Discoidal Capacitors

TBC Series

FEATURES

- Discoidal Multilayer Ceramic Capacitors
- Diameters: 0.053" (1.35 mm)– 0.61" (15.5 mm)
- NP0 and X7R dielectrics
- Very low ESL
- Capacitance range: 10pF to 12µF
- Voltage range: $25V_{DC}$ to $1,000V_{DC}$

PHYSICAL CHARACTERISTICS

CONSTRUCTION

Discoidal multilayer capacitors with Silver/Palladium/Platinum terminations.

Option T: central lead enables to get rid of thermal, mechanical shocks and plating deterioration during soldering process.

MARKING (on packaging)
Series, capacitance value, tolerance, rated voltage, batch number.

ELECTRICAL SPECIFICATIONS

Description	NPO	X7R
Operating temperature	–55°C to +125°C	–55°C to +125°C
Maximum ΔC/C over temperature range without DC voltage applied	NA	±15%
Temperature coefficient	(0±30)ppm/°C	NA
Climatic category	55 / 125 / 56	55 / 125 / 56
Dielectric withstanding voltage at 25°C	2.5 U_{RC} for $U_{RC} \leq$ 500V 1.5 U_{RC} for U_{RC} >500V	2.5 U_{RC} for $U_{RC} \leq$ 500V 1.5 U_{RC} for U_{RC} >500V
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 at25°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 under U_{RC} for $U_{RC} \leq$ 500V under 500V for U_{RC} > 500V	≥ 20,000MΩ for C ≤ 25nF ≥ 500MΩ.µF for C > 25nF	≥ 20,000MΩ for C ≤ 25nF ≥ 500MΩ.µF for C> 25nF
Aging	None	≤ 2.5% per decade hour

BX and BR dielectrics available on request.

HOW TO ORDER

TBC	2	81	W	T	10nF	10%	100 V
Series	Dielectric code	Exxelia size code	RoHS compliant	Central conductor	Capacitance	Tolerance	Rated voltage
TBC = discoidal capacitors	**1** = NP0 **2** = X7R	**14** **82** **78** **99** **77** **12** **13** **81**	**-** = No RoHS **W** = RoHS compliant	**-:** no central lead **T** = Central lead requested	Capacitance value in clear	NP0: **±1%** (Cap. value ≥ 27pF) **±2%** (Cap. value ≥ 15pF) **±5%** **±10%** **±20%** X7R: **±10%** **±20%**	**25 V** **50 V** **100 V** **150 V** **200 V** **250 V** **300 V** **500 V** **1,000 V**

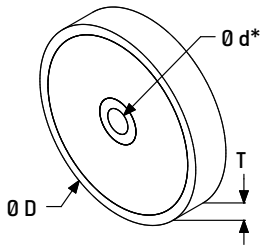
FEED-THRU

TBC Series

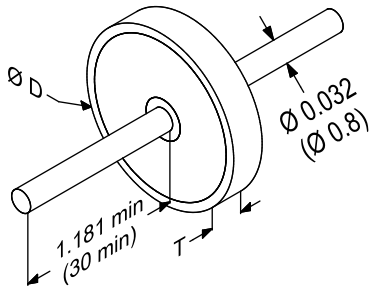
Discoidal Capacitors

DIMENSIONS in inches (mm)

Discoidal capacitor



Discoidal capacitor with central lead



STANDARD RATINGS

Size		14		82		78		99		77		12		13		81	
Dimensions inches (mm)	D	0.053 ± 0.002 (1.35 ± 0.05)		0.098 ± 0.008 (2.5 ± 0.2)		0.138 ± 0.008 (3.5 ± 0.2)		0.256 ± 0.008 (6.5 ± 0.2)		0.335 ± 0.008 (8.5 ± 0.2)		0.373 ± 0.005 (9.47 ± 0.13)		0.502 ± 0.008 (12.75 ± 0.2)		0.61 ± 0.008 (15.5 ± 0.2)	
	d max.	0.022 (0.55)		0.04 (1)		0.04 (1)		0.048 (1.2)		0.063 (1.6)		0.063 (1.6)		0.079 (2)		0.079 (2)	
	T max.	0.04 (1)		0.087 (2.2)		0.119 (3)		0.099 **(2.5)**		0.119 (3)		0.119 (3)		0.119 (3)		0.119 (3)	
Dielectric		NPO	X7R	NPO	X7R	NPO	X7R	NPO	X7R	NPO	X7R	NPO	X7R	NPO	X7R	NPO	X7R
Exxelia dielectric code		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Min. Capacitance value		10pF	100pF	10pF	100pF	15pF	100pF	18pF	100pF	47pF	100pF	56pF	150pF	82pF	390pF	100pF	820pF
Rated voltage (U_{RC})	**25V**	100pF	2.2nF	2.7nF	82nF	12nF	390nF	68nF	1.8µF	100nF	2.7µF	120nF	3.9µF	330nF	8.2µF	390nF	12µF
	50V	100pF	1.5nF	2.7nF	56nF	12nF	330nF	68nF	1.5µF	100nF	2.2µF	120nF	3.3µF	330nF	6.8µF	390nF	10µF
	100V	56pF	470pF	1.2nF	22nF	8.2nF	100nF	39nF	560nF	68nF	1µF	100nF	1.2µF	220nF	2.7µF	330nF	3.9µF
	150V	-	-	1.0nF	12nF	5.6nF	82nF	22nF	330nF	47nF	680nF	68nF	820nF	120nF	1.8µF	180nF	2.2µF
	200V	-	-	680pF	6.8nF	3.9nF	47nF	18nF	180nF	33nF	390nF	39nF	560nF	82nF	1.2µF	120nF	1.5µF
	250V	-	-	-	-	3.3nF	39nF	12nF	120nF	22nF	270nF	33nF	390nF	68nF	820nF	82nF	1µF
	300V	-	-	-	-	2.2nF	33nF	10nF	120nF	18nF	270nF	27nF	390nF	56nF	820nF	68nF	1µF
	500V	-	-	-	-	-	-	6.8nF	68nF	15nF	150nF	18nF	220nF	39nF	470nF	56nF	560nF
	1,000V	-	-	-	-	-	-	1.5nF	15nF	3.3nF	33nF	4.7nF	47nF	10nF	100nF	12nF	120nF

* Diameter d can be different: consult your sales representative

Available capacitance values:
NP0: E6, E12, E24, E48, E96 (see page 14). Specific values upon request.
X7R: E6, E12 (see page 14). Specific values upon request.
The above table defines the standard products, other components may be built upon request.

General Information

Discoidal capacitors with NP0, X7R ceramics (BX and BR available on request) feature unique frequency performance due to very low inductance inherent to the configuration.

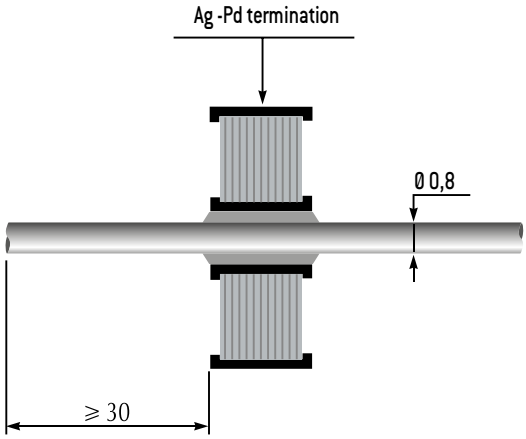
They are ideally suited to interconnect power amplifier stages through a shielding wall (high impedance electronic circuits).

Silver-palladium terminations can be directly mounted on the metal surface of the shielding wall.

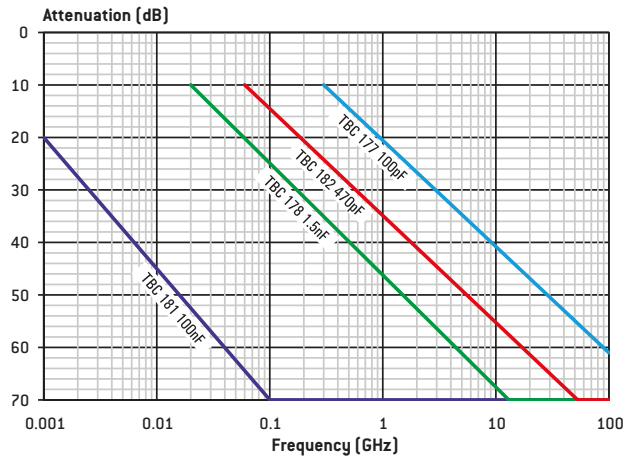
Multiple lines can be filtered simultaneously using the BPM Series which consist of multiple capacitors in the same component. These capacitors can have the same or different values. EXXELIA expertise and flexible manufacturing processes enable a wide range of arrays: custom configuration or geometry. Consult our Engineering team to support your design requirements.

Another version (option T) featuring central conductor configuration (illustrated below) enables to get rid of thermal and mechanical shocks inherent to lead soldering. This also eliminates the risks of plating deterioration during the soldering process.

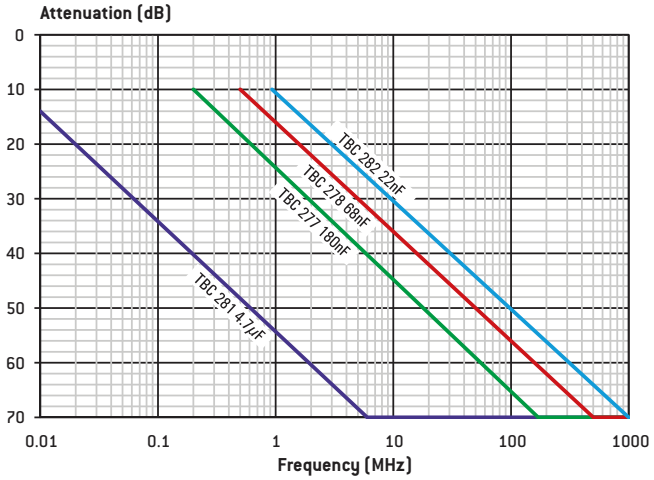
At last 2 lines can be filtered simultaneously using the BPM 12 or BPM 22 which consists of two capacitors in the same component (4 lines with the BPM24 or BPM224). These capacitors can have the same or different values (consult us).



NP0: TYPICAL ATTENUATION CURVE VERSUS FREQUENCY (50Ω IMPEDANCE)



X7R: TYPICAL ATTENUATION CURVE VERSUS FREQUENCY (50Ω IMPEDANCE)



General Information

MATERIALS EXPERT

For 50 years and as a market leader, EXXELIA's comprehensive knowledge of the materials properties and performances have enabled us to design capacitors in Porcelain, NP0, BX, 2C1, BP, X7R and –2200ppm/°C ceramics.

CUSTOM DESIGNS

Our catalog products don't meet your application?

Based on the valuable experience accumulated over the design of 2,000+ specific ceramic capacitors, you can trust EXXELIA to define a qualitative custom solution in a time effective manner.

NO OBSOLESCENCE

Choosing a standard or custom EXXELIA product means you won't have to worry about obsolescence.

TYPICAL APPLICATIONS

- Aerospace & Defense: cockpit panels, flight control, radio systems, missile guidance systems…
- Space: military and commercial satellites, launcher…
- Medical: MRI, external defibrillators, implantable devices…
- Telecommunications: base stations…
- Oil and gas: drilling tools, MWD, LWD, wellheads…

ISO 9001 AND AS9100C

Quality is at the core of Exxelia's corporate culture. Each sites has its own certifications.

CERTIFICATIONS

Capacitors manufactured by EXXELIA comply with American and European standards and meet the requirements of many international standards.
For Space qualified parts (ESA QPL), please refer to our catalog «Ceramic capacitors for Space applications».

QUALITY & RELIABILITY

EXXELIA is committed to design and manufacture high quality and reliability products. The test cycles reproducing the most adverse operating conditions over extended periods (up to 10 000 hours) have logged to date well over 5.10^9 hours/°Component.
Failure rate data can be provided upon request.

CONFLICT MINERALS

EXXELIA is committed to an approach based on «Conflict Minerals Compliance». This US SEC rule demands complete traceability and a control mechanism for the mineral procurement chain, encouraging importers to buy only «certified» ore.
We have discontinued relations with suppliers that procure from the Democratic Republic of the Congo or an adjoining country.

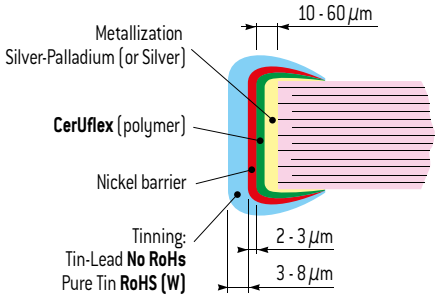
ENVIRONMENT

EXXELIA is committed to applying a robust environmental policy, from product design through to shipment. To control its environmental footprint and reconcile this with the company' functional imperatives, our environmental policy provides for the reduction or elimination of hazardous substances. We also focus on compliance with European Union directives and regulations, notably REACH and RoHS.

RoHS COMPLIANCY

SMD CAPACITORS

The capacitor terminations are generally protected by a nickel barrier formed by electrolytic deposit. This barrier gives chip capacitors leaching performance far exceeding the requirements of all applicable standards. The nickel barrier guarantees a minimum resistance to soldering heat for a period of 1 minute at 260°C in a tin-lead (60/40) or tin-lead-silver (62/36/2) bath without noticeable alteration to the solderability. It also allows repeated soldering-unsoldering and the longer soldering times required by reflow techniques.
However nickel barrier amplifies thermal shock and is not recommended for chip sizes equal or greater than CNC Y (30 30) - (C 282 to C 288 - CNC 80 to CNC 94).



LEADED COMPONENTS

As well as for SMD products, leaded capacitors ranges can also be RoHS. These products, which are characterized by the suffix «W» added to the commercial type, are naturally compatible with the soldering alloys used in RoHS mounting technology. The connections coating is generally an alloy SnAg (with a maximum of 4% Ag). However, on a few products that EXXELIA will precise on request, the coating is pure silver.

Selection Guide

Main Characteristic	Model	Size	Dielectric	Voltage	Capacitance	Temperature	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	**CEC / CNC SERIES** Low and Medium Voltage Chips Capacitors	0402 to 3040	NP0 BX 2C1 X7R	10V to 1,000V	1pF to 12µF	−55°C to +125°C	●									●		Precision, stability, decoupling	22
	NON MAGNETIC CHIPS SERIES Low and Medium Voltage Chips Capacitors	0603 to 2220	NP0 X7R	63V to 500V	10pF to 1µF	−55°C to +125°C	●									●		Precision, stability, decoupling	26
	OP SERIES Open Mode Chips Capacitors	0805 to 2220	NP0 X7R	10V to 100V	1pF to 4.7µF	−55°C to +125°C	●									●		Precision, stability, decoupling. Significantly reduce risk of short circuit	28
	CER /CNR SERIES Low Inductance Chips Capacitors	0306 to 0612	NP0 X7R	16V to 100V	1pF to 270nF	−55°C to +125°C	●									●		Decoupling, low ESL, medical embedded	30
	C3N / C4N / C3E / C4E SERIES Capacitors Arrays	-	NP0 X7R	25V to 200V	4.7pF to 33nF	−55°C to +125°C	●									●		Medical embedded, miniaturisation	32
	30 S4 SERIES Safety Capacitors	-	NP0 X7R	40V to 100V	470pF to 820nF	−55°C to +125°C	●						●			●		Railway	33
	TCE / TCX / TCN / TXR MOLDED SERIES Radial Molded Capacitors	-	NP0 BX 2C1 X7R	25V to 500V	1pF to 4.7µF	−55°C to +125°C				●					●		●	Precision, stability, decoupling	34
	LA SERIES Radial Molded Capacitors	-	NP0 Temp. coeff.	25V to 63V	1pF to 680nF	−55°C to +125°C				●					●		●	Decoupling	36
	TCE / TCX / TCN / TXR AXIAL SERIES Axial Molded Capacitors	-	NP0 BX - 2C1 X7R	25V to 500V	1pF to 3.9µF	−55°C to +125°C				●				●			●	Precision, stability, decoupling	38
	TCE / TCX / TCN / TXR CONFORMAL COATED SERIES Radial Dipped Capacitors	-	NP0 BX - 2C1 X7R	25V to 500V	1pF to 6.8µF	−55°C to +125°C			●						●		●	Precision, stability, decoupling	40
	NON MAGNETIC CONFORMAL COATED SERIES Radial Dipped Capacitors	-	NP0 X7R	63V to 500V	180pF to 1µF	−55°C to +125°C			●						●		●	Precision, stability, decoupling	42
	CK SERIES Radial Molded Capacitors	-	BX	25V to 250V	10pF to 1µF	−55°C to +125°C				●					●		●	Decoupling	44
HIGH VOLTAGE	**C Series** High voltage chips Capacitors	1812 to 16080	NP0 C4xx X7R	200V to 10kV	10pF to 39µF	−55°C to +125°C	●									●		Power supply, voltage multiplier, radars. • aerospace • space • defence • railways	51
	TCL / TCK Series High voltage Molded & Varnished leaded Capacitors	-	NP0 C4xx X7R	200V to 10kV	10pF to 39µF	−55°C to +125°C		●		●					●		●		54
	TCF Series High voltage Conformal coated leaded Capacitors	-	NP0 C4xx X7R	200V to 10kV	10pF to 39µF	−55°C to +125°C			●						●		●		57
	TKD Series High voltage Conformal coated leaded Capacitors	-	NP0 C4xx X7R	200V to 10kV	10pF to 39µF	−55°C to +125°C			●						●		●		60
	CS Series High voltage Stacked Capacitors	2220 to 16080	NP0 C4xx X7R	1kV to 10kV	220pF to 15µF	−55°C to +125°C	●	●				●	●			●	●		62
	VM Series Voltage Multipliers	-	-	-	-	−55°C to +125°C				●						●			65

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	73
	R SERIES (LEADED) Radial Leaded Conformal Coated Capacitors		-	X7R	50V to 500V	47nF to 27µF	−55°C to +125°C			●						●		●		77
	TEF SERIES Radial Leaded Conformal Coated Capacitors		-	NP0	63V to 500V	10nF to 680nF	−55°C to +125°C			●						●		●		80
	SV / SC SERIES High Capacitance Stacked Capacitors		2225 to 125205	X7R	50V to 500V	47nF to 390µF	−55°C to +125°C	●	●				●	●			●	●		81
	CNC3X SERIES High Capacitance Stacked Capacitors		2220 to 4040	X7R	16V to 25V	1.2µF to 68µF	−55°C to +125°C	●	●				●				●	●		88
	CEC5X SERIES High Capacitance Stacked Capacitors		3033 to 80150	NP0	63V to 500V	10nF to 6.8µF	−55°C to +125°C	●	●				●				●	●		90
	TEP / TEV SERIES High Capacitance Stacked Capacitors		-	NP0	63V to 500V	10nF to 6.8µF	−55°C to +125°C		●							●		●		93
	TCN8X SERIES High Capacitance Molded Stacked Capacitors		-	X7R	63V to 500V	0.47µF to 120µF	−55°C to +125°C				●						●			95
HIGH TEMPERATURE	**CE / CN SERIES** High Temperature Chips Capacitors		0402 to 3040	NP0 X7R	16V to 100V	1pF to 8.2µF	−55°C to +250°C	●									●		Oil drilling, motor control, braking systems.	100
	SCT SERIES High Temperature Stacked Capacitors		2225 to 125205	X7R	50V to 500V	47nF to 390µF	−55°C to +215°C	●	●				●				●	●		102
	TCE / TCN MOLDED SERIES HT High Temperature Molded Capacitors		-	NP0 X7R	16V to 100V	1pF to 10µF	−55°C to +220°C				●				●	●		●		107
	TCE / TCN SELF-PROTECTED SERIES High Temperature Self-Protected Capacitors		-	NP0 X7R	25V to 500V	10pF to 3.9µF	−55°C to +250°C					●			●	●		●		109
	TCH SERIES High Temperature High Voltage Capacitors		-	NP0 X7R	200V to 10kV	10pF to 15µF	−55°C to +250°C		●							●		●		111
FEED-THRU	**TBC SERIES** Discoidal Capacitors		-	NP0 X7R	25V to 1kV	10pF to 12µF	−55°C to +125°C	●									●		Very low ESL	115
	BPM SERIES Planar Array		-	X7R	25V to 200V	330pF to 68nF	−55°C to +125°C	●									●		Very low ESL, miniaturisation	117

Selection Guide

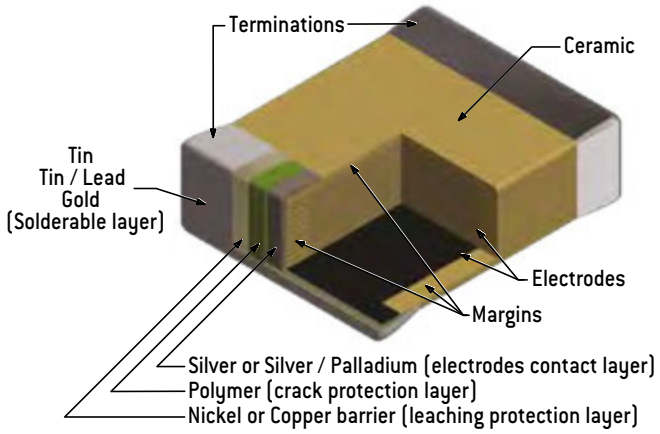
Main Characteristic	Model	Size range	Dielectric	Voltage range	Capacitance range	Temperature range	Coating: Uncoated	Coating: Varnished	Coating: Conformal coated	Coating: Molded	Coating: Self protected	Leads: DIL	Leads: Ribbon	Leads: Axial	Leads: Radial	Mounting: SMD	Mounting: Through hole	Main Applications	Page
HIGH Q	**XBL SERIES** Broadband	0402	X7R	16V	100nF	−55°C to +125°C	●									●		DC Blocking, Coupling, Bypassing	138
	UBL SERIES Broadband	0402	X7R	16V	100nF	−55°C to +125°C	●									●			140
	UBZ SERIES Broadband	0201	X5R X6T	10V	100nF	−55°C to +105°C	●									●			142
	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.	144
	SH SERIES Super HiQ	0402 to 1210	NP0	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	147
	SHD / SHR SERIES Reverse Geometry	0709 0711	NP0	500V	0.5pF to 100pF	−55°C to +175°C	●									●			150
	NHB SERIES High Self Resonant Frequency	1111	NP0	500V	0.3pF to 100pF	−55°C to +175°C	●									●			152
	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	154
	CL SERIES High Power	2225 to 7065	NP0	200V to 7kV	1pF to 10nF	−55°C to +125°C	●		●				●	●	●	●	●	RF power amplifier Plasma chamber MRI coils	158

ADDITIONAL AVAILABLE RANGES (consult our website)

STANDARD	**TCE1X Series**	-	NP0	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	NP0 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	-	NP0	100V to 300V	10nF to 1µF	−55°C to +125°C	●	●					●	●		●	●		-

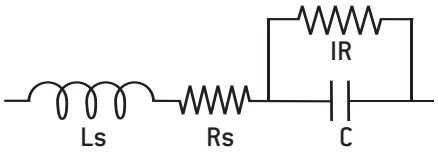
Ceramic Capacitors Technology

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 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	NP0	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	+		+	++		

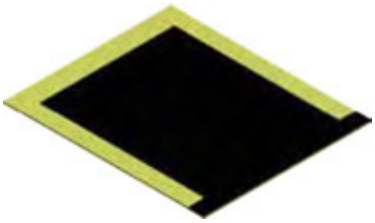
Ceramic Capacitors Technology

MANUFACTURING STEPS

SLIP CASTING

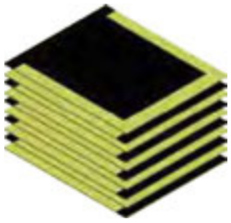
A slurry, a mix of ceramic powder, binder and solvents, is poured onto conveyor belt inside a drying oven, resulting in a dry ceramic sheet.

ELECTRODE SCREEN PRINTING



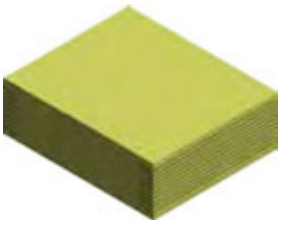
The electrode ink, made from a metal powder mixed with solvents, is printed onto the ceramic sheets using a screen printing process.

STACKING



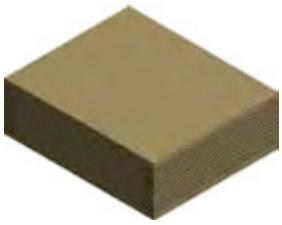
The sheets with electrode printed are stacked to create a multilayer structure.

PRESSING



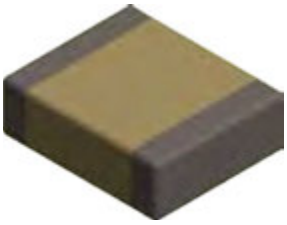
Pressure is applied to the stack to fuse all the separate layers, this created a monolithic structure.

SINTERING



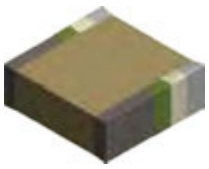
The parts are sintered in an oven with a precise temperature profile which is very important to the characteristics of the capacitors.

TERMINATIONS



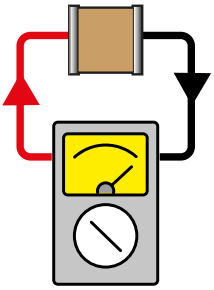
Each terminal of the capacitor is dipped in the termination ink, mix of metal powder, solvents and glass frit and the parts are fired in an oven.

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 + Ni + dipped Sn/Pb 60/40	**T****	-	**-**	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**	Ag + Ni + electrolytic Sn	**EW**	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.
** Maintenance only.
*** 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

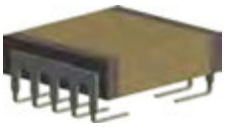
DIL LEADS

P style

PL style

L style

J style



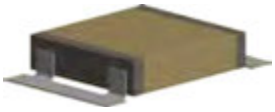
RIBBON LEADS

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

Axial (Type 2)

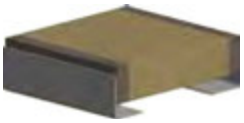
Radial (Type 3)

R style



RX style

RJ style



Please contact Exxelia sales for any lead configuration not shown.

TROUGH-HOLE MOUNTING

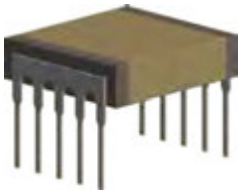
AXIAL AND RADIAL

Radial leads (Type 6)

Radial leads (4 leads)

Axial leads (Type 7)

DIL leads: N style



ENCAPSULATION STYLES

Ceramic encapsulation
(selfprotected)

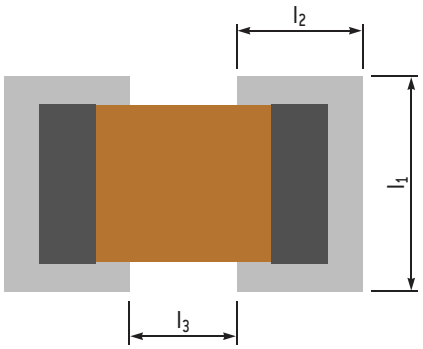
Varnish

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					
	I_1		I_2		I_3		I_1		I_2		I_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

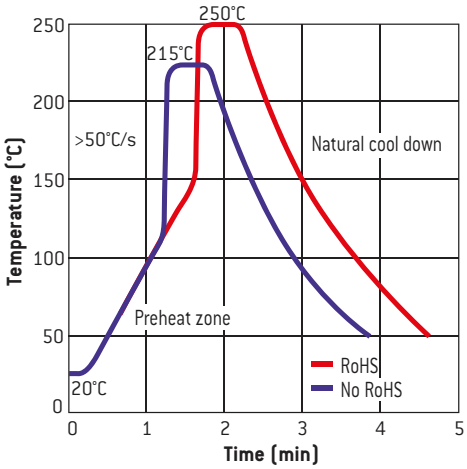
Ceramic is by nature a material which is sensitive both thermally and mechanically. Stresses caused by the physical and thermal properties of the capacitors, substrates and solders are attenuated by the leads.

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).

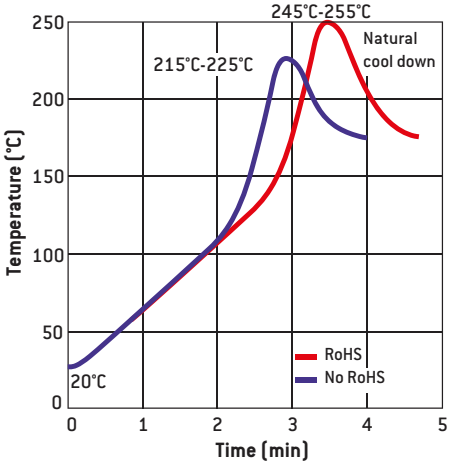
Infrared and vapor phase reflow, are preferred for high reliability applications as inherent thermo-mechanical strains are lower than those inherent to wave soldering.

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

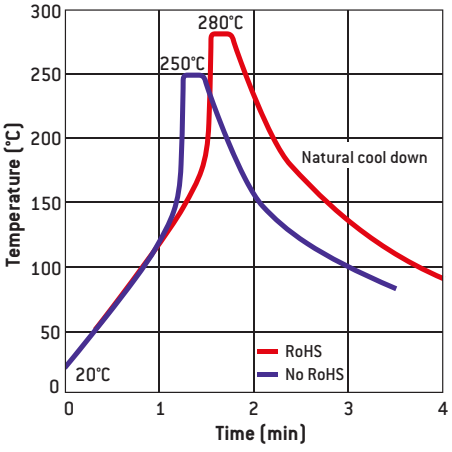
RECOMMENDED VAPOR PHASE REFLOW PROFILE



RECOMMENDED IR REFLOW 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.

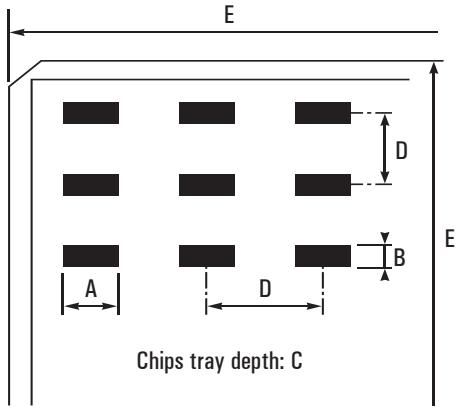
Maximum quantities per reel are as follows:

- 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.

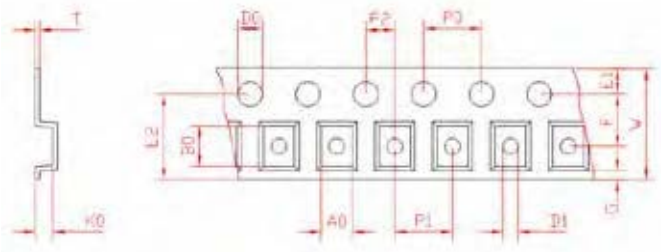
TRAY PACKAGES



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 ±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	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

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

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

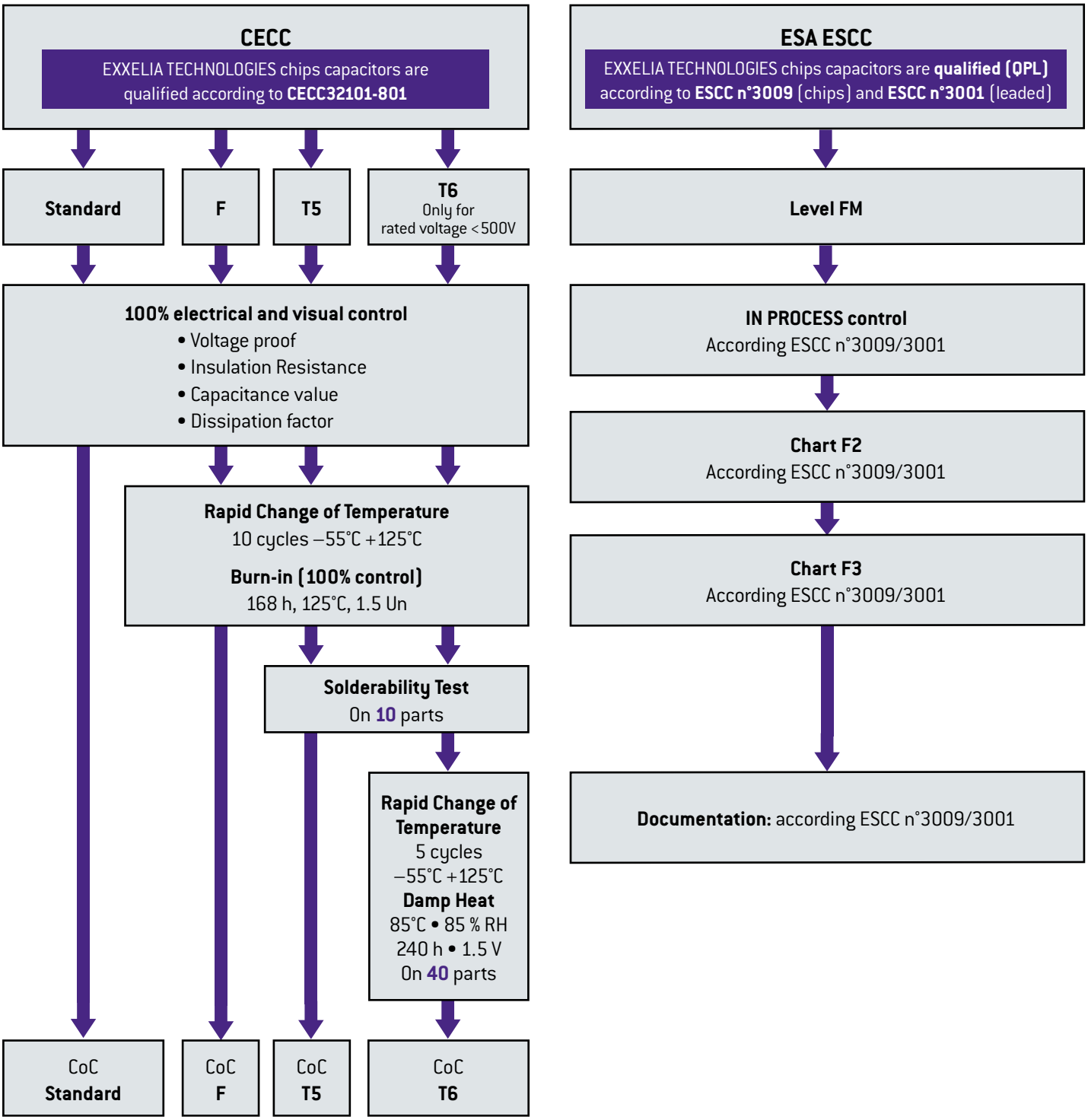
PART MARKING TOLERANCE CODES

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

RELIABILITY LEVELS

Exxelia proposes different reliability levels for the ceramic capacitors for both NP0 and X7R ceramics.



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.

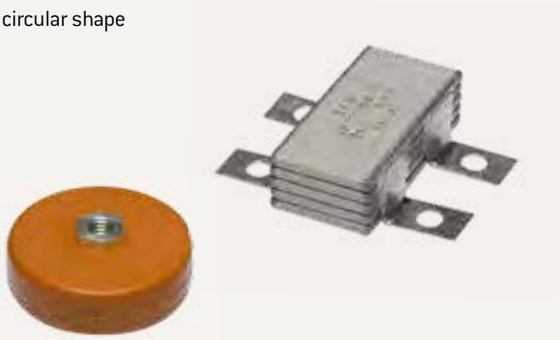
Where necessary, special testing is done to verify requirements, such as low dielectric absorption, ultra-high insulation resistance, low dissipation factor, stability under temperature cycling or under specified environmental conditions, etc.

HIGH CAPACITANCE

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

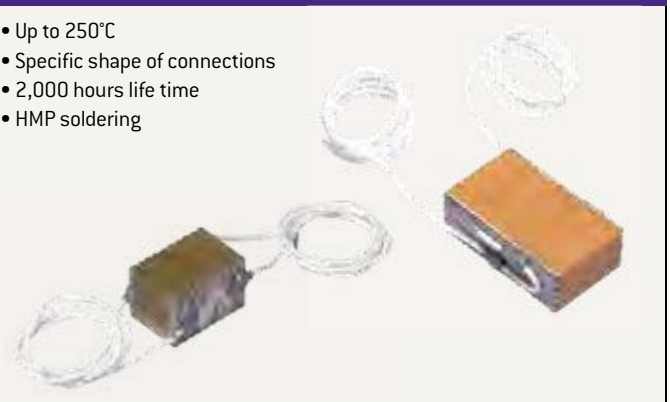
HIGH VOLTAGE

- 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