TCF Series

High Voltage Conformal Coated Leaded Capacitors

According to

Available space ranges: consult our detail specifications

FEATURES

- Multilayer chip ceramic capacitors
- NP0, C4xx and X7R dielectrics
- Capacitance range: 10pf to 39µF
- Voltage range: 200 V_{DC} to 10,000 V_{DC}

PHYSICAL CHARACTERISTICS

CONSTRUCTION

Epoxy conformal coated radial leaded capacitors suited to through-hole circuits.

MARKING

Series, capacitance value, tolerance, rated voltage, date code.

ELECTRICAL SPECIFICATIONS

DIELECTRIC	NP0	C4xx	X7R
Dielectric code	**1**	**4**	**2**
Maximum ΔC/°C over temperature range without voltage	NA	NA	±15%
Temperature coefficient	(0±30) ppm/°C	(−2,200±500) ppm/°C	NA
Aging	None	None	≤ 2.5% per decade hour
Operating temperature	−55°C to +125°C		
Rated voltage (U_{RC})	200 V_{DC} to 10,000 V_{DC}	200 V_{DC} to 5,000 V_{DC}	200 V_{DC} to 10,000 V_{DC}
Dielectric withstanding voltage	2.5 U_{RC} for U_{RC} ≤ 500 V_{DC} 1.6 U_{RC} for U_{RC} ≥ 1,000 V_{DC} **Extended range:** 2 U_{RC} for U_{RC} ≤ 500 V_{DC} 1.3 U_{RC} for U_{RC} ≥ 1,000 V_{DC}	2.5 U_{RC} for U_{RC} = 200 V_{DC} 2 U_{RC} for U_{RC} = 500 V_{DC} 1.5 U_{RC} for U_{RC} = 1,000 V_{DC} 1.4 U_{RC} for U_{RC} > 1,000 V_{DC} **Extended range:** 1.5 U_{RC} for U_{RC} ≤ 500 V_{DC} 1.2 U_{RC} for U_{RC} ≥ 1,000 V_{DC}	2.5 U_{RC} for U_{RC} = 200 V_{DC} 2 U_{RC} for U_{RC} = 500 V_{DC} 1.5 U_{RC} for U_{RC} = 1,000 V_{DC} 1.2 U_{RC} for U_{RC} > 1,000 V_{DC} **Extended range:** 1.5 U_{RC} for U_{RC} ≤ 500 V_{DC} 1.2 U_{RC} for U_{RC} ≥ 1,000 V_{DC}
Capacitance	at 1MHz for C ≤ 1,000pf at 1kHz for C > 1,000pf	at 1kHz	at 1kHz
Dissipation factor	≤ 0.015 (150/C + 7)% at 1MHz for C ≤ 50pf ≤ 0.15% at 1MHz for 50pf < C ≤ 1,000pf ≤ 0.15% at 1 kHz for C > 1,000pf	≤ 0.10% at 1 kHz	≤ 2.5% at 1 kHz
Insulation resistance at 25°C under U_{RC} for U_{RC} ≤ 500 V under 500 V_{DC} for U_{RC} > 500 V	≥ 100,000 MΩ for C ≤ 10nf ≥ 1,000 MΩ.µF for C > 10nf	≥ 20,000 MΩ for C ≤ 25nf ≥ 500 MΩ.µF for C > 25nf	
Voltage proof body insulation	under U_{RC} for U_{RC} ≤ 1,250 V_{DC} under 1,300 V_{DC} for U_{RC} > 1,250 V_{DC}		

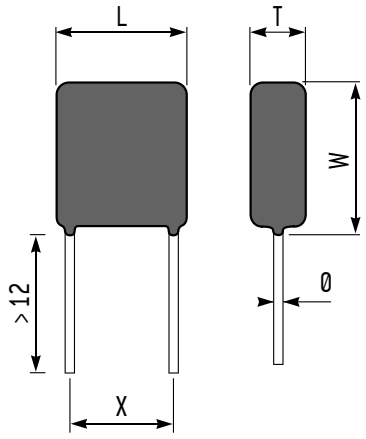
HOW TO ORDER

TCF	1	82	W	F	680pF	10%	4,000 V	B
Series	Dielectric code	Exxelia size code	RoHS compliant	Quality level	Capacitance	Tolerance	Rated voltage	Reliability level
TCF = Conformal coated radial leaded capacitor	**1** = NP0 **2** = X7R **4** = C4xx	**79** **90** **80** **91** **81** **82** **83** **84** **89** **85** **87** **88**	**-** = No RoHS **W** = RoHS compliant	**-** = standard quality level **F** = Hi-Rel quality: screening in accordance with Exxelia specification	Capacitance value in clear	NP0 dielectric: **±1%** **±2%** **±5%** **±10%** **±20%** C4xx dielectric: **±2%** **±5%** **±10%** **±20%** X7R dielectric: **±10%** **±20%**	**200 V** **500 V** **1,000 V** **1,500 V** **2,000 V** **3,000 V** **4,000 V** **5,000 V** **7,500 V** **10,000 V** Intermediary and higher voltages available: contact your sales representative.	For F parts only. Acc. to Exxelia spec. **-** **T5** **T6** See page 15

High Voltage Conformal Coated Leaded Capacitors

TCF Series

DIMENSIONS in inches (mm)



STANDARD RATINGS

	Exxelia size code	78		79			90			80			91			81			82		
Dimensions inches (mm)	L max.	0.249 (6.3)		0.256 (6.5)			0.256 (6.5)			0.315 (8)			0.319 (8.1)			0.394 (10)			0.414 (10.5)		
	W max.	0.229 (5.8)		0.237 (6)			0.355 (9)			0.355 (9)			0.355 (9)			0.355 (9)			0.453 (11.5)		
	T max.	0.205 (5.2)		0.197 (5)			0.197 (5)			0.197 (5)			0.2kV up to 3kV: 0.237 (6) 4kV-5kV: 0.276 (7)			0.2kV up to 3kV: 0.237 (6) 4kV: 0.276 (7) 5kV: 0.315 (8)			0.2kV up to 3kV: 0.237 (6) 4kV: 0.276 (7) 5kV: 0.315 (8)		
	Ø ± 10%	0.024 (0.6)		0.024 (0.6)			0.024 (0.6)			0.024 (0.6)			0.024 (0.6)			0.031 (0.8)			0.031 (0.8)		
	X	0.2 ± 0.02 (5.08 ± 0.5)		0.2 ± 0.012 (5.08 ± 0.3)			0.2 ± 0.012 (5.08 ± 0.3)			0.2 ± 0.012 (5.08 ± 0.3)			0.2 ± 0.012 (5.08 ± 0.3)			0.3 ± 0.012 (7.62 ± 0.3)			0.4 ± 0.012 (10.16 ± 0.3)		
Dielectric		NPO	X7R	NPO	C4xx	X7R	NPO	C4xx	X7R	NPO	C4xx	X7R	NPO	C4xx	X7R	NPO	C4xx	X7R	NPO	C4xx	X7R
Exxelia ceramic code		1	2	1	4	2	1	4	2	1	4	2	1	4	2	1	4	2	1	4	2
Min. Capacitance value		12pF	120pF	10pF	27pF	100pF	10pF	33pF	150pF	10pF	33pF	150pF	15pF	47pF	150pF	18pF	56pF	150pF	33pF	82pF	330pF
Rated voltage (U_{RC})	0.2kV Standard	-	-	5.6nF	120nF	220nF	12nF	220nF	470nF	12nF	220nF	390nF	15nF	330nF	560nF	18nF	390nF	820nF	33nF	680nF	1.5µF
	0.2kV Extended	-	-	18nF	-	470nF	27nF	-	-	22nF	-	1µF	39nF	-	-	56nF	-	1.8µF	100nF	-	2.7µF
	0.5kV Standard	-	-	3.3nF	22nF	47nF	6.8nF	47nF	100nF	5.6nF	47nF	100nF	6.8nF	68nF	150nF	8.2nF	82nF	220nF	22nF	120nF	390nF
	0.5kV Extended	-	-	10nF	39nF	150nF	18nF	68nF	-	18nF	68nF	270nF	22nF	100nF	-	27nF	120nF	560nF	68nF	220nF	1µF
	1kV Standard	-	-	1.8nF	6.8nF	15nF	2.7nF	12nF	24nF	2.2nF	12nF	22nF	3.3nF	18nF	33nF	3.9nF	22nF	47nF	10nF	39nF	68nF
	1kV Extended	820pF	12nF	5.6nF	10nF	27nF	8.2nF	15nF	-	6.8nF	15nF	56nF	10nF	22nF	-	12nF	27nF	120nF	33nF	56nF	220nF
	1.5kV Standard	-	-	820pF	2.7nF	5.6nF	1.2nF	5.6nF	10nF	1.5nF	5.6nF	10nF	2.2nF	8.2nF	15nF	2.7nF	10nF	18nF	4.7nF	18nF	33nF
	1.5kV Extended	-	-	1.5nF	3.9nF	12nF	2.2nF	8.2nF	-	2.2nF	6.8nF	22nF	3.3nF	12nF	-	4.7nF	15nF	47nF	8.2nF	27nF	82nF
	2kV Standard	-	-	390pF	1.5nF	3.3nF	680pF	2.7nF	5.6nF	470pF	2.7nF	5.6nF	820pF	4.7nF	6.8nF	1.2nF	5.6nF	10nF	3.3nF	10nF	18nF
	2kV Extended	470pF	2.7nF	820pF	2.2nF	5.6nF	1.2nF	3.9nF	-	1nF	3.9nF	12nF	1.8nF	6.8nF	-	2.7nF	8.2nF	27nF	6.8nF	15nF	47nF
	3kV Standard	-	-	180pF	680pF	1.2nF	180pF	1.2nF	2.2nF	220pF	1.2nF	2.2nF	330pF	1.8nF	3.3nF	470pF	2.2nF	3.9nF	820pF	3.9nF	6.8nF
	3kV Extended	220pF	1nF	390pF	1nF	2.7nF	680pF	1.8nF	-	470pF	1.8nF	4.7nF	820pF	2.7nF	-	1nF	3.3nF	12nF	1.8nF	5.6nF	22nF
	4kV Standard	-	-	100pF	330pF	680pF	120pF	680pF	1nF	150pF	820pF	1.2nF	220pF	1.2nF	1.8nF	390pF	1.5nF	2.7nF	680pF	3.3nF	4.7nF
	4kV Extended	150pF	470pF	220pF	560pF	-	330pF	1nF	-	330pF	1.2nF	2.2nF	680pF	1.8nF	-	820pF	2.2nF	4.7nF	1.5nF	4.7nF	10nF
	5kV Standard	-	-	-	-	-	-	-	-	100pF	560pF	820pF	150pF	820pF	1nF	270pF	1nF	1.8nF	470pF	2.2nF	3.3nF
	5kV Extended	-	-	-	-	-	-	-	-	220pF	820pF	1.5nF	320pF	1.2nF	-	560pF	1.5nF	3.3nF	1nF	2.7nF	6.8nF

Available capacitance values:
NP0, C4xx dielectrics: E6, E12, E24 (see page 14). Specific values upon request.
X7R dielectric: E6, E12 in standard (see page 14). Specific values upon request.
The above table defines the standard products, other components may be built upon request.

TCF Series

High Voltage Conformal Coated Leaded Capacitors

STANDARD RATINGS

	Exxelia size code	83			84			89			85			87			88		
Dimensions inches (mm)	L max.	0.552 (14)			0.689 (17.5)			0.701 (17.8)			0.788 (20)			1.221 (31)			1.772 (45)		
	W max.	0.571 (14.5)			0.571 (14.5)			0.689 (17.5)			0.749 (19)			0.945 (24)			0.906 (23)		
	T max.	0.2kV up to 3kV: 0.237 (6) 4kV: 0.276 (7) 5kV up to 10kV: 0.315 (8)			0.2kV up to 3kV: 0.237 (6) 4kV: 0.276 (7) 5kV up to 10kV: 0.315 (8)			0.2kV up to 3kV: 0.237 (6) 4kV: 0.276 (7) 5kV up to 10kV: 0.315 (8)			0.2kV up to 3kV: 0.237 (6) 4kV: 0.276 (7) 5kV up to 10kV: 0.315 (8)			0.2kV up to 3kV: 0.237 (6) 4kV: 0.276 (7) 5kV: 0.315 (8) 7.5kV up to 10kV: 0.335 (8.5)			0.2kV up to 3kV: 0.237 (6) 4kV: 0.276 (7) 5kV: 0.315 (8) 7.5kV up to 10kV: 0.335 (8.5)		
	Ø ± 10%	0.031 (0.8)			0.031 (0.8)			0.031 (0.8)			0.031 (0.8)			0.039 (1)			0.039 (1)		
	X	0.5 ± 0.012 (12.7 ± 0.3)			0.6 ± 0.012 (15.24 ± 0.3)			0.6 ± 0.012 (15.24 ± 0.3)			0.7 ± 0.012 (17.8 ± 0.3)			1.1 ± 0.012 (27.94 ± 0.3)			1.6 ± 0.012 (40.64 ± 0.3)		
Dielectric		NPO	C4xx	X7R	NPO	C4xx	X7R	NPO	C4xx	X7R	NPO	C4xx	X7R	NPO	C4xx	X7R	NPO	C4xx	X7R
Exxelia ceramic code		1	4	2	1	4	2	1	4	2	1	4	2	1	4	2	1	4	2
Min. Capacitance value		10pF	180pF	270pF	22pF	270pF	390pF	27pF	390pF	560pF	47pF	470pF	1nF	120pF	1nF	2.2nF	150pF	1.8nF	2.7nF
Rated voltage (U_{RC})	0.2kV Standard	56nF	1.2µF	2.7µF	82nF	1.5µF	3.9µF	100nF	1.8µF	4.7µF	180nF	2.7µF	6.8µF	330nF	6.8µF	12µF	390nF	8.2µF	15µF
	0.2kV Extended	180nF	-	5.6µF	270nF	-	6.8µF	220nF	-	8.2µF	560nF	-	12µF	1µF	-	33µF	1.2µF	-	39µF
	0.5kV Standard	33nF	270nF	680nF	47nF	330nF	1µF	56nF	390nF	1.2µF	82nF	680nF	1.8µF	150nF	1.5µF	3.9µF	270nF	1.8µF	4.7µF
	0.5kV Extended	100nF	390nF	1.5µF	150nF	560nF	2.2µF	150nF	680nF	2.7µF	270nF	1µF	3.9µF	470nF	2.2µF	10µF	820nF	2.7µF	12µF
	1kV Standard	15nF	82nF	150nF	22nF	82nF	220nF	33nF	120nF	270nF	39nF	220nF	390nF	82nF	560nF	1µF	150nF	680nF	1.2µF
	1kV Extended	47nF	120nF	390nF	68nF	120nF	560nF	82nF	220nF	560nF	120nF	330nF	1µF	270nF	680nF	2.7µF	470nF	1µF	3.3µF
	1.5kV Standard	8.2nF	39nF	82nF	12nF	39nF	100nF	15nF	68nF	150nF	22nF	100nF	180nF	47nF	220nF	470nF	68nF	330nF	560nF
	1.5kV Extended	18nF	56nF	180nF	22nF	56nF	220nF	33nF	100nF	330nF	47nF	150nF	470nF	100nF	330nF	1.2µF	150nF	470nF	1.5µF
	2kV Standard	4.7nF	18nF	33nF	6.8nF	22nF	68nF	8.2nF	39nF	68nF	12nF	56nF	100nF	27nF	120nF	220nF	39nF	180nF	330nF
	2kV Extended	10nF	27nF	100nF	15nF	33nF	150nF	18nF	56nF	150nF	27nF	82nF	220nF	56nF	180nF	560nF	82nF	270nF	820nF
	3kV Standard	1.5nF	8.2nF	15nF	2.7nF	10nF	27nF	3.3nF	18nF	27nF	4.7nF	27nF	39nF	12nF	56nF	100nF	15nF	68nF	120nF
	3kV Extended	3.3nF	12nF	39nF	5.6nF	15nF	56nF	10nF	22nF	68nF	10nF	39nF	100nF	27nF	82nF	270nF	33nF	100nF	330nF
	4kV Standard	1.2nF	6.8nF	10nF	2.2nF	6.8nF	15nF	2.7nF	12nF	18nF	3.9nF	18nF	27nF	10nF	39nF	68nF	12nF	47nF	100nF
	4kV Extended	2.7nF	10nF	18nF	4.7nF	10nF	27nF	6.8nF	18nF	39nF	8.2nF	27nF	47nF	22nF	56nF	120nF	27nF	82nF	150nF
	5kV Standard	1nF	4.7nF	5.6nF	1.8nF	4.7nF	10nF	1.8nF	8.2nF	12nF	3.3nF	12nF	18nF	8.2nF	27nF	56nF	10nF	33nF	68nF
	5kV Extended	2.2nF	6.8nF	15nF	3.9nF	6.8nF	22nF	4.7nF	12nF	27nF	6.8nF	18nF	39nF	15nF	39nF	82nF	18nF	47nF	100nF
	7.5kV Standard	150pF	-	1.5nF	270pF	-	2.7nF	470pF	-	3.3nF	560pF	-	6.8nF	1.5nF	-	18nF	2.2nF	-	27nF
	7.5kV Extended	330pF	-	3.3nF	560pF	-	5.6nF	1.2nF	-	6.8nF	1.2nF	-	12nF	3.3nF	-	33nF	4.7nF	-	47nF
	10kV Standard	100pF	-	680pF	180pF	-	1.2nF	270pF	-	1.5nF	390pF	-	3.3nF	1nF	-	8.2nF	1.5nF	-	12nF
	10kV Extended	220pF	-	1.8nF	390pF	-	3.3nF	680pF	-	3.9nF	820pF	-	6.8nF	2.2nF	-	15nF	3.3nF	-	27nF

Available capacitance values:
NP0, C4xx dielectrics: E6, E12, E24 (see page 14). Specific values upon request.
X7R dielectric: E6, E12 in standard (see page 14). Specific values upon request.
The above table defines the standard products, other components may be built upon request.

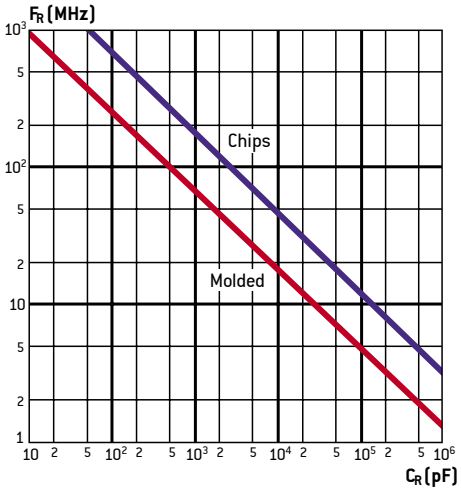
General Information

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 ppm/°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.

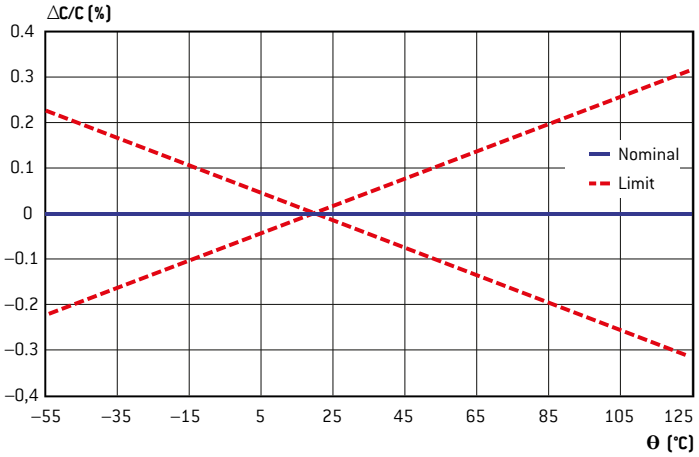
NPO, X7R, C4xx: SELF-RESONANCE FREQUENCE VS CAPACITANCE



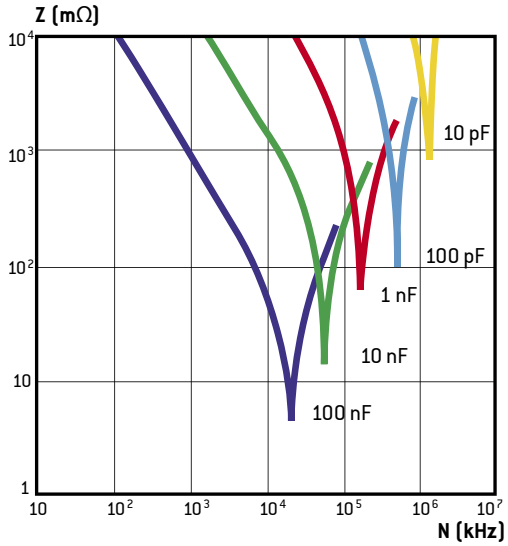
NPO/COG DIELECTRICS (CLASS 1)

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:

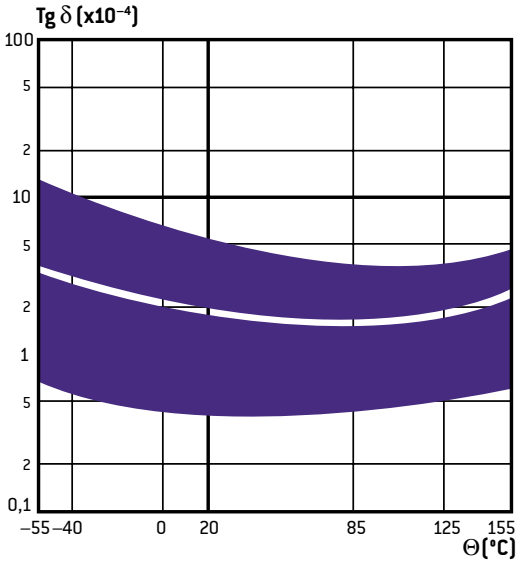
NPO: RELATIVE CAPACITANCE CHANGE VS TEMPERATURE



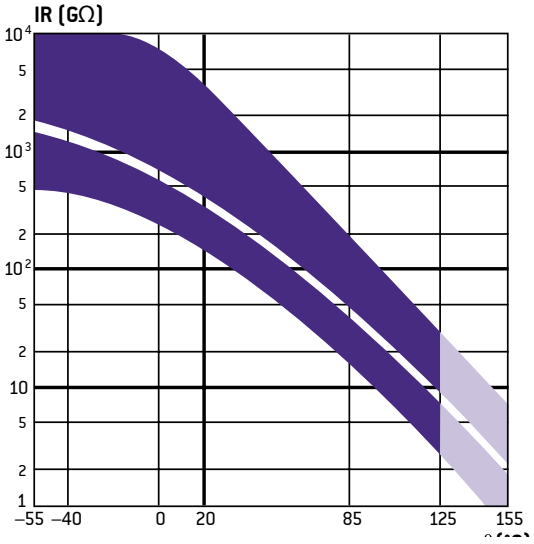
NPO: IMPEDANCE VS FREQUENCE



NPO: LOSS TANGENT VS TEMPERATURE



NPO: INSULATION RESISTANCE VS TEMPERATURE



General Information

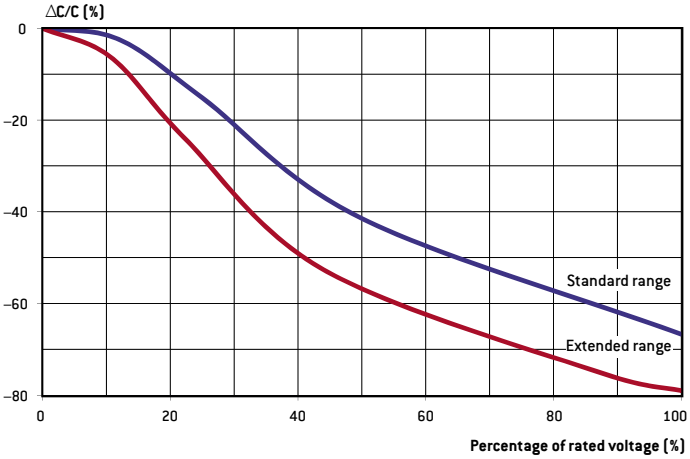
X7R DIELECTRICS (CLASS 2)

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.

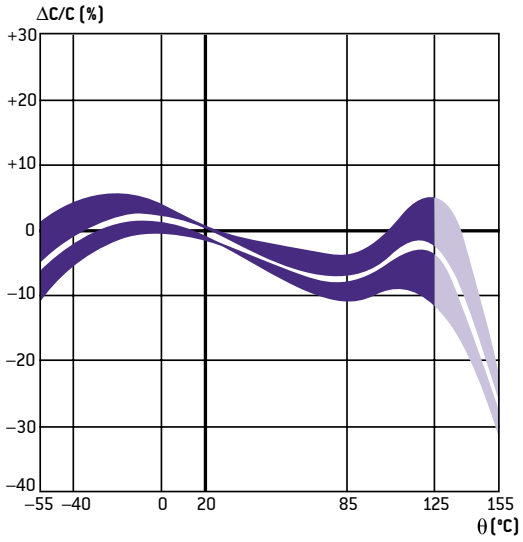
For optimum use, the specific properties of barium titanate in function of the different parameters must be taken into account.

See the variations illustrated in figures below:

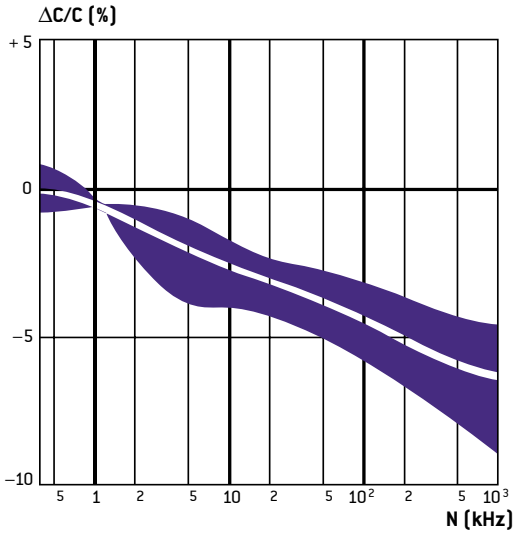
CHANGE VS PERCENTAGE OF RATED VOLTAGE APPLIED



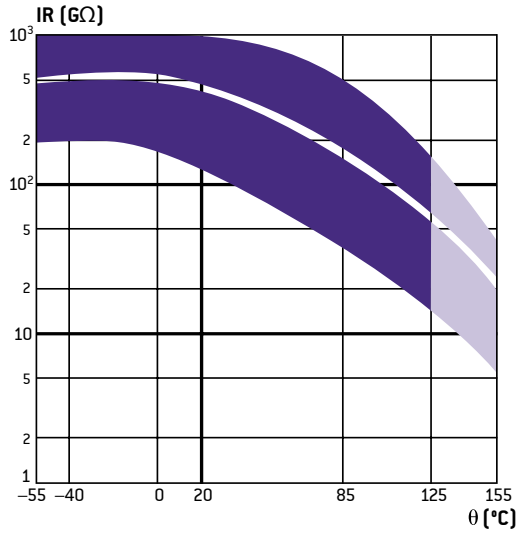
X7R: CAPACITANCE CHANGE VS TEMPERATURE



X7R: CAPACITANCE CHANGE VS FREQUENCY

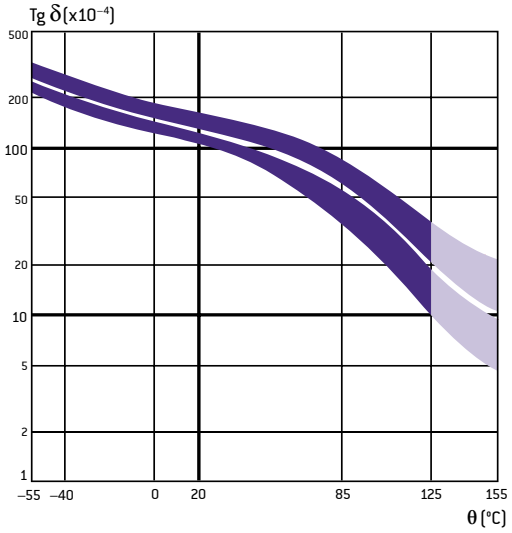


X7R: INSULATION RESISTANCE VS TEMPERATURE

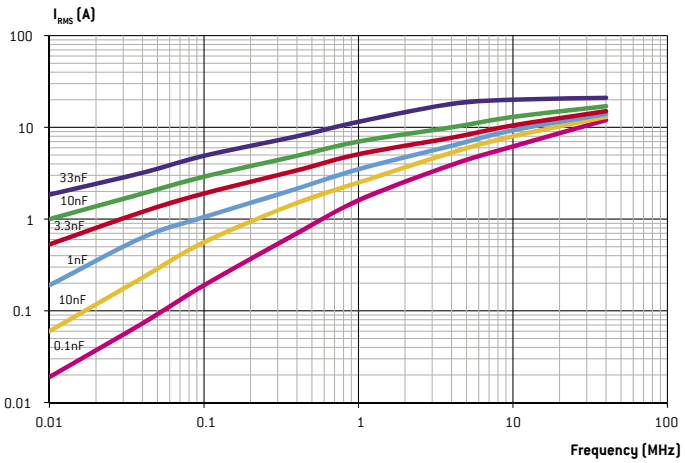


General Information

X7R: LOSS TANGENT CHANGE VS TEMPERATURE



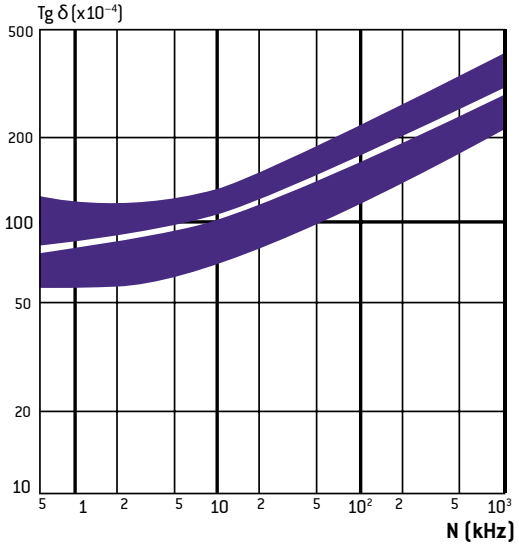
X7R: MAXIMUM ADMISSIBLE CURRENT VS FREQUENCY



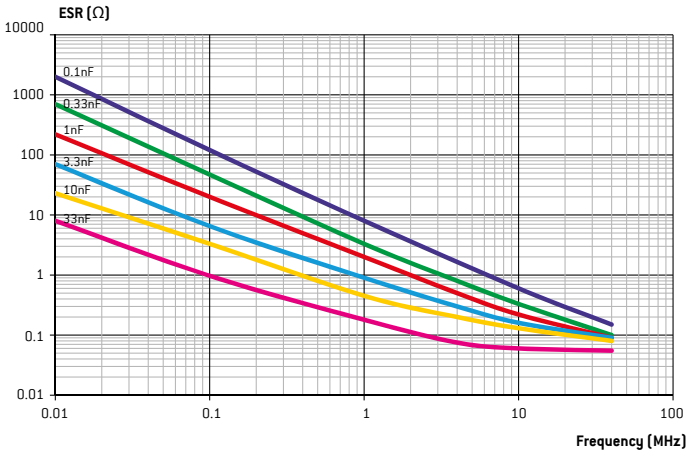
These typical curves are examples of admissible currents for one family of chip capacitors (size 3333). For other curves and products or for further information, please contact us.

Note: for the calculations, we have considered that the terminations are directly connected to an infinite heat sink. In other words, the thermal resistance of the circuit itself which depends on its type and design has not been taken into account. Moreover, the ambient temperature taken is 25°C.

X7R: LOSS TANGENT CHANGE VS FREQUENCY



X7R: ESR VS FREQUENCY



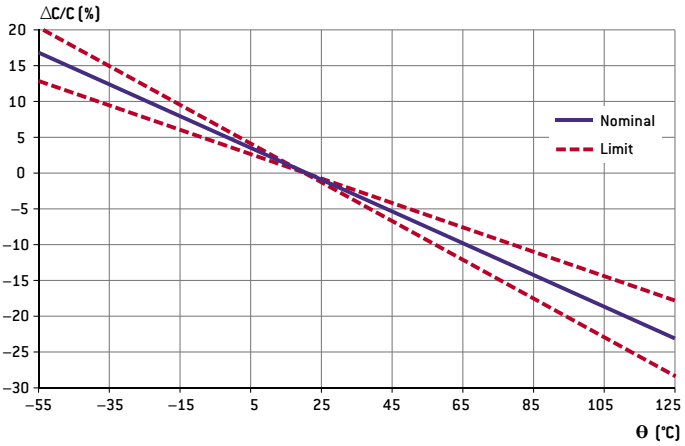
The ESR (Equivalent Serial Resistance) typical curves are given, here for SMD (chip) capacitors. Regarding the curves for the leaded capacitors, they are rather the same. Indeed, due to the resistivity of the raw material used and the wire diameters, the resistance of the wires is much lower than the ESR of the chips. So, in a first approach, their influence can be considered as negligible.

General Information

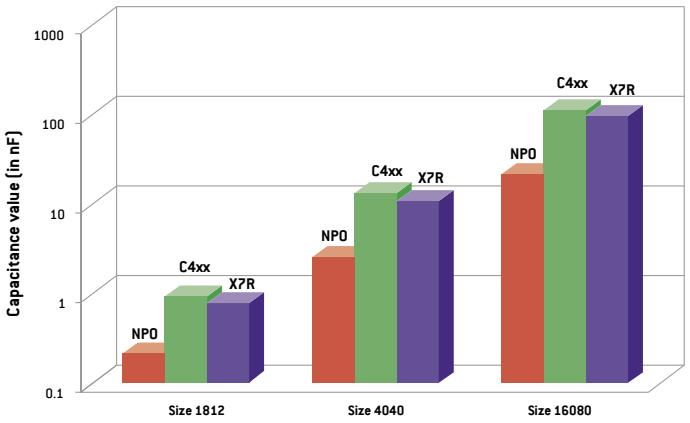
C4xx DIELECTRIC

This ceramic is a negative temperature coefficient dielectric (–2,200 ppm/°C). Its advantage is that it combines the high dielectric constant of an X7R dielectric with the stability of an NP0 dielectric. As the C4xx ceramic features low dissipation factor it is recommended for AC line filtering from 110 Vrms to 230 Vrms, 20 to 400 Hz, for high power RF at high voltage up to 5,000 V and for pulse applications.

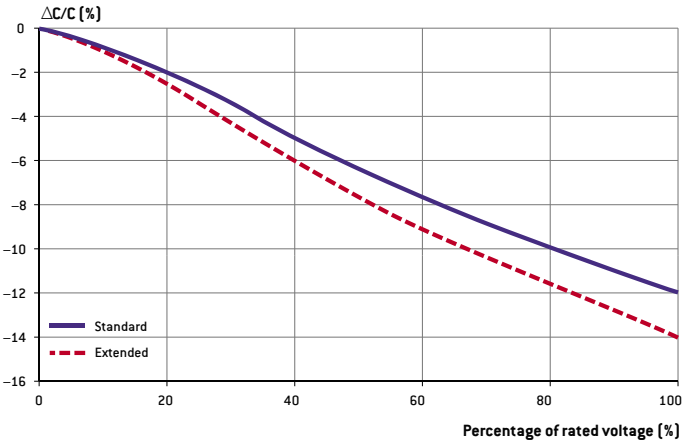
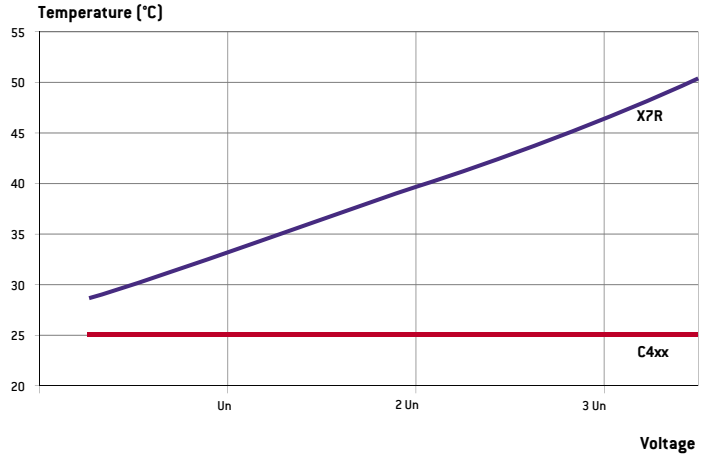
C4xx: TEMPERATURE COEFFICIENT



COMPARISON OF CAPACITANCE VALUE UNDER RATED VOLTAGE AT 125°C



C4xx: VOLTAGE COEFFICIENT



COMPARISON OF SELF-HEATING AT 400 Hz BETWEEN C4xx AND X7R DIELECTRICS