangent δ at −55°C. Tangent Tg δ (−55°C) 350.10^{-4} in flux free dielectrics.

Flux free dielectrics are identified by suffix «A» after capacitor type (e.g. CNC2A).

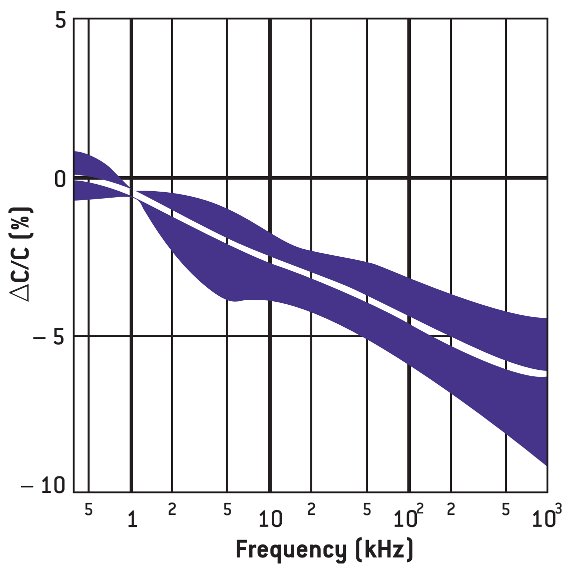
CAPACITANCE/TEMPERATURE RELATIONSHIP

Capacitance variations are defined within a specified temperature range, + 20°C being the reference temperature. This characteristic is expressed by associating the temperature range and capacitance stability.

Stability category Code letter	Max. capacitance variation (%) with reference to capacitance at 20°C	
	Without voltage	At rated DC voltage (U_{DC})
B	± 10	+ 10– 15
C	± 20	+ 20 – 30
D	+ 20 – 30	+ 20 – 40
E	+ 20 – 55	+ 20 – 65
R	+ 15 – 15	Not applicable
X	+ 15 – 15	+ 15 – 25

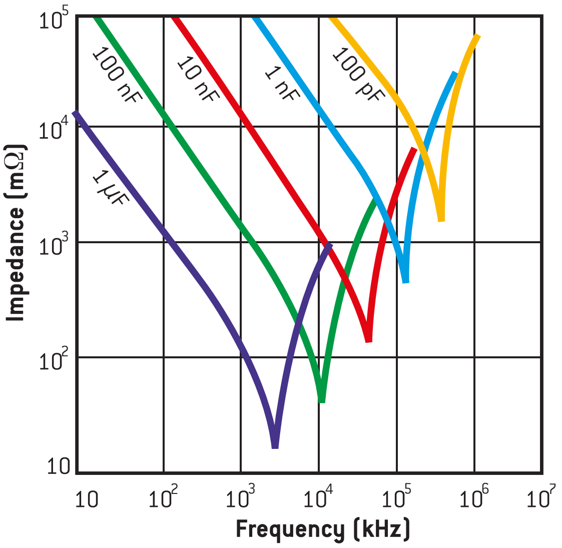
Temperature category	
Code	Temperature range
1	– 55°C +125°C
2	– 55°C + 85°C
4	– 25°C + 85°C

CAPACITANCE CHANGE VERSUS FREQUENCY

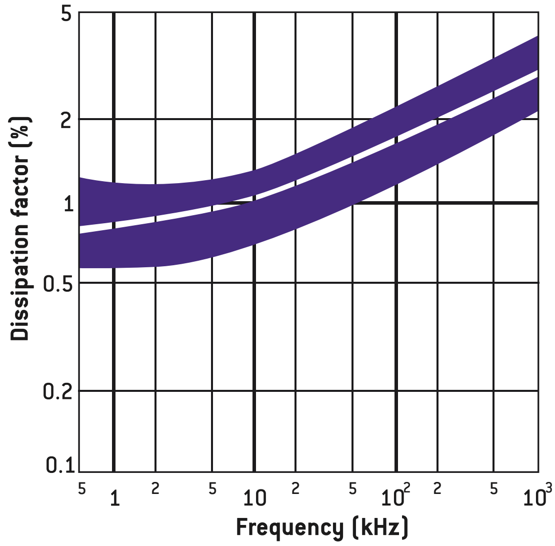


General Information X7R (Class 2)

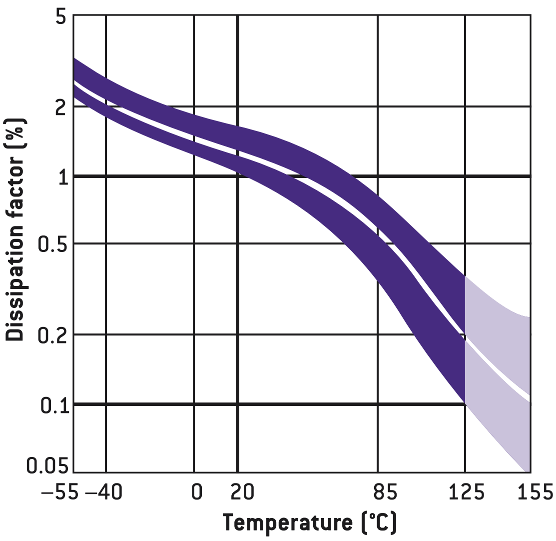
IMPEDANCE VERSUS FREQUENCY



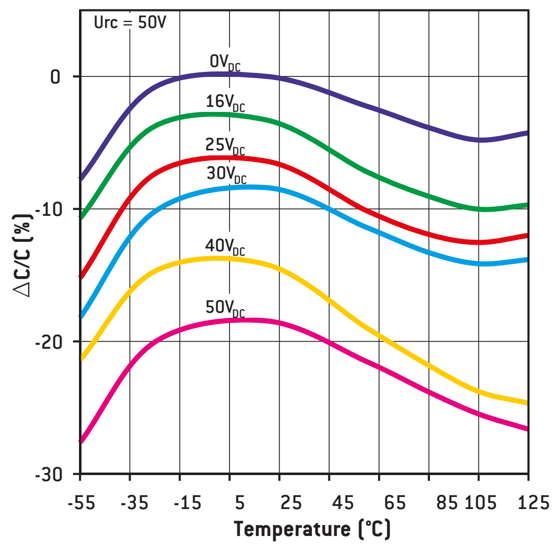
DISSIPATION FACTOR VERSUS FREQUENCY



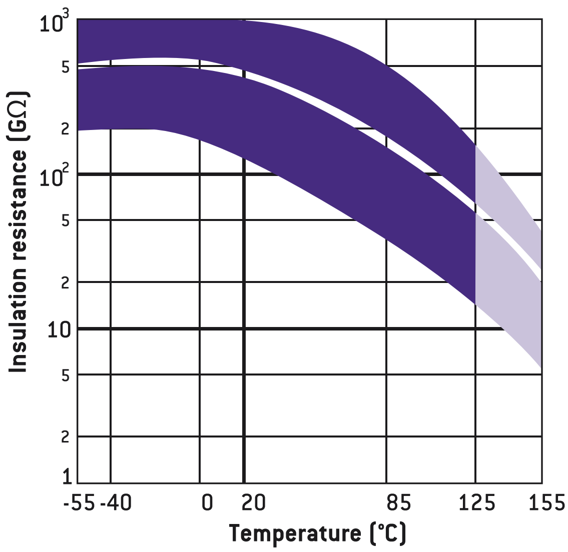
DISSIPATION FACTOR VERSUS TEMPERATURE



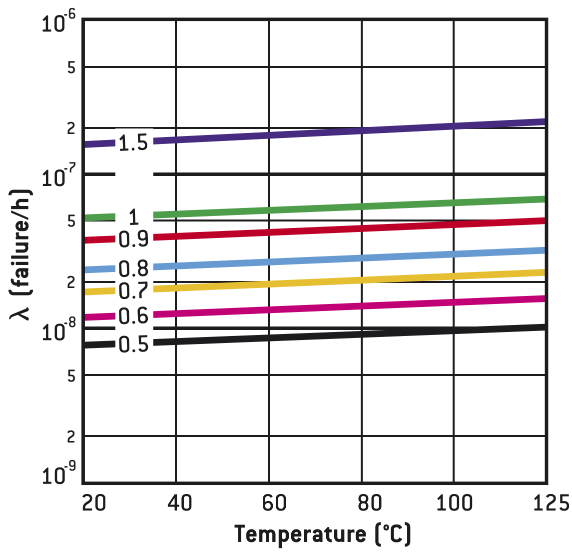
CAPACITANCE CHANGE VERSUS TEMPERATURE



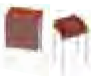
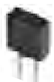
IR VERSUS TEMPERATURE



TYPICAL FAILURE RATE VERSUS TEMPERATURE



Selection Guide

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

Selection Guide

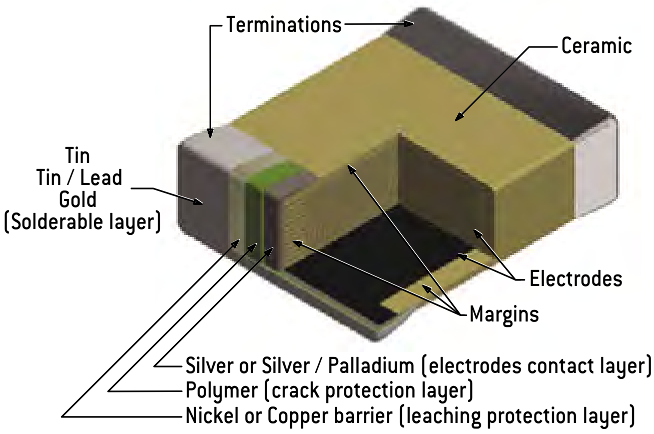
Main Characteristic	Model	Size range	Dielectric	Voltage range	Capacitance range	Temperature range	Coating: Uncoated	Coating: Varnished	Coating: Conformal coated	Coating: Molded	Coating: Self protected	Leads: DIL	Leads: Ribbon	Leads: Axial	Leads: Radial	Mounting: SMD	Mounting: Through hole	Main Applications	Page
HIGH Q	**XBL SERIES** Broadband NEW	0402	X7R	16V	100nF	−55°C to +125°C	•									•		DC Blocking, Coupling, Bypassing	144
HIGH Q	**UBL SERIES** Broadband NEW	0402	X7R	16V	100nF	−55°C to +125°C	•									•		DC Blocking, Coupling, Bypassing	146
HIGH Q	**UBZ SERIES** Broadband NEW	0201	X5R X6T	10V	100nF	−55°C to +105°C	•									•		DC Blocking, Coupling, Bypassing	148
HIGH Q	**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
HIGH Q	**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
HIGH Q	**SHD / SHR SERIES** Reverse Geometry	0709 0711	NPO	500V	0.5pF to 100pF	−55°C to +175°C	•									•		Cellular base station equipment Broadband Point to point/ multi-point radios RF generators	156
HIGH Q	**NHB SERIES** High Self Resonant Frequency	1111	NPO	500V	0.3pF to 100pF	−55°C to +175°C	•									•		Cellular base station equipment Broadband Point to point/ multi-point radios RF generators	158
HIGH Q	**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
HIGH Q	**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)

Main Characteristic	Model	Size range	Dielectric	Voltage range	Capacitance range	Temperature range	Coating: Uncoated	Coating: Varnished	Coating: Conformal coated	Coating: Molded	Coating: Self protected	Leads: DIL	Leads: Ribbon	Leads: Axial	Leads: Radial	Mounting: SMD	Mounting: Through hole	Main Applications	Page
STANDARD	**TCE1X Series**	-	NPO	63V to 100V	0,5pF to 10nF	−55°C to +125°C				•					•		•	Precision, stability, decoupling	-
STANDARD	**TCN19 Series**	-	2C1	63V to 250V	10pF to 1µF	−55°C to +125°C				•					•		•	Decoupling	-
STANDARD	**TCN3X Series**	-	2C1	50V to 100V	100pF to 1,8µF	−55°C to +125°C				•					•		•	Decoupling	-
STANDARD	**LA6 Series**	-	2C1	25V to 63V	100pF to 1µF	−55°C to +125°C				•					•		•	Decoupling	-
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	-
HIGH CAPACITANCE	**CNC8X Series (chips)**	3033 to 33110	X7R	63V to 400V	47nF to 27µF	−55°C to +125°C	•									•		Switch Mode Power Supply, filtering, smoothing, decoupling. • aerospace • space • defence	-
HIGH CAPACITANCE	**CNC8X Series (DIL)**	3333 to 80150	X7R	63V to 400V	47nF to 180µF	−55°C to +125°C	•	•				•				•	•	Switch Mode Power Supply, filtering, smoothing, decoupling. • aerospace • space • defence	-
HIGH CAPACITANCE	**TCP / TCV8X Series**	3333 to 80150	X7R	63V to 400V	47nF to 180µF	−55°C to +125°C		•							•		•	Switch Mode Power Supply, filtering, smoothing, decoupling. • aerospace • space • defence	-
HIGH CAPACITANCE	**TCP / TCV5X 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	-
HIGH CAPACITANCE	**TCF Series**	-	X7R	63V to 500V	0,1µF to 18µF	−55°C to +125°C			•							•	•	Switch Mode Power Supply, filtering, smoothing, decoupling. • aerospace • space • defence	-
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	-
HIGH Q	**SPT519 / CAW CEW Series**	-	NPO	100V to 300V	10nF to 1µF	−55°C to +125°C	•	•					•	•		•	•	Power amplifier	-

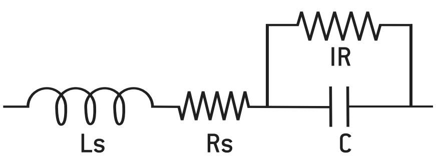
Ceramic Capacitors Technology

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 x IR) is often specified in Ω.F or MΩ.µF.

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:

$P = 2\pi f C\ Vrms^2\ DF$

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:

$Z = Rs + j\,(Ls.\omega - 1/(C.\omega))$ with $\omega = 2\pi f$

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

$Z = Rs$ and $LsC.\omega^2 = 1$

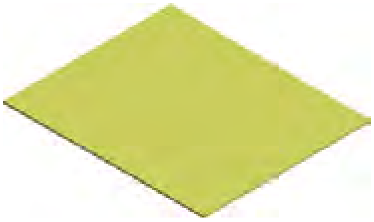
Above this frequency the capacitor behaves like an inductor.

	P100	NPO	N2200 (C4xx)	BX	2C1	X7R
Dielectric material	Porcelain	Magnesium titanate or Neodynium 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

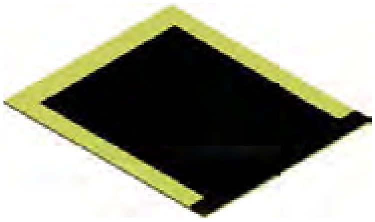
MANUFACTURING STEPS

SLIP CASTING



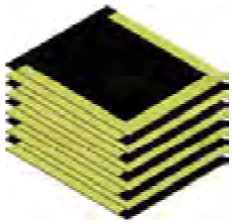
A slurry, a mix of ceramic powder, binder and solvents, is poured onto conveyor belt inside a drying oven, resulting in a dry ceramic sheet.

ELECTRODE SCREEN PRINTING



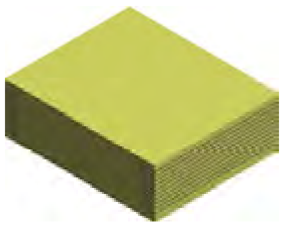
The electrode ink, made from a metal powder mixed with solvents, is printed onto the ceramic sheets using a screen printing process.

STACKING



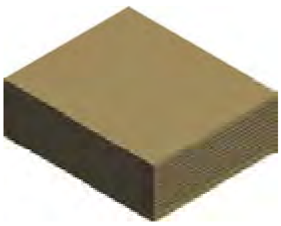
The sheets with electrode printed are stacked to create a multilayer structure.

PRESSING



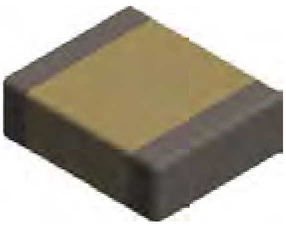
Pressure is applied to the stack to fuse all the separate layers, this created a monolithic structure.

SINTERING



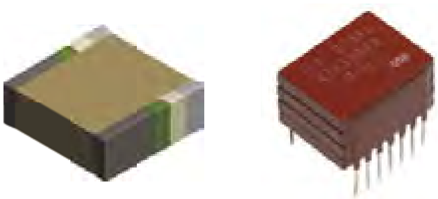
The parts are sintered in an oven with a precise temperature profile which is very important to the characteristics of the capacitors.

TERMINATIONS



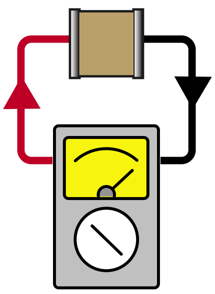
Each terminal of the capacitor is dipped in the termination ink, mix of metal powder, solvents and glass frit and the parts are fired in an oven.

TERMINATIONS PLATING



Stacking + leads soldering + encapsulation
(see pages 10-11)

FINAL TESTING



PACKAGING

User Guide

SMD TERMINATIONS

NON RoHS COMPLIANT	Code	RoHS COMPLIANT	Code	Magnetic	Recommended mounting process						Storage (months)*
					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.

LEAD STYLES

SURFACE MOUNTING

DIL LEADS

P style

PL style

L style

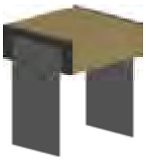
J style

RIBBON LEADS

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

Axial (Type 2)

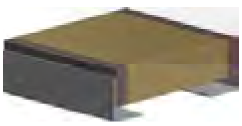
Radial (Type 3)



R style

RX style

RJ style



Please contact Exxelia sales for any lead configuration not shown.

TROUGH-HOLE MOUNTING

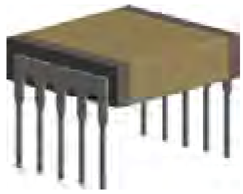
AXIAL AND RADIAL

Radial leads (Type 6)

Radial leads (4 leads)

Axial leads (Type 7)

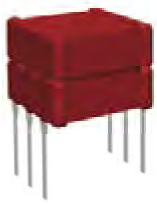
DIL leads: N style



ENCAPSULATION STYLES

Ceramic encapsulation
(selfprotected)

Varnish

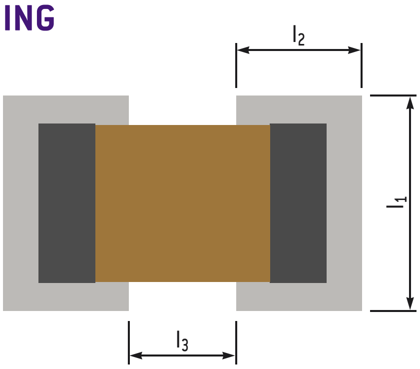


Conformal coating

Molding

User Guide

SOLDERING ADVICES FOR REFLOW SOLDERING



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)

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.

RECOMMENDED FOOTPRINT FOR SMD CAPACITORS

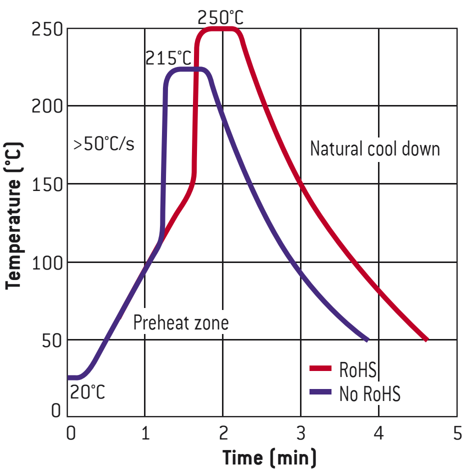
Ceramic is by nature a material which is sensitive both thermally and mechanically. Stresses caused by the physical and thermal properties of the capacitors, substrates and solders are attenuated by the leads.

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).

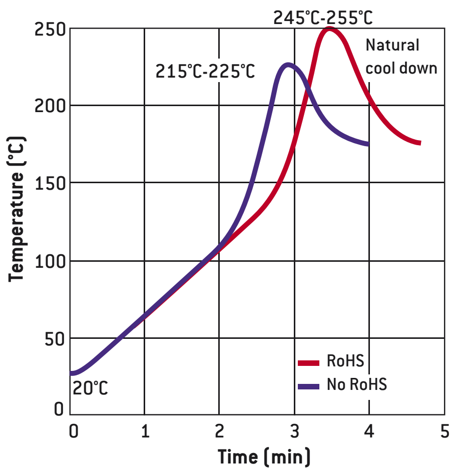
Infrared and vapor phase reflow, are preferred for high reliability applications as inherent thermo-mechanical strains are lower than those inherent to wave soldering.

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

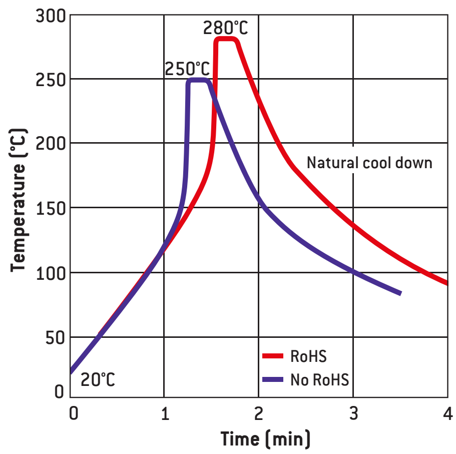
RECOMMENDED VAPOR PHASE REFLOW PROFILE



RECOMMENDED IR REFLOW PROFIL



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,

- 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.

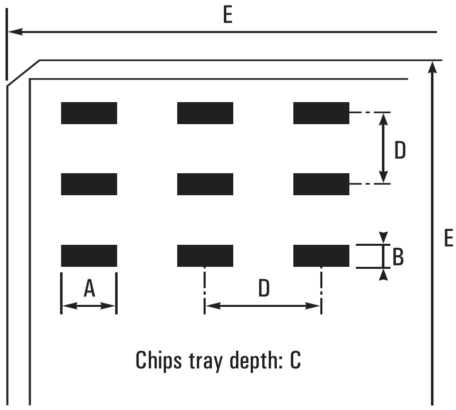
Maximum quantities per reel are as follows:

- 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.

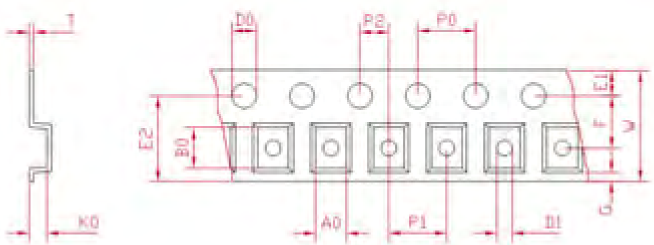
TRAY PACKAGES



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	Ø 0.112 (Ø 3.02)		0.065 (1.65)	0.167 (4.24)	2 (50.8)
0403	100	No	Ø 0.112 (Ø 3.02)		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)
	25	Yes	0.24 (6.1)	0.265 (6.73)	0.07 (1.78)	0.345 (8.76)	2 (50.8)
2220	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)	$0{,}453^{\pm0{,}004}$ ($11.5^{\pm0.1}$)	0,630 (16)	0,018 (0,45)	12,992 (330)	700
E (4040)	V	1,260 (32)	$0{,}559^{\pm0{,}004}$ ($14.2^{\pm0.1}$)	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	12
		13
15	15	15
		16
	18	18
		20
22	22	22
		24
	27	27
		30
33	33	33
		36
	39	39
		43
47	47	47
		51
	56	56
		62
68	68	68
		75
	82	82
		91

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 VOLTAGE CODES

Use the following voltage code chart for part markings:

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

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