Radial Leaded Conformal Coated Capacitors

R Series (Leaded)

FEATURES

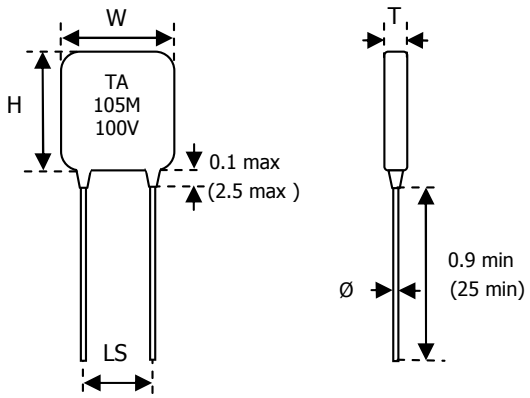
- Multilayer conformal coated radial ceramic capacitors
- Dielectric type II
- Capacitance range: 47 nF to 27 µF
- Voltage range: 50 V_{DC} to 500 V_{DC}

PACKAGING

«BLISTER» BOXES:

For all products, special «blister» boxes are used to optimize the protection of the parts during the carriage and the storage. Depending upon the termination (with or without connection) and the size, the number of the parts in each box is defined. Please, consult us for more details.

DIMENSIONS in inches (mm)



ELECTRICAL SPECIFICATIONS

Description	«X» Series (type II)	«T» Series (type II)
CECC	2R1	2R1
EIA	X7R	X7R
Exxelia Temex Code	X	T
Operating temperature range	−55°C to +125°C	−55°C to +125°C
Storage temperature range	−55°C to +125°C	−55°C to +125°C
Maximun ΔC/°C over Temperature range without voltage applied	± 15%	± 15%
Ageing	≤2.5% per decade hour	≤2.5% per decade hour
Dissipation Factor (DF)	≤ 2.5%	≤ 2.5%
Voltage proof	$U_R \leq 200$ V: 2.5 x U_R $U_R > 200$ V: 2.0 x U_R	$U_R \leq 200$ V: 2.5 x U_R $U_R > 200$ V: 2.0 x U_R
Insulation Resistance (IR) @ 25°C under Ur	100GΩ or 1000Ω.F whichever is the less	100GΩ or 1000Ω.F whichever is the less
Insulation Resistance (IR) @ 125°C under Ur	10GΩ or 100Ω.F whichever is the less	10GΩ or 100Ω.F whichever is the less
Measurement Conditions for C and DF @ 20°C	≤ 100pF: 1MHz / 1Vrms (no bias) > 100pF: 1KHz / 1Vrms (no bias)	≤ 100pF: 1MHz / 1Vrms (no bias) > 100pF: 1KHz / 1Vrms (no bias)
Capacitance versus applied Voltage and Temperature	See page xx	See page xx

MARKING

Size	Marking codes	Example
≤ 2225	Cap code + Tolerance code Rated voltage value	103M 100 V
> 2225	«TA» logo Cap code + Tolerance code Rated voltage value	TA 103M 100 V

Note: the marking is only available for leaded capacitors.

HOW TO ORDER

501	R	6560	X	105	K	R		-	-RoHS
Rated voltage	Series	Exxelia size code	Dielectric code	Capacitance	Tolerance	Termination		Coating	RoHS compliant
500: 50 V **101**: 100 V **201**: 200 V **501**: 500 V	**R:** Radial leaded 2 wires, epoxy coated.	**2225** **3033** **3740** **5440** **5550** **6560** **6080** **8060** **45107**	**X** = X7R **T** = X7R	1st two digits represent significant figures; last digit specifies the number of zeros to follow. Examples: **104**: 0.1µF **335**: 3.3µF **276**: 27µF	**K** = ±10% **M** = ±20%	**R** (RoHS)	100% tinned copper, non magnetic. Lead status: 0% Pb.	Not applicable	**-** = Not RoHS compliant Both RoHS and non-RoHS versions exist. This is due to the wishes of some customers who still need non-RoHS components in their applications. This suffix must be required for RoHS compliancy.
						R (not RoHS)	Sn (70%) Pb (30%) plated Copper, non magnetic. Lead status: Pb 30% of the plated layer		

R Series (Leaded)

Radial Leaded Conformal Coated Capacitors

STANDARD RATINGS

	Exxelia size code	2225								3033								3740								Capacitance value coded (C_R)
Dimensions inches (mm)	W max.	0.300 (7.6)								0.434 (11.0)								0.500 (12.7)								
	H max.	0.386 (9.8)								0.434 (11.0)								0.485 (12.3)								
	LS	0.2 ± 0.02 (5.08 ± 0.5)								0.2 ± 0.02 (5.08 ± 0.5)								0.402 ± 0.02 (10.2 ± 0.5)								
	D ± 10%	0.020 (0.5)								0.020 (0.5)								0.024 (0.6)								
U_R		50 V		100 V		200 V		500 V		50 V		100 V		200 V		500 V		50 V		100 V		200 V		500 V		
Dielectric		X	T	X	T	X	T	X	T	X	T	X	T	X	T	X	T	X	T	X	T	X	T	X	T	
47 nF								0.170 (4.3)																		473
56								0.170 (4.3)																		563
68								0.170 (4.3)																		683
82								0.170 (4.3)																		823
100						0.123 (3.1)		0.170 (4.3)	0.142 (3.6)							0.15 (3.8)	0.154 (3.9)						0.17 (4.3)		104
120						0.123 (3.1)		0.170 (4.3)	0.142 (3.6)							0.15 (3.8)	0.154 (3.9)						0.17 (4.3)		124
150						0.130 (3.3)		0.181 (4.6)	0.142 (3.6)							0.15 (3.8)	0.154 (3.9)						0.17 (4.3)		154
180		0.123 (3.1)		0.123 (3.1)		0.130 (3.3)		0.201 (5.1)	0.154 (3.9)							0.178 (4.5)	0.154 (3.9)					0.134 (3.4)		0.17 (4.3)	0.154 (3.9)	184
220		0.123 (3.1)		0.123 (3.1)		0.150 (3.8)		0.229 (5.8)	0.162 (4.1)							0.178 (4.5)	0.154 (3.9)					0.134 (3.4)		0.17 (4.3)	0.154 (3.9)	224
270		0.123 (3.1)		0.123 (3.1)		0.150 (3.8)	0.142 (3.6)		0.173 (4.4)					0.134 (3.4)		0.189 (4.8)	0.154 (3.9)					0.134 (3.4)		0.17 (4.3)	0.154 (3.9)	274
330		0.123 (3.1)		0.123 (3.1)		0.170 (4.3)	0.142 (3.6)			0.134 (3.4)		0.134 (3.4)		0.134 (3.4)		0.217 (5.5)	0.162 (4.1)	0.134 (3.4)		0.134 (3.4)		0.134 (3.4)		0.182 (4.6)	0.154 (3.9)	334
390		0.123 (3.1)		0.123 (3.1)		0.170 (4.3)	0.142 (3.6)			0.134 (3.4)		0.134 (3.4)		0.134 (3.4)			0.174 (4.4)	0.134 (3.4)		0.134 (3.4)		0.134 (3.4)		0.189 (4.8)	0.154 (3.9)	394
470		0.123 (3.1)		0.123 (3.1)		0.181 (4.6)	0.142 (3.6)			0.134 (3.4)		0.134 (3.4)		0.134 (3.4)	0.142 (3.6)		0.189 (4.8)	0.134 (3.4)		0.134 (3.4)		0.134 (3.4)		0.209 (5.3)	0.154 (3.9)	474
560		0.130 (3.3)		0.130 (3.3)		0.205 (5.2)	0.150 (3.8)			0.134 (3.4)		0.134 (3.4)		0.15 (3.8)	0.142 (3.6)			0.134 (3.4)		0.134 (3.4)		0.134 (3.4)		0.221 (5.6)	0.166 (4.2)	564
680		0.130 (3.3)	0.142 (3.6)	0.130 (3.3)	0.142 (3.6)		0.173 (4.4)			0.134 (3.4)		0.134 (3.4)		0.17 (4.3)	0.142 (3.6)			0.134 (3.4)		0.134 (3.4)		0.150 (3.8)			0.186 (4.7)	684
820		0.130 (3.3)	0.142 (3.6)	0.130 (3.3)	0.142 (3.6)		0.177 (4.5)			0.134 (3.4)		0.134 (3.4)		0.189 (4.8)	0.146 (3.7)			0.134 (3.4)		0.134 (3.4)		0.150 (3.8)	0.142 (3.6)		0.201 (5.1)	824
1 µF		0.138 (3.5)	0.142 (3.6)	0.138 (3.5)	0.142 (3.6)					0.150 (3.8)		0.150 (3.8)			0.154 (3.9)			0.134 (3.4)		0.134 (3.4)		0.170 (4.3)	0.142 (3.6)			105
1.2		0.150 (3.8)	0.142 (3.6)	0.150 (3.8)	0.142 (3.6)					0.150 (3.8)		0.150 (3.8)			0.166 (4.2)			0.134 (3.4)		0.134 (3.4)		0.189 (4.8)	0.142 (3.6)			125
1.5		0.170 (4.3)	0.142 (3.6)	0.170 (4.3)	0.142 (3.6)					0.162 (4.1)	0.142 (3.6)	0.162 (4.1)	0.142 (3.6)		0.186 (4.7)			0.134 (3.4)	0.142 (3.6)	0.134 (3.4)	0.142 (3.6)	0.209 (5.3)	0.154 (3.9)			155
1.8		0.177 (4.5)	0.142 (3.6)	0.177 (4.5)	0.142 (3.6)					0.162 (4.1)	0.142 (3.6)	0.162 (4.1)	0.142 (3.6)					0.15 (3.8)	0.142 (3.6)	0.15 (3.8)	0.142 (3.6)	0.232 (5.9)	0.162 (4.1)			185
2.2		0.201 (5.1)	0.154 (3.9)	0.201 (5.1)	0.154 (3.9)					0.162 (4.1)	0.142 (3.6)	0.162 (4.1)	0.142 (3.6)					0.15 (3.8)	0.142 (3.6)	0.15 (3.8)	0.142 (3.6)		0.178 (4.5)			225
2.7			0.165 (4.2)		0.165 (4.2)					0.182 (4.6)	0.146 (3.7)	0.182 (4.6)	0.146 (3.7)					0.162 (4.1)	0.142 (3.6)	0.162 (4.1)	0.142 (3.6)		0.193 (4.9)			275
3.3			0.177 (4.5)		0.177 (4.5)					0.201 (5.1)	0.150 (3.8)	0.201 (5.1)	0.150 (3.8)					0.162 (4.1)	0.142 (3.6)	0.162 (4.1)	0.142 (3.6)					335
3.9											0.162 (4.1)		0.162 (4.1)					0.182 (4.6)	0.142 (3.6)	0.182 (4.6)	0.142 (3.6)					395
4.7											0.174 (4.4)		0.174 (4.4)					0.189 (4.8)	0.142 (3.6)	0.189 (4.8)	0.142 (3.6)					475
5.6																		0.193 (4.9)	0.154 (3.9)	0.193 (4.9)	0.154 (3.9)					565
6.8																			0.17 (4.3)		0.17 (4.3)					685
8.2																			0.193 (4.9)		0.193 (4.9)					825
10																			0.201 (5.1)		0.201 (5.1)					106

The thickness Tmax in inches (in mm) is indicated in the cells.

Radial Leaded Conformal Coated Capacitors

R Series (Leaded)

STANDARD RATINGS

Dimensions inches (mm)	Exxelia size code	5550								6560								6080/8060								Capacitance value coded (C_R)
	W max.	0.678 (17.2)								0.800 (20.3)								0.741 / 0.930 (18.8) / (23.6)								
	H max.	0.583 (14.8)								0.721 (18.3)								0.890 / 0.697 (22.6) / (17.7)								
	LS	0.598 ± 0.02 (15.2 ± 0.5)								0.701 ± 0.02 (17.8 ± 0.5)								0.598 ± 0.02 (15.2 ± 0.5) / (20.3 ± 0.5)								
	D ± 10%	0.035 (0.9)								0.035 (0.9)								0.035 / 0.035 (0.9) / (0.9)								
U_R		50 V		100 V		200 V		500 V		50 V		100 V		200 V		500 V		50 V		100 V		200 V		500 V		
Dielectric		X	T	X	T	X	T	X	T	X	T	X	T	X	T	X	T	X	T	X	T	X	T	X	T	
	270 nF							0.150 (3.8)	0.154 (3.9)							0.150 (3.8)	0.154 (3.9)									274
	330							0.150 (3.8)	0.154 (3.9)							0.150 (3.8)	0.154 (3.9)									334
	390							0.150 (3.8)	0.154 (3.9)							0.150 (3.8)	0.154 (3.9)									394
	470							0.170 (4.3)	0.154 (3.9)							0.150 (3.8)	0.154 (3.9)									474
	560							0.170 (4.3)	0.154 (3.9)					0.150 (3.8)		0.150 (3.8)	0.154 (3.9)									564
	680							0.170 (4.3)	0.154 (3.9)					0.150 (3.8)		0.150 (3.8)	0.154 (3.9)							0.170 (4.3)	0.154 (3.9)	684
	820					0.170 (4.3)		0.189 (4.8)	0.154 (3.9)					0.150 (3.8)		0.170 (4.3)	0.154 (3.9)							0.170 (4.3)	0.154 (3.9)	824
	1 µF	0.150 (3.8)		0.150 (3.8)		0.170 (4.3)		0.237 (6)	0.162 (4.1)	0.150 (3.8)		0.150 (3.8)		0.150 (3.8)	0.154 (3.9)	0.170 (4.3)	0.154 (3.9)							0.170 (4.3)	0.154 (3.9)	105
	1.2	0.150 (3.8)		0.150 (3.8)		0.170 (4.3)	0.154 (3.9)		0.182 (4.6)	0.150 (3.8)		0.150 (3.8)		0.150 (3.8)	0.154 (3.9)	0.189 (4.8)	0.154 (3.9)							0.189 (4.8)	0.154 (3.9)	125
	1.5	0.150 (3.8)		0.150 (3.8)		0.170 (4.3)	0.154 (3.9)		0.193 (4.9)	0.150 (3.8)		0.150 (3.8)		0.150 (3.8)	0.154 (3.9)	0.209 (5.3)	0.17 (4.3)					0.170 (4.3)		0.209 (5.3)	0.154 (3.9)	155
	1.8	0.150 (3.8)		0.150 (3.8)		0.170 (4.3)	0.154 (3.9)		0.213 (5.4)	0.150 (3.8)		0.150 (3.8)		0.150 (3.8)	0.154 (3.9)	0.229 (5.8)	0.17 (4.3)					0.170 (4.3)		0.229 (5.8)	0.154 (3.9)	185
	2.2	0.150 (3.8)		0.150 (3.8)		0.170 (4.3)	0.154 (3.9)			0.150 (3.8)		0.150 (3.8)		0.150 (3.8)	0.154 (3.9)		0.182 (4.6)					0.170 (4.3)	0.154 (3.9)	0.229 (5.8)	0.154 (3.9)	225
	2.7	0.150 (3.8)		0.150 (3.8)		0.189 (4.8)	0.154 (3.9)			0.150 (3.8)	0.154 (3.9)	0.150 (3.8)	0.154 (3.9)	0.170 (4.3)	0.154 (3.9)		0.201 (5.1)					0.170 (4.3)	0.154 (3.9)		0.182 (4.6)	275
	3.3	0.150 (3.8)	0.154 (3.9)	0.150 (3.8)	0.154 (3.9)	0.209 (5.3)	0.162 (4.1)			0.150 (3.8)	0.154 (3.9)	0.150 (3.8)	0.154 (3.9)	0.170 (4.3)	0.154 (3.9)		0.221 (5.6)					0.170 (4.3)	0.154 (3.9)		0.205 (5.2)	335
	3.9	0.150 (3.8)	0.154 (3.9)	0.150 (3.8)	0.154 (3.9)		0.174 (4.4)			0.150 (3.8)	0.154 (3.9)	0.150 (3.8)	0.154 (3.9)	0.189 (4.8)	0.154 (3.9)			0.170 (4.3)		0.170 (4.3)		0.189 (4.8)	0.154 (3.9)		0.225 (5.7)	395
	4.7	0.170 (4.3)	0.154 (3.9)	0.170 (4.3)	0.154 (3.9)		0.189 (4.8)			0.150 (3.8)	0.154 (3.9)	0.150 (3.8)	0.154 (3.9)	0.209 (5.3)	0.154 (3.9)			0.170 (4.3)		0.170 (4.3)		0.209 (5.3)	0.154 (3.9)			475
	5.6	0.170 (4.3)	0.154 (3.9)	0.170 (4.3)	0.154 (3.9)		0.213 (5.4)			0.150 (3.8)	0.154 (3.9)	0.150 (3.8)	0.154 (3.9)		0.166 (4.2)			0.170 (4.3)		0.170 (4.3)		0.209 (5.3)	0.154 (3.9)			565
	6.8	0.170 (4.3)	0.154 (3.9)	0.170 (4.3)	0.154 (3.9)					0.150 (3.8)	0.154 (3.9)	0.150 (3.8)	0.154 (3.9)		0.182 (4.6)			0.170 (4.3)	0.154 (3.9)	0.170 (4.3)	0.154 (3.9)	0.228 (5.8)	0.170 (4.3)			685
	8.2	0.189 (4.8)	0.154 (3.9)	0.189 (4.8)	0.154 (3.9)					0.170 (4.3)	0.154 (3.9)	0.170 (4.3)	0.154 (3.9)		0.201 (5.1)			0.170 (4.3)	0.154 (3.9)	0.170 (4.3)	0.154 (3.9)		0.193 (4.9)			825
	10	0.201 (5.1)	0.154 (3.9)	0.201 (5.1)	0.154 (3.9)					0.170 (4.3)	0.154 (3.9)	0.170 (4.3)	0.154 (3.9)					0.189 (4.8)	0.154 (3.9)	0.189 (4.8)	0.154 (3.9)		0.201 (5.1)			106
	12	0.209 (5.3)	0.162 (4.1)	0.209 (5.3)	0.162 (4.1)					0.189 (4.8)	0.154 (3.9)	0.189 (4.8)	0.154 (3.9)					0.189 (4.8)	0.154 (3.9)	0.189 (4.8)	0.154 (3.9)					126
	15		0.178 (4.5)		0.178 (4.5)					0.209 (5.3)	0.154 (3.9)	0.209 (5.3)	0.154 (3.9)					0.189 (4.8)	0.154 (3.9)	0.189 (4.8)	0.154 (3.9)					156
	18										0.154 (3.9)		0.154 (3.9)						0.154 (3.9)		0.154 (3.9)					186
	22										0.17 (4.3)		0.17 (4.3)						0.162 (4.1)		0.162 (4.1)					226
	27										0.193 (4.9)		0.193 (4.9)						0.182 (4.6)		0.182 (4.6)					276

The thickness Tmax in inches (in mm) is indicated in the cells.

HIGH CAPACITANCE

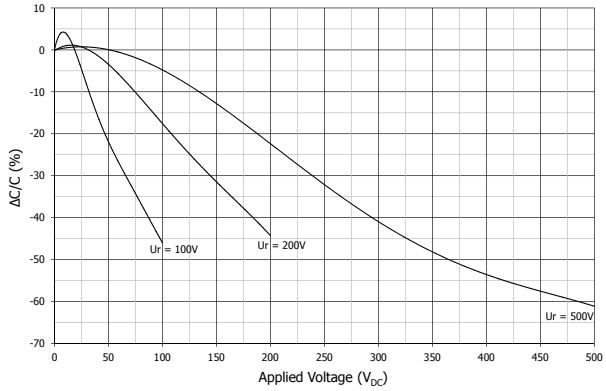
General Information

These capacitors have been developed in response to demand from switched mode power supply (S.M.P.S.) and DC-DC converters manufacturers. They are particularly suitable for filtering, smoothing and decoupling purpose in Hi-Rel equipments. The capacitors utilize advanced ceramic technology to achieve Hi-Rel long operating life and small size. They are designed for hybrid assemblies and low profile printed circuit applications.

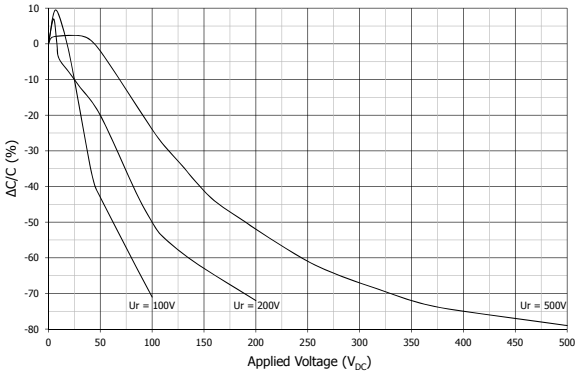
Customized assemblies may be achieved with standard bare chip sizes mentioned in the following chapters.

TYPICAL CURVES: R Series, SC/SV Series

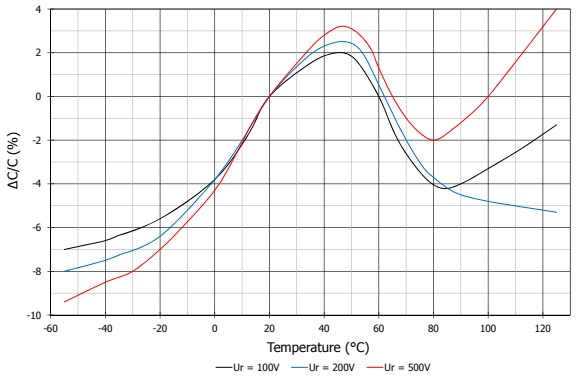
X DIELECTRIC: TYPICAL VOLTAGE COEFFICIENT @ 25°C (FOR ALL SIZES)



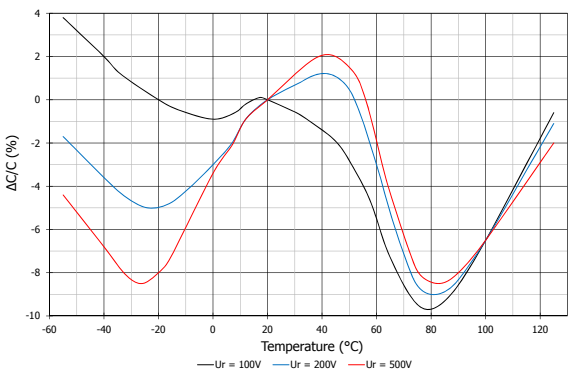
T DIELECTRIC: TYPICAL VOLTAGE COEFFICIENT @ 25°C (for all sizes)



X DIELECTRIC: TYPICAL TEMPERATURE COEFFICIENT WITHOUT VOLTAGE (for all sizes)

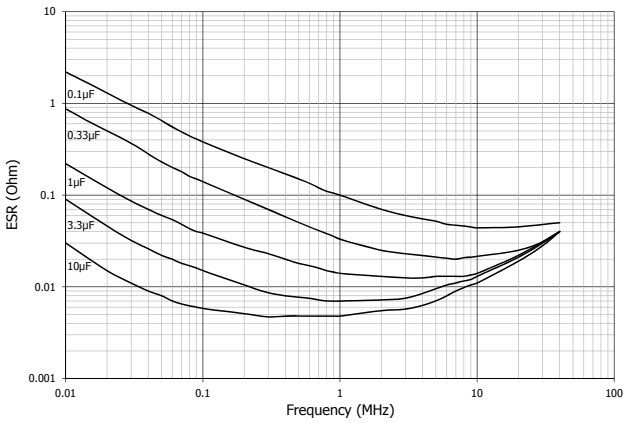


T DIELECTRIC: TYPICAL TEMPERATURE COEFFICIENT WITHOUT VOLTAGE (for all sizes)



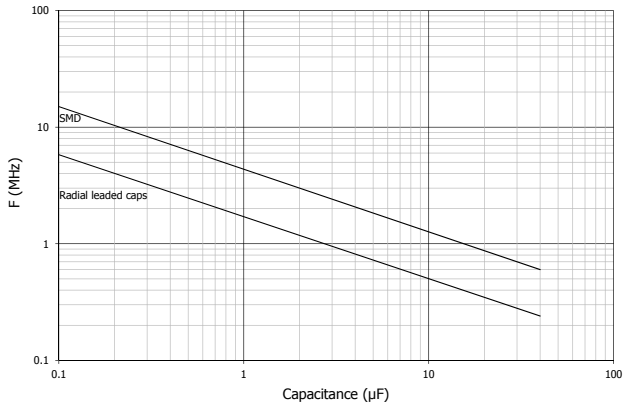
TYPICAL CURVES: R Series, SC/SV Series

TYPICAL ESR VS FREQUENCY

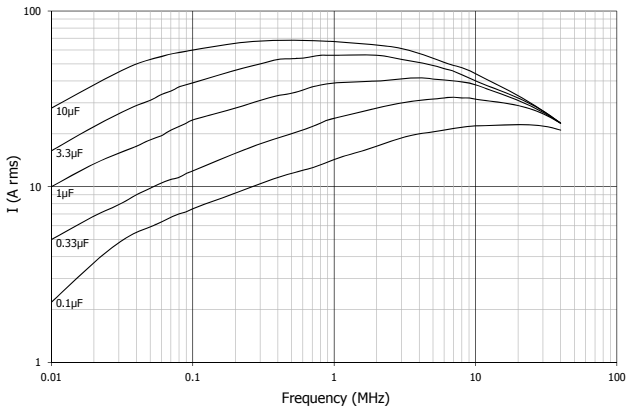


The ESR (Equivalent Serial Resistance) curves are given for SMD (chips all case sizes) capacitors. Regarding the curves for the leaded capacitors, they are rather the same. ndeed, due to the resistivity of the raw material used and the wire diameters, the resistance of the wires is much lower than the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

TYPICAL ESR VS FREQUENCY



TYPICAL MAXIMUM ADMISSIBLE CURRENT VS FREQUENCY

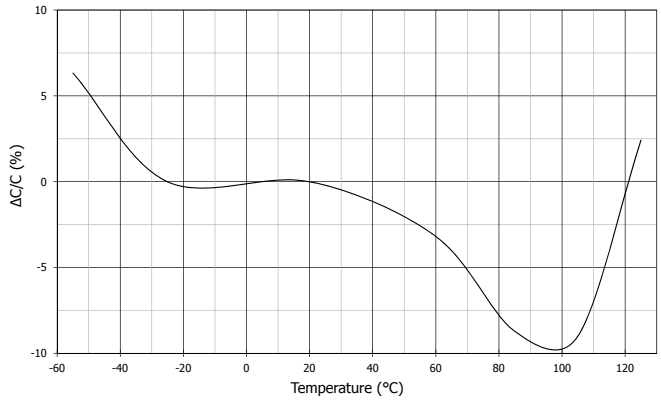


These typical curves are an example of admissible currents for one family of chip capacitors: 501R3740X chip series. For other curves and products or for further information, please contact us. Note: for the calculations, we have considered that the terminations are directly connected to an infinite heat sink. In other words, the thermal resistance of the circuit itself which depends of its type and design has not been taken into account. Moreover, the ambient temperature taken is 25°C.

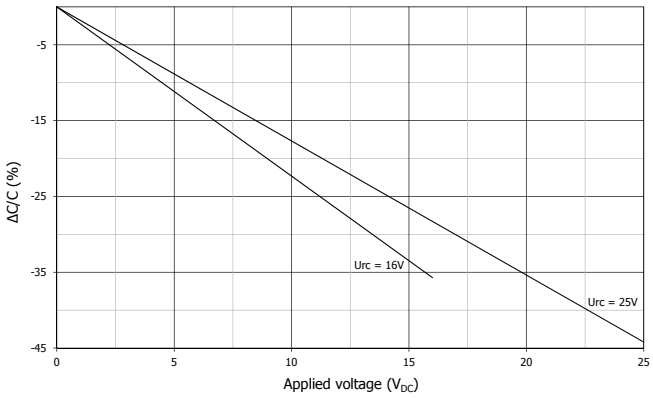
General Information

TYPICAL CURVES: CNC3X Series

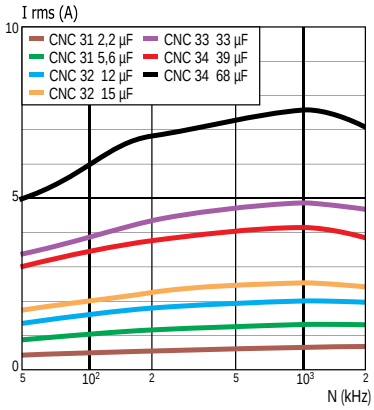
TYPICAL TEMPERATURE COEFFICIENT



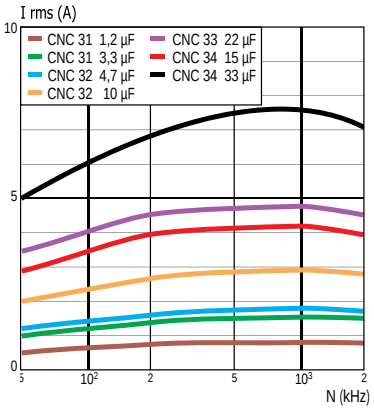
TYPICAL VOLTAGE COEFFICIENT



MAXIMUM CURRENT VS FREQUENCY



U_{RC} = 16V $_{DC}$ (Typical curves for Δθ = 20°C).

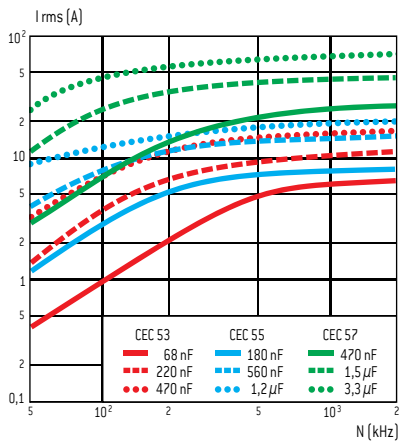


U_{RC} = 25 V $_{DC}$ (Typical curves for Δθ = 20°C).

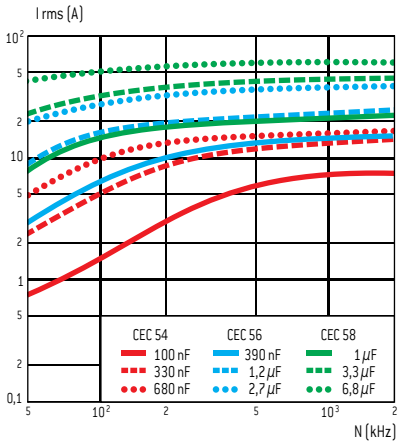
General Information

TYPICAL CURVES: CEC5X Series

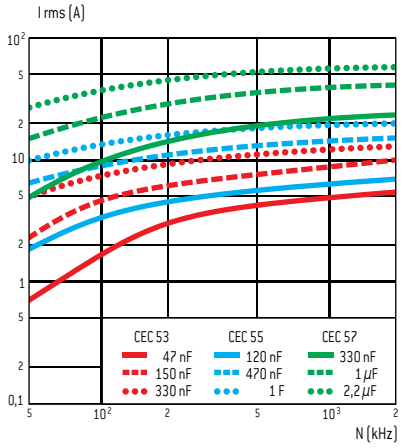
NPO: CURRENT VS FREQUENCY



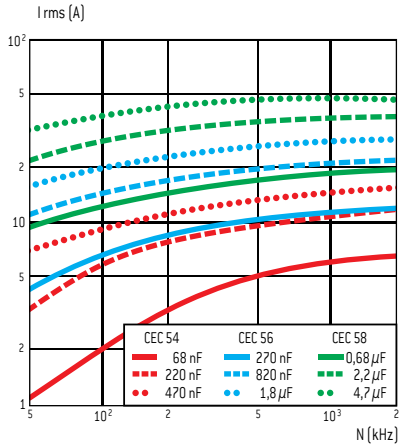
$U_{RC} = 63\ V_{DC}$ (Typical curve for $\Delta\theta = 20°C$).



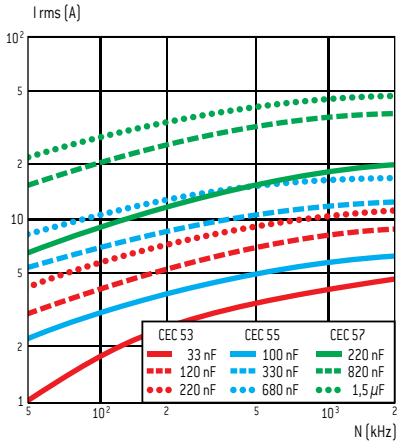
$U_{RC} = 63\ V_{DC}$ (Typical curve for $\Delta\theta = 20°C$).



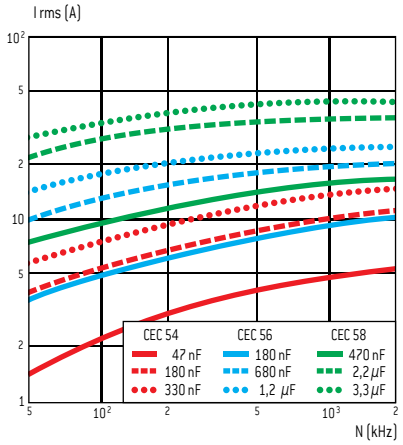
$U_{RC} = 100\ V_{DC}$ (Typical curve for $\Delta\theta = 20°C$).



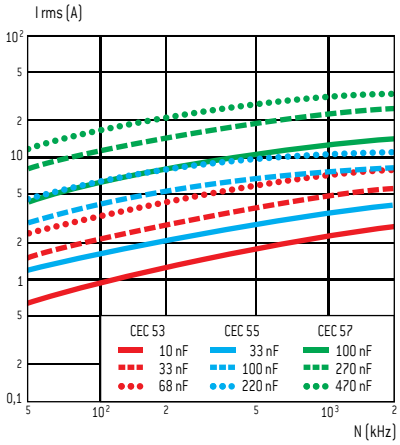
$U_{RC} = 100\ V_{DC}$ (Typical curve for $\Delta\theta = 20°C$).



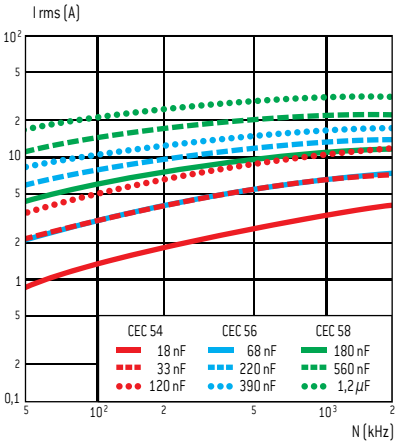
$U_{RC} = 200\ V_{DC}$ (Typical curve for $\Delta\theta = 20°C$).



$U_{RC} = 200\ V_{DC}$ (Typical curve for $\Delta\theta = 20°C$).



$U_{RC} = 500\ V_{DC}$ (Typical curve for $\Delta\theta = 20°C$).

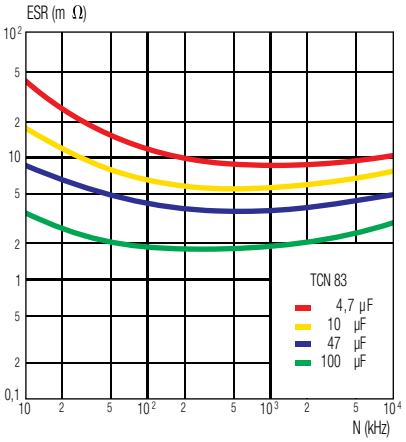


$U_{RC} = 500\ V_{DC}$ (Typical curve for $\Delta\theta = 20°C$).

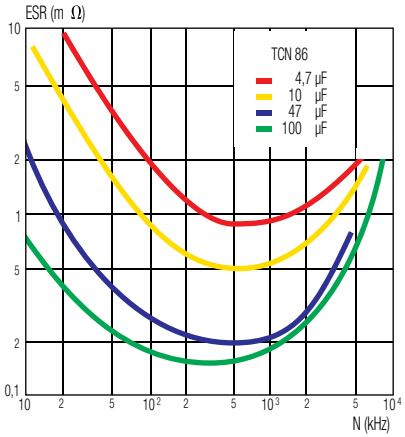
General Information

TYPICAL CURVES: TCN8X Series

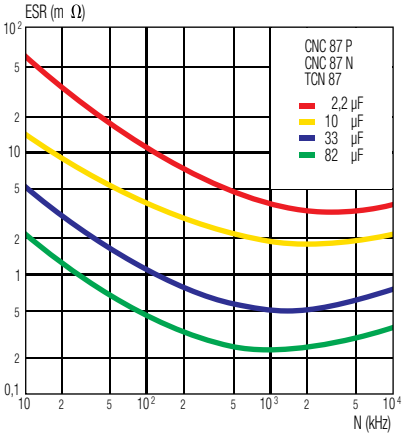
TCN83: TYPICAL EQUIVALENT SERIAL RESISTANCE (ESR) VS FREQUENCY (N)



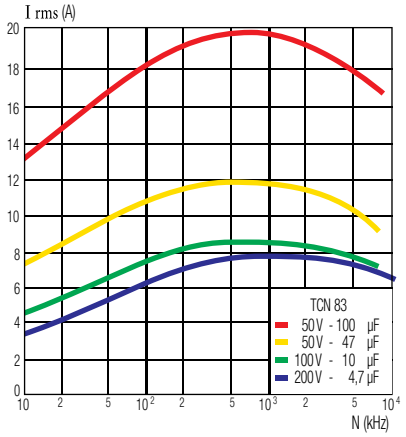
TCN86: TYPICAL EQUIVALENT SERIAL RESISTANCE (ESR) VS FREQUENCY (N)



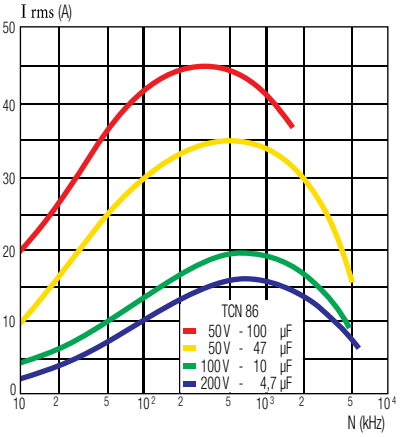
TCN87: TYPICAL EQUIVALENT SERIAL RESISTANCE (ESR) VS FREQUENCY (N)



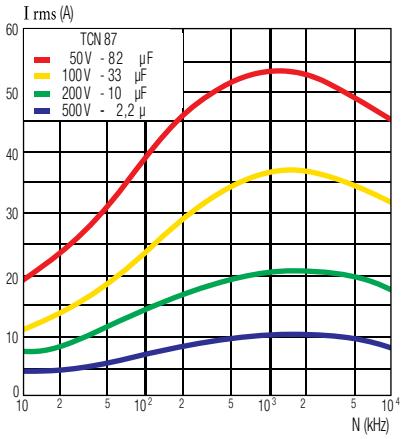
TCN83: CURRENT (I_{RMS}) VS FREQUENCY (N) TYPICAL CURVES FOR $\Delta\Theta \leq 20°C$



TCN86: CURRENT (I_{RMS}) VS FREQUENCY (N) TYPICAL CURVES FOR $\Delta\Theta \leq 20°C$

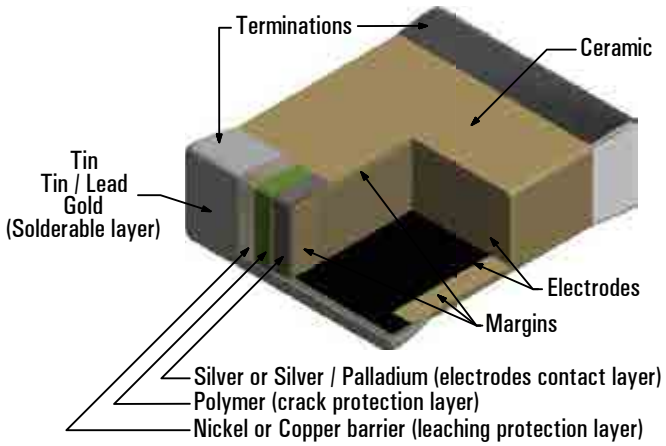


TCN87: CURRENT (I_{RMS}) VS FREQUENCY (N) TYPICAL CURVES FOR $\Delta\Theta \leq 20°C$



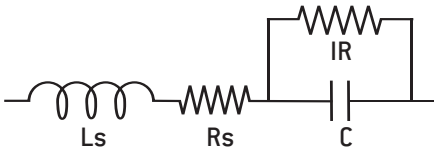
Ceramic Capacitors Technology

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 M$\Omega.\mu$F.

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

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

DF = 2π f C ESR

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

P = 2π 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.ω - 1/(C.ω)) with ω = 2πf

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

Z = Rs and LsC.ω^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	+		+	++		

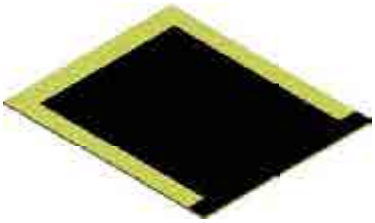
Ceramic Capacitors Technology

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.

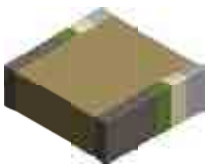
SINTERING

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.

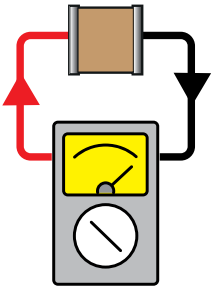
TERMINATIONS PLATING



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.

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

STORAGE IN INDUSTRIAL ENVIRONMENT:

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

STORAGE IN CONTROLLED NEUTRAL NITROGEN ENVIRONMENT:

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

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

User Guide

LEAD STYLES

SURFACE MOUNTING

DIL LEADS

P style

PL style

L style

J style

RIBBON LEADS

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

Axial (Type 2)

Radial (Type 3)

R style

RX style

RJ style

Please contact Exxelia sales for any lead configuration not shown.

TROUGH-HOLE MOUNTING

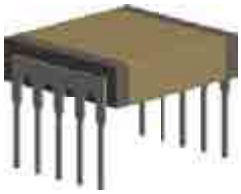
AXIAL AND RADIAL

Radial leads (Type 6)

Radial leads (4 leads)

Axial leads (Type 7)

DIL leads: N style



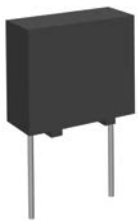
ENCAPSULATION STYLES

Ceramic encapsulation
(selfprotected)

Varnish

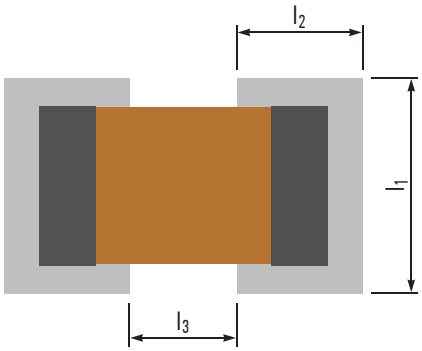
Conformal coating

Molding



User Guide

SOLDERING ADVICES FOR REFLOW SOLDERING



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

Dimensions in inches (in mm)	Reflow soldering						Wave soldering					
	l_1		l_2		l_3		l_1		l_2		l_3	
0402	0.043	(1.1)	0.035	(0.9)	0.012	(0.3)	0.043	(1.1)	0.047	(1.2)	0.012	(0.3)
0403	0.055	(1.4)	0.035	(0.9)	0.012	(0.3)	0.055	(1.4)	0.047	(1.2)	0.012	(0.3)
0504	0.063	(1.6)	0.051	(1.3)	0.016	(0.4)	0.063	(1.6)	0.063	(1.6)	0.016	(0.4)
0603	0.055	(1.4)	0.059	(1.5)	0.02	(0.5)	0.055	(1.4)	0.071	(1.8)	0.02	(0.5)
0805	0.073	(1.85)	0.065	(1.65)	0.024	(0.6)	0.073	(1.85)	0.077	(1.95)	0.024	(0.6)
0907	0.094	(2.4)	0.065	(1.65)	0.035	(0.9)	0.094	(2.4)	0.077	(1.95)	0.035	(0.9)
1005	0.073	(1.85)	0.067	(1.7)	0.039	(1)	0.073	(1.85)	0.079	(2)	0.039	(1)
1206	0.083	(2.1)	0.067	(1.7)	0.059	(1.5)	0.083	(2.1)	0.079	(2)	0.059	(1.5)
1210	0.118	(3)	0.069	(1.75)	0.059	(1.5)	0.118	(3)	0.081	(2.05)	0.059	(1.5)
1605	0.073	(1.85)	0.071	(1.8)	0.087	(2.2)	0.073	(1.85)	0.083	(2.1)	0.087	(2.2)
1806	0.087	(2.2)	0.073	(1.85)	0.102	(2.6)	0.087	(2.2)	0.085	(2.15)	0.102	(2.6)
1812	0.152	(3.85)	0.073	(1.85)	0.102	(2.6)	0.152	(3.85)	0.085	(2.15)	0.102	(2.6)
1825	0.281	(7.15)	0.073	(1.85)	0.102	(2.6)	0.281	(7.15)	0.085	(2.15)	0.102	(2.6)
2210	0.13	(3.3)	0.079	(2)	0.146	(3.7)	0.13	(3.3)	0.091	(2.3)	0.146	(3.7)
2220	0.228	(5.8)	0.079	(2)	0.146	(3.7)	0.228	(5.8)	0.091	(2.3)	0.146	(3.7)
2225	0.281	(7.15)	0.079	(2)	0.146	(3.7)	0.281	(7.15)	0.091	(2.3)	0.146	(3.7)

RECOMMENDED FOOTPRINT FOR SMD CAPACITORS

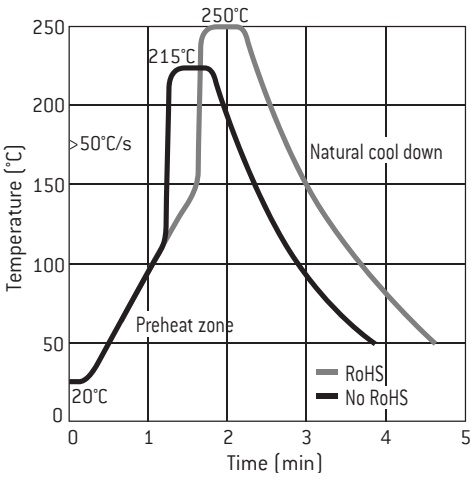
Ceramic is by nature a material which is sensitive both thermally and mechanically. Stresses caused by the physical and thermal properties of the capacitors, substrates and solders are attenuated by the leads.

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

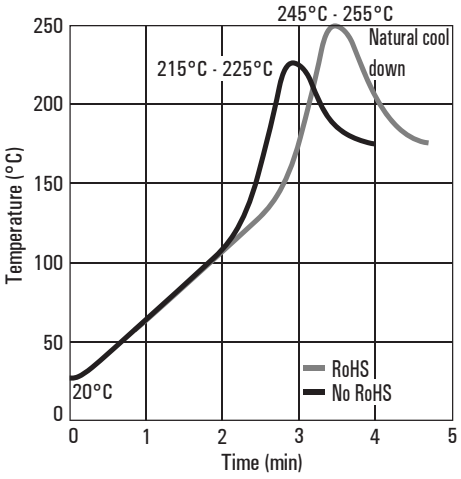
Infrared and vapor phase reflow, are preferred for high reliability applications as inherent thermo-mechanical strains are lower than those inherent to wave soldering.

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

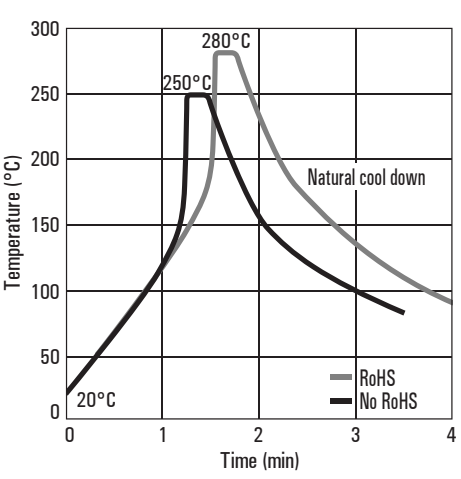
RECOMMENDED VAPOR PHASE REFLOW PROFILE



RECOMMENDED IR REFLOW PROFIL



RECOMMENDED WAVE SOLDERING PROFILE



User Guide

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.

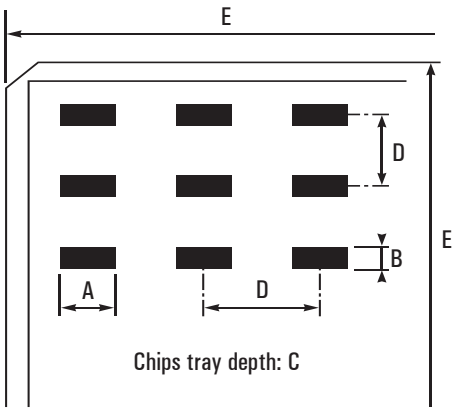
Maximum quantities per reel are as follows:

- 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)

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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.