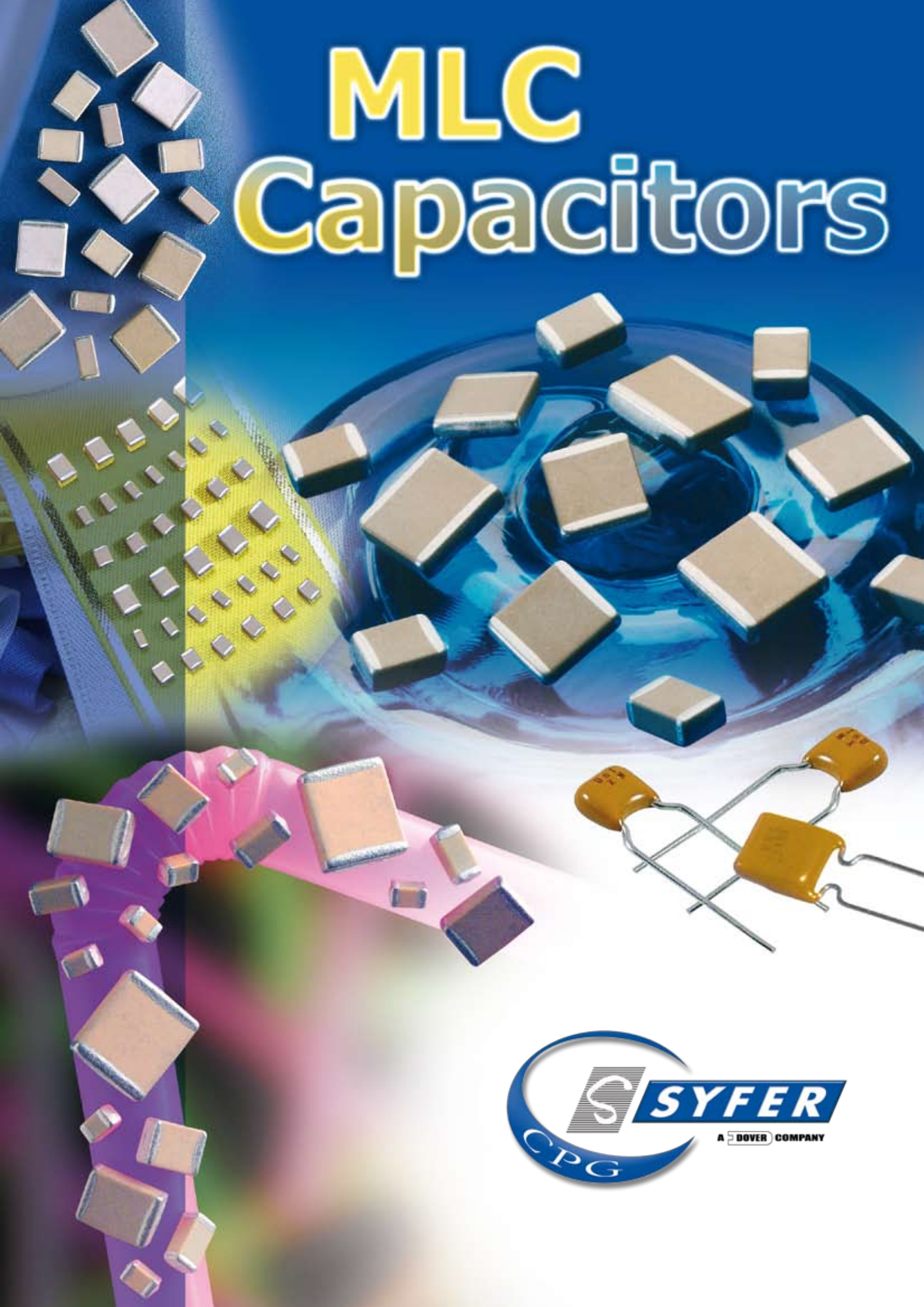
MLC Capacitors



SYFER

A DOVER COMPANY

CPG

Introduction to Syfer Technology

First in the market with flexible polymer terminations - the revolutionary FlexiCap™ capacitors - our capacitor range also includes X8R high temperature types, Tip & Ring/Ring Detect and other application specific types. Our renowned high voltage MLCC expertise has led to the development of an impressive range with working voltage capability up to 10kV. This includes surface mount Class 'X' and 'Y' approved surge and safety capacitors, 0603 chips with working voltages up to 500V, and 0805 types up to 1kV.

As part of the Dover Ceramic Products Group (CPG), we are able to offer unrivalled product quality with short lead-times, backed up by excellent sales and technical support.

With a commitment to product innovation, new ranges are continually being developed. Our experienced applications engineers are also available to provide custom solutions for specific applications. Flexibility is key, not only in design but in all aspects of customer service and support. Our quality management systems meet international requirements, with approval to IS0 9001, environmental approval to IS0 14001 and Occupational Health and Safety approval to OHSAS 18001. Product approvals include, IECQ CECC, UL, TÜV and qualification to AEC-Q200. SPC is used extensively, supported by Continuous Improvement Programmes, 6 Sigma projects and Lean Manufacturing initiatives.

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Products

Syfer's excellence in ceramic materials technology, has enabled us to offer an unrivalled range of multilayer ceramic products including:

- Multilayer ceramic chip capacitors
- High voltage MLCCs
- FlexiCap™ capacitors with flexible terminations
- Class 'X' and 'Y' SMD Surge and Safety capacitors
- Radial leaded capacitors
- AEC-Q200 approved capacitors
- IECQ CECC approved capacitors and radials
- Capacitors for space applications

Benefits

- High quality and reliability
- World-leading high voltage expertise
- Suitable for the most demanding applications including: automotive, aerospace, miltary, space and medical
- Approvals to international specifications
- Continual product improvement and innovation
- Tight tolerances available
- Large case sizes, up to 8060
- Custom product capability
- Strong technical support
- Short lead-times
- Environmentally responsible

Other Syfer products

- 3 terminal EMI chips
- Surface mount Pi filters
- X2Y Integrated Passive Components
- Panel mount threaded filters
- Panel mount solder-in filters
- Custom filter assembly capability
- Varistor filters
- Discoidal capacitors
- Planar capacitor and planar varistor arrays
- Low Temperature Co-fired Ceramic (LTCC) filters
- EMI Power Filters
- Hermetically sealed EMI filters

Syfer - *Innovative, World-Class Ceramic Capacitors*

Definitions of Ultra-Stable and Stable — Technical Summary

Multilayer Ceramic Capacitors are generally divided into classes which are defined by the capacitance temperature characteristics over specified temperature ranges.

These are designated by alpha numeric codes.
Code definitions are summarised below and are also available in the relevant national and international specifications.

1. C0G/NP0 - Ultra Stable Class 1 Ceramic (EIA Class 1)

Spec.	Classification	Temperature range °C	Maximum capacitance change	Syfer dielectric code
CECC	1B/CG	-55 +125	0 ± 30ppm/°C	C
EIA	C0G/NP0	-55 +125	0 ± 30ppm/°C	C
MIL	CG (BP)	-55 +125	0 ± 30ppm/°C	C

Capacitors within this class have a dielectric constant range from 10 to 100. They are used in applications which require ultra stable dielectric characteristics with negligible dependence of capacitance and dissipation factor with time, voltage and frequency. They exhibit the following characteristics:-

a) Time does not significantly affect capacitance and dissipation factor (Tan δ) – no ageing.
b) Capacitance and dissipation factor are not affected by voltage.
c) Linear temperature coefficient.

2. X8R, X7R and X5R - Stable Class II Ceramic (EIA Class II)

Spec.	Classification	Temperature range °C	Maximum capacitance change % over temperature range		Syfer dielectric code
			No DC volt applied	Rated DC Volt	
CECC	2C1	-55 +125	±20	+20 -30	R
	2R1	-55 +125	±15	- -	X
	2X1	-55 +125	±15	+15 -25	B
EIA	X8R	-55 +150	±15	- -	N
	X7R	-55 +125	±15	- -	X
	X5R	-55 +85	±15	- -	P
MIL	BX	-55 +125	±15	+15 -25	B
	BZ	-55 +125	±20	+20 -30	R

Capacitors of this type have a dielectric constant range of 1000-4000, and also have a non-linear temperature characteristic which exhibits a dielectric constant variation of less than ±15% (2R1) from its room temperature value, over the specified temperature range. Generally used for by-passing (decoupling), coupling, filtering, frequency discrimination, DC blocking and voltage transient suppression with greater volumetric efficiency than Class I units, whilst maintaining stability within defined limits.

Capacitance and dissipation factor are affected by:-
Time (Ageing)
Voltage (AC or DC)
Frequency

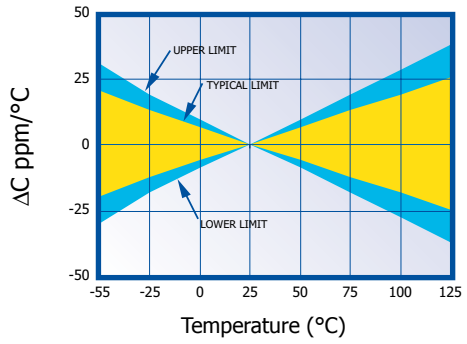
3. Technical Summary

	C0G/NP0			X8R	X7R			X5R
Dielectric characteristics	Ultra stable			Stable	Stable			Stable
IECQ-CECC	1B/CG	-	-	-	2C1	2R1	2X1	-
EIA	-	C0G/NP0	-	X8R	-	X7R	-	X5R
MIL	-	-	CG (BP)	-	BZ	-	BX	-
Rated temperature range	-55ºC to +125ºC			-55ºC to +150ºC	-55ºC to +125ºC			-55ºC to +85ºC
Maximum capacitance change over temperature range	0 ± 30 ppm/ºC							
No DC voltage applied				± 15%	± 20%	± 15%	± 15%	± 15%
Rated DC voltage applied				-	+20 -30%	-	+15 -25%	-
Syfer dielectric ordering code	C			N	R	X	B	P
Tangent of loss angle (tan δ)	Cr > 50pF ≤ 0.0015 Cr ≤ 50pF = 0.0015 $(\frac{15}{Cr} + 0.7)$			≤ 0.025	≤ 0.025			≤ 0.025

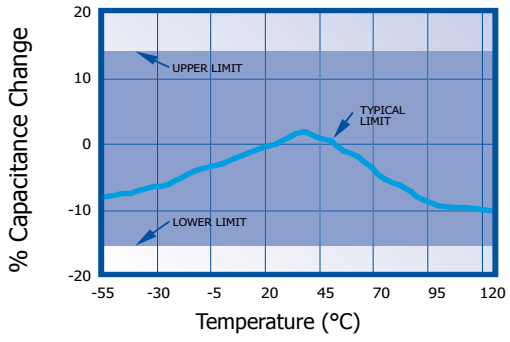
The table above highlights the difference in coding for IECQ-CECC, EIA and MIL standards when defining the temperature coeffiecient and the voltage coefficient.

	C0G/NP0	X8R	X7R	X5R
Insulation resistance (Ri) Time constant (Ri x Cr) (whichever is the least)	100G Ω or 1000s	100G Ω or 1000s	100G Ω or 1000s	100G Ω or 1000s
Capacitance tolerance	Cr < 10pF ± 0.05pF (H) ± 0.10pF (B) ± 0.25pF (C) ± 0.50pF (D) Cr ≥ 10pF ± 1.0pF (F) ± 1% (F) ± 2% (G) ± 5% (J) ± 10% (K)	± 5% (J) ± 10% (K) ± 20% (M)	± 5% (J) ± 10% (K) ± 20% (M)	± 5% (J) ± 10% (K) ± 20% (M)
Dielectric strength	**Voltage applied for 5 seconds. Charging current limited to 50 mA maximum.**			
16-200V ≥200V 500V 500V/630V >1kV 4-6kV	2.5 times Rated voltage + 250V 1.5 times 1.5 times 1.2 times	2.5 times	2.5 times Rated voltage + 250V 1.5 times 1.25 times 1.2 times	2.5 times
Climatic category (IEC)				
Chip	55/125/56	55/150/56	55/125/56	55/85/56
Dipped	55/125/21	-	55/125/21	-
Discoidal	55/125/56	-	55/125/56	-
Ageing characteristic (Typical)	Zero	1% per time decade	1% per time decade	1% per time decade
Approvals				
Chip	QC-32100	-	QC-32100	-
Dipped radial	IECQ-CECC 30601-008	-	IECQ-CECC 30701-013	-

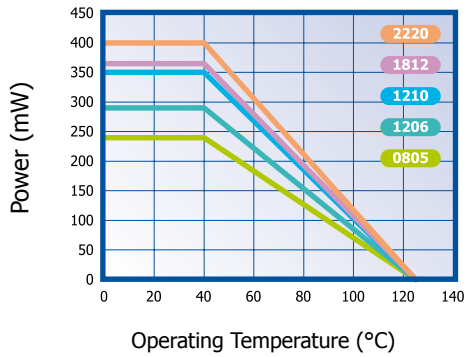
Typical dielectric temperature characteristics C0G/NP0 capacitance vs temperature



X7R capacitance vs temperature

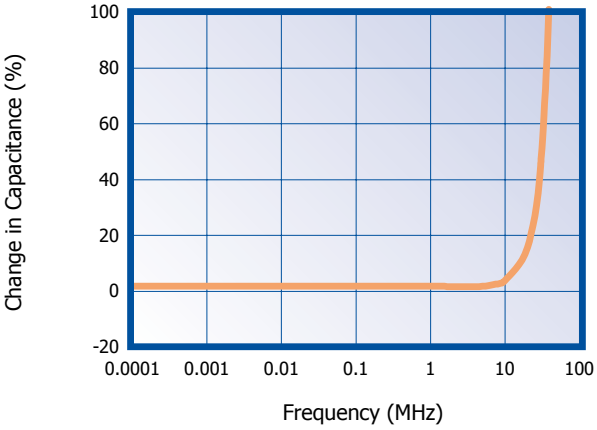


Power ratings for C0G/NP0 and X7R

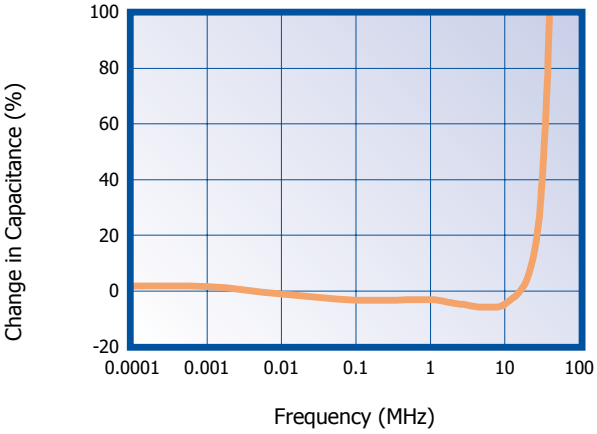


Capacitance vs Frequency - 10nF chip

Ultra Stable C0G dielectric

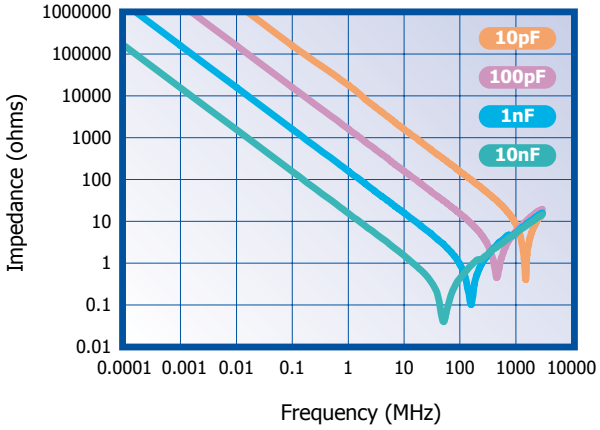


Stable X7R dielectric

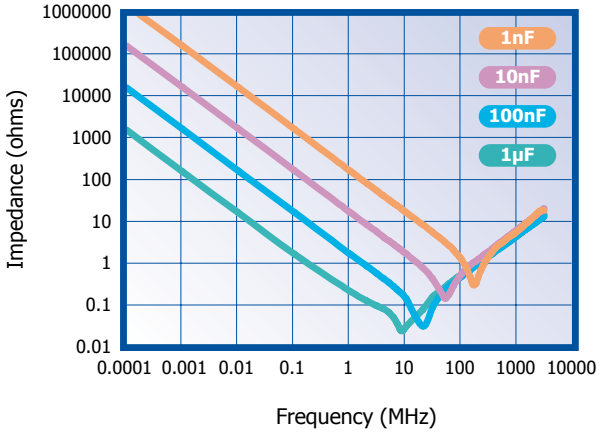


Impedance vs Frequency - chips

Ultra Stable C0G dielectric

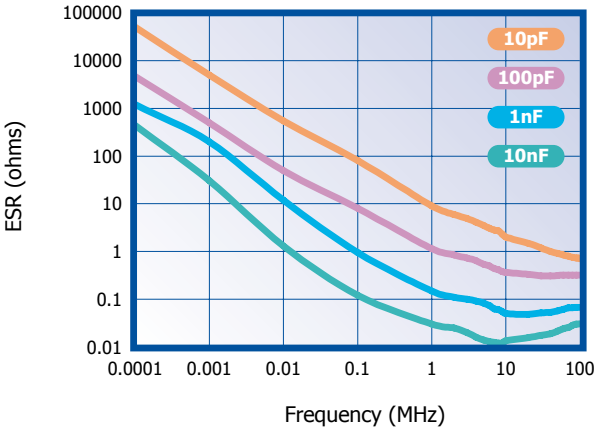


Stable X7R dielectric

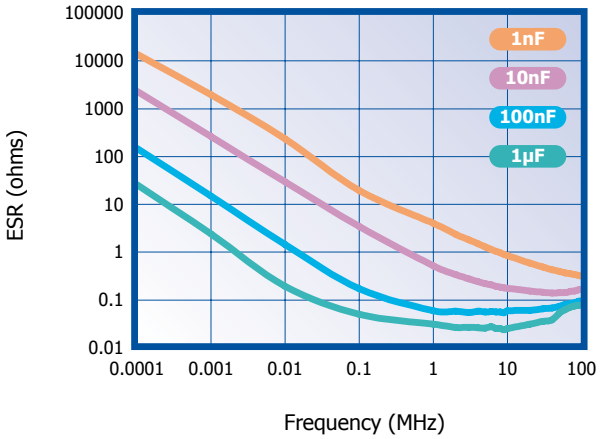


E.S.R. vs Frequency - chips

Ultra Stable C0G dielectric



Stable X7R dielectric



Ageing

Capacitor ageing is a term used to describe the negative, logarithmic capacitance change which takes place in ceramic capacitors with time. The crystalline structure for barium titanate based ceramics changes on passing through its Curie temperature (known as the Curie Point) at about 125°C. This domain structure relaxes with time and in doing so, the dielectric constant reduces logarithmically; this is known as the ageing mechanism of the dielectric constant. The more stable dielectrics have the lowest ageing rates.

The ageing process is reversible and repeatable. Whenever the capacitor is heated to a temperature above the Curie Point the ageing process starts again from zero.

The ageing constant, or ageing rate, is defined as the percentage loss of capacitance due to the ageing process of the dielectric which occurs during a decade of time (a tenfold increase in age) and is expressed as percent per logarithmic decade of hours. As the law of decrease of capacitance is logarithmic, this means that in a capacitor with an ageing rate of 1% per decade of time, the capacitance will decrease at a rate of:

a) 1% between 1 and 10 hours
b) An additional 1% between the following 10 and 100 hours
c) An additional 1% between the following 100 and 1000 hours
d) An additional 1% between the following 1000 and 10000 hours etc
e) The ageing rate continues in this manner throughout the capacitor's life.

Typical values of the ageing constant for our Multilayer Ceramic Capacitors are:

Dielectric class	Typical agreed value
Ultra Stable C0G/NP0	Negligible capacitance loss through ageing
Stable X7R	1% per decade of time

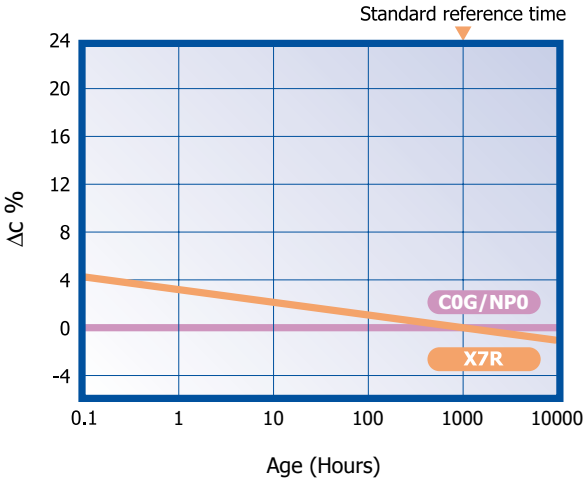
Capacitance measurements

Because of ageing it is necessary to specify an age for reference measurements at which the capacitance shall be within the prescribed tolerance. This is fixed at 1000 hours, since for practical purposes there is not much further loss of capacitance after this time.

All capacitors shipped are within their specified tolerance at the standard reference age of 1000 hours after having cooled through their Curie temperature.

The ageing curve for any ceramic dielectric is a straight line when plotted on semi-log paper.

Capacitance vs time - Ageing



Summary and conclusions

1.0 The recommended sequence of testing Multilayer Ceramic Capacitors is as follows:

a) Capacitance. Applying factors based on the manufacturer's ageing rate and the time elapsed since the last Curie temperature excursion.

b) Dissipation factor

c) Voltage proof test

d) Insulation resistance

e) Other tests. If any limits are specified for change in capacitance during a long term test (life test, for example), the capacitor should be de-aged before both initial and final measurements. De-ageing is accomplished by exposure of the capacitors to 150°C for 1 hour (without voltage) and stabilised at room temperature for 24 hours before capacitance measurements are made.

2.0 The ageing process is completely repeatable and predictable for a given capacitor.

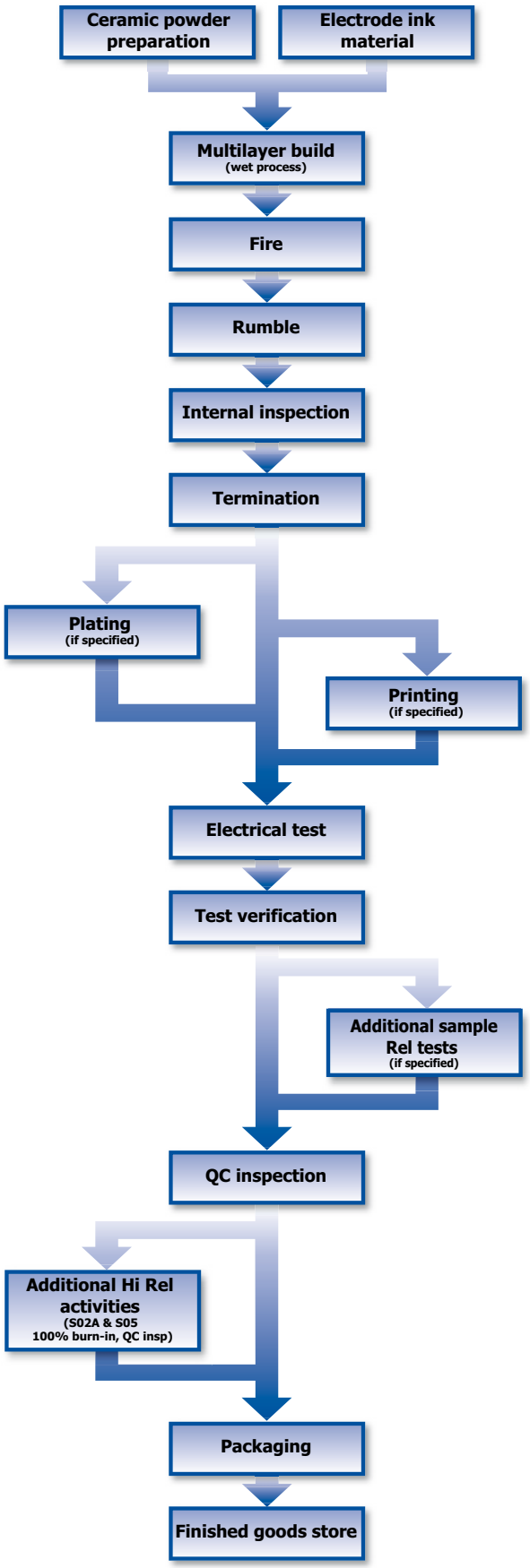
3.0 Capacitance change is negative and logarithmic in respect to time.

4.0 Class C0G/NP0 dielectric has a negligible ageing rate.

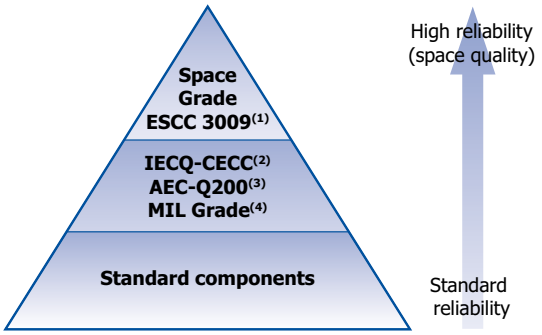
5.0 Class 2 ceramic dielectrics have ageing rates which will be typically 1% for X8R, X7R and X5R but up to 8% for other dielectrics dependent upon particular ceramic composition employed. This wide capacitance change, as a result of 'shelf' ageing and temperature cycling, illustrates why close-tolerance (less than ±5%) high dielectric constant ceramics should not be specified.

6.0 Soldering both leaded and chip class 2 capacitors into a circuit will, because of the ageing phenomenon, give a temporary increase in capacitance value. The magnitude of this change will be dependent on the soldering temperature, time and dielectric class.

Production process flowchart



Syfer reliability grades



Notes:

(1) Space grade tested in accordance with ESCC 3009. Refer to Syfer specification S02A 0100.

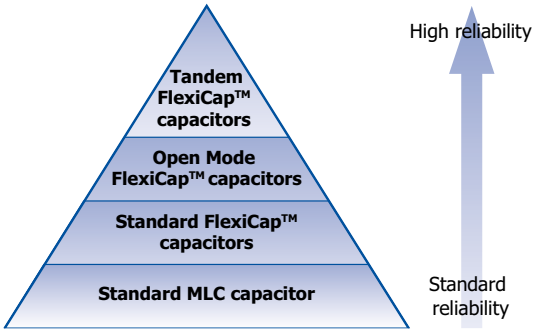
(2) IECQ-CECC. The International Electrotechnical Commission (IEC) Quality Assessment System for Electronic Components. This is an internationally recognised product quality certification which provides customers with assurance that the product supplied meets high quality standards.

View Syfer's IECQ-CECC approvals at http://www.iecq.org/certificates or at www.syfer.com

(3) AEC-Q200. Automotive Electronics Council Stress Test Qualification For Passive Components. Refer to Syfer application note reference AN0009.

(4) MIL Grade. Released in accordance with US standards available on request.

Syfer reliability surface mount product groups



Notes:

(1) "Tandem" construction capacitors (page 25), ie internally having the equivalent of 2 series capacitors. If one of these should fail short-circuit, there is still capacitance end to end and the chip will still function as a capacitor, although capacitance maybe affected. Refer to application note AN0021.

(2) "Open Mode" capacitors (page 24) with FlexiCap™ termination also reduce the possibility of a short circuit by utilising inset electrode margins. Refer to application note AN0022.

(3) Multilayer capacitors with Syfer FlexiCap™ termination. By using FlexiCap™ termination, there is a reduced possibility of the mechanical cracking occurring.

(4) "Standard" capacitors includes MLCCs with tin finish over nickel, but no FlexiCap™.

MLCC's are widely used in electronic circuit design for a multitude of applications. Their small package size, technical performance and suitability for automated assembly makes them the component of choice for the specifier.

However, despite the technical benefits, ceramic components are brittle and need careful handling on the production floor. In some circumstances they may be prone to mechanical stress damage if not used in an appropriate manner. Board flexing, depanelisation, mounting through hole components, poor storage and automatic testing may all result in cracking.

Careful process control is important at all stages of circuit board assembly and transportation - from component placement to test and packaging. Any significant board flexing may result in stress fractures in ceramic devices that may not always be evident during the board assembly process. Sometimes it may be the end customer who finds out - when equipment fails!

Syfer has the solution - FlexiCap™

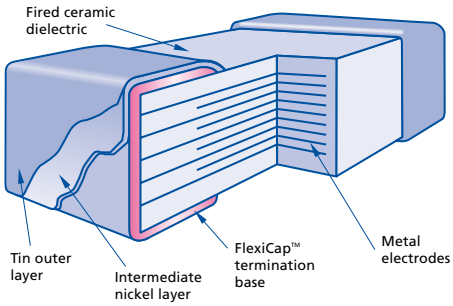
FlexiCap™ has been developed as a result of listening to customers' experiences of stress damage to MLCC's from many manufacturers, often caused by variations in production processes.

Our answer is a proprietary flexible epoxy polymer termination material, that is applied to the device under the usual nickel barrier finish. FlexiCap™ will accommodate a greater degree of board bending than conventional capacitors.

Syfer FlexiCap™ termination

All ranges are available with FlexiCap™ termination material offering increased reliability and superior mechanical performance (board flex and temperature cycling) when compared with standard termination materials. Refer to Syfer application note reference AN0001. As can be seen from the table below (Summary of Bend Test Results), FlexiCap™ capacitors enable the board to be bent almost twice as much before mechanical cracking occurs.

An additional benefit of FlexiCap™ is that MLCCs can withstand temperature cycling -55ºC to 125ºC in excess of 1,000 times without cracking.



FlexiCap™ MLCC cross section

FlexiCap™ benefits

The benefit to the user is to facilitate a wider process window - giving a greater safety margin and substantially reducing the typical root causes of mechanical stress cracking.

FlexiCap™ may be soldered using your traditional wave or reflow solder techniques and needs no adjustment to equipment or current processes.

Syfer has delivered millions of FlexiCap™ components and during that time has collected substantial test and reliability data, working in partnership with customers world wide, to eliminate mechanical cracking.

With traditional termination materials and assembly, the chain of materials from bare PCB to soldered termination, provides no flexibility. In circumstances where excessive stress is applied - the weakest link fails. This means the ceramic itself, which may fail short circuit.

● Picture taken at 1,000x magnification using a SEM to demonstrate the fibrous nature of the FlexiCap™ termination that absorbs increased levels of mechanical stress.

Available on the following ranges:

- Standard and High Voltage chips
- Surge Protection and Safety capacitor chips
- 3 terminal EMI chips
- X2Y Integrated Passive Components
- X8R High Temperature capacitors

Summary of PCB bend test results

The bend tests conducted on X7R have proven that the FlexiCap™ termination withstands a greater level of mechanical stress before mechanical cracking occurs.

The AEC-Q200 test for X7R requires a bend level of 2mm minimum and a cap change of less than 10%.

Product X7R	Typical bend performance under AEC-Q200 test conditions	Pass/Fail
Standard termination	1.5mm to 3mm	Fail
FlexiCap™	Typically 8mm to 10mm	Pass

Application notes

FlexiCap™ may be handled, stored and transported in the same manner as standard terminated capacitors. The requirements for mounting and soldering FlexiCap™ are the same as for standard SMD capacitors.

For customers currently using standard terminated capacitors there should be no requirement to change the assembly process when converting to FlexiCap™.

Based upon board bend tests in accordance with IEC 60384-1 the amount of board bending required to mechanically crack a polymer terminated capacitor is significantly increased compared with standard terminated capacitors.

It must be stressed however, that capacitor users must not assume that the use of FlexiCap™ terminated capacitors will totally eliminate mechanical cracking. Good process controls are still required for this objective to be achieved.

FlexiCap™

Tests conducted during batch manufacture

	Syfer reliability SM product group				
	Standard SM capacitors	IECQ-CECC / MIL grade	AEC-Q200	S (space grade) High Rel	
				S05	S02A
Solderability	●	●	●	●	●
Resistance to soldering heat	●	●	●	●	●
Plating thickness verification (if plated)	●	●	●	●	●
DPA (Destructive Physical Analysis)	●	●	●	●	●
Voltage proof test (DWV / Flash)	●	●	●	●	●
Insulation resistance	●	●	●	●	●
Capacitance test	●	●	●	●	●
Dissipation factor test	●	●	●	●	●
100% visual inspection	❍	❍	●	●	●
100% burn-in. (2xRV @125ºC for 168 hours)	❍	❍	❍	●	●
Load sample test @ 125ºC	❍	❍	❍	❍	LAT1 & LAT2 (1000 hours)
Humidity sample test. 85ºC/85%RH	❍	❍	❍	❍	240 hours
Hot IR sample test	❍	❍	❍	❍	❍
Axial pull sample test (MIL-STD-123)	❍	❍	❍	❍	❍
Breakdown voltage sample test	❍	❍	❍	❍	❍
Deflection (bend) sample test	❍	❍	❍	❍	❍
SAM (Scanning Acoustic Microscopy)	❍	❍	❍	❍	❍
LAT1 (4 x adhesion, 8 x rapid temp change + LAT2 and LAT3)	-	-	-	-	❍
LAT2 (20 x 1000 hour life test + LAT3)	-	-	-	-	❍
LAT3 (6 x TC and 4 x solderability)	-	-	-	-	❍

● Test conducted as standard.
❍ Optional test. Please discuss with Syfer Sales.

Termination types available

	Syfer reliability SM product group				
	Standard SM capacitors	IECQ-CECC / MIL grade	AEC-Q200	S (space grade) High Rel	
				S05	S02A
F: Silver Palladium	●	●	-	●	●
J: Silver base with nickel barrier (100% matte tin plating)	●	●	C0G/NP0 dielectric only	❍	❍
A: Silver base with nickel barrier (tin/lead plating with min 10% lead)	●	●	-	●	●
Y: FlexiCap™ with nickel barrier (100% matte tin plating)	●	●	●	❍	❍
H: FlexiCap™ with nickel barrier (tin/lead plating with min 10% lead)	●	●	-	❍	❍

● Termination available.
❍ Termination available but generally not requested for space grade components. Please discuss with Syfer Sales.

Release documentation

	Syfer reliability SM product group				
	Standard SM capacitors	IECQ-CECC	AEC-Q200 MIL grade	S (space grade) High Rel	
				S05	S02A
Certificate of conformance	●	-	●	●	●
IECQ-CECC Release certificate of conformity	-	●	-	-	-
Batch electrical test report	❍	❍	❍	Included in data pack	Included in data pack
S (space grade) data documentation package	-	-	-	●	●

● Release documentation supplied as standard.
❍ Original documentation.

Periodic tests conducted and reliability data availability

Standard Surface Mount Capacitors

Components are randomly selected on a sample basis and the following routine tests are conducted:

- Load Test. 1,000 hours @125ºC. Applied voltage depends on components tested.
- Humidity Test. 168 hours @ 85ºC/85%RH.
- Board Deflection (bend test).

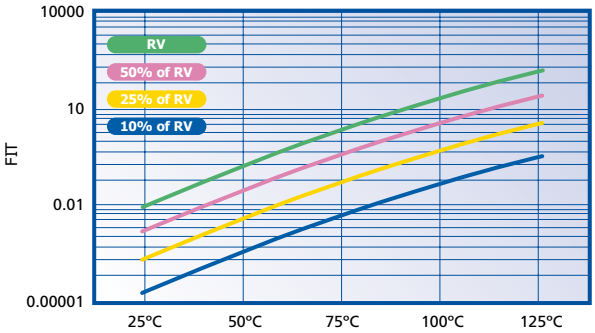
Test results are available on request.

Conversion factors

From	To	Operation
FITS	MTBF (hours)	$10^9 \div$ FITS
FITS	MTBF (years)	$10^9 \div$ (FITS x 8760)

FITS = Failures in 10^9 hours.
MTBF = Mean time between failures.

Example of FIT (Failure In Time) data available:



Component type: 0805 (C0G/NP0 and X7R).
Testing location: Syfer reliability test department.
Results based on: 14,942,000 component test hours.

REACH (Registration, Evaluation, Authorisation and restriction of Chemicals) statement

The main purpose of REACH is to improve the protection of human health and the environment from the risks arising from the use of chemicals.

Syfer Technology Ltd maintains both ISO14001, Environmental Management System and OHSAS 18001 Health and Safety Management System approvals that require and ensure compliance with corresponding legislation such as REACH.

For further information, please contact Syfer at sales@syfer.co.uk

RoHS compliance

All Syfer surface mount capacitors (excluding Sn/Pb plated) are compliant with the EU RoHS directive. Breakdown of materials content is available on request.

Periodic tests conducted for IECQ-CECC and AEC-Q200

Test ref	Test	Termination type	Additional requirements	Sample acceptance			Reference
				P	n	c	
P1	High temperature exposure (storage)	All types	Un-powered. 1,000 hours @ T=150ºC. Measurement at 24 ± 2 hours after test conclusion	12	77	0	MIL-STD-202 Method 108
P2	Temperature cycling	C0G/NP0: All types X7R: Y and H only	1,000 cycles -55ºC to +125ºC Measurement at 24 ± 2 hours after test conclusion	12	77	0	JESD22 Method JA-104
P3	Moisture resistance	All types	T = 24 hours/cycle. Note: Steps 7a and 7b not required. Un-powered. Measurement at 24 ± 2 hours after test conclusion	12	77	0	MIL-STD-202 Method 106
P4	Biased humidity	All types	1,000 hours 85ºC/85%RH. Rated voltage or 50V whichever is the least and 1.5V. Measurement at 24 ± 2 hours after test conclusion	12	77	0	MIL-STD-202 Method 103
P5	Operational life	All types	Condition D steady state TA=125ºC at full rated. Measurement at 24 ± 2 hours after test conclusion	12	77	0	MIL-STD-202 Method 108
P6	Resistance to solvents	All types	Note: Add aqueous wash chemical. Do not use banned solvents	12	5	0	MIL-STD-202 Method 215
P7	Mechanical shock	C0G/NP0: All types X7R: Y and H only	Figure 1 of Method 213. Condition F	12	30	0	MIL-STD-202 Method 213
P8	Vibration	C0G/NP0: All types X7R: Y and H only	5*g's* for 20 minutes, 12 cycles each of 3 orientations. Note: Use 8" x 5" PCB 0.031" thick 7 secure points on one long side and 2 secure points at corners of opposite sides. Parts mounted within 2" from any secure point. Test from 10-2,000Hz	12	30	0	MIL-STD-202 Method 204
P9	Resistance to soldering heat	All types	Condition B, no pre-heat of samples: Single wave solder - Procedure 2	3	12	0	MIL-STD-202 Method 210
P10	Thermal shock	C0G/NP0: All types X7R: Y and H only	-55ºC/+125ºC. Number of cycles 300. Maximum transfer time - 20 seconds, dwell time - 15 minutes. Air-Air	12	30	0	MIL-STD-202 Method 107
P11	Adhesion, rapid temp change and climatic sequence	X7R: A, F and J only	5N force applied for 10s, -55ºC/ +125ºC for 5 cycles, damp heat cycles	12	27	0	BS EN132100 Clause 4.8, 4.12 and 4.13
P12	Board flex	C0G/NP0: All types X7R: Y and H only	3mm deflection Class I 2mm deflection Class II	12	30	0	AEC-Q200-005
P13		X7R: A, F and J only	1mm deflection.	12	12	0	BS EN132100 Clause 4.9
P14	Terminal strength	All types	Force of 1.8kg for 60 seconds	12	30	0	AEC-Q200-006
P15	Beam load test	All types	-	12	30	0	AEC-Q200-003
P16	Damp heat steady state	All types	56 days, 40ºC / 93% RH 15x no volts, 15x 5Vdc, 15x rated voltage or 50V whichever is the least.	12	45	0	BS EN132100 Clause 4.14

Test results are available on request.
P = Period in months.
N = Sample size.
C = Acceptance criteria.

Notes intended to guide and assist our customers in using multilayer ceramic capacitors in surface mount technology are available from Syfer.

The information concentrates on the handling, mounting, connection, cleaning, test and re-work requirements particular to MLC's for SMD technology, to ensure a suitable match between component capability and user expectation. Some extracts are given below.

Handling

Ceramics are dense, hard, brittle and abrasive materials. They are liable to suffer mechanical damage, in the form of chips or cracks, if improperly handled.

Terminations will be abraded onto chip surfaces if loose chips are tumbled in bulk. Metallic tracks will be left on the chip surfaces which might pose a reliability hazard.

Surface mount MLC's should never be handled with fingers; perspiration and skin oils can inhibit solderability and will aggravate cleaning.

MLC's should never be handled with metallic instruments. Metal tweezers should never be used as these can chip the product and may leave abraded metal tracks on the product surface. Plastic or plastic coated metal type are readily available and recommended - these should be used with an absolute minimum of applied pressure.

Counting or visual inspection of MLC's is best performed on a clean glass or hard plastic surface.

If MLC's are dropped or subjected to rough handling, they should be visually inspected before use. Electrical inspection may also reveal gross damage via a change in capacitance, an increase in dissipation factor or a decrease either in insulation resistance or electrical strength.

Transportation

Where possible, any transportation should be carried out with the product in its unopened original packaging. If already opened, any environmental control agents supplied should be returned to packaging and the packaging re-sealed.

Avoid paper and card as a primary means of handling, packing, transportation and storage of loose chip capacitors. Many grades have a sulphur content which will adversely affect termination solderability.

Loose chips should always be packed with sulphur-free wadding to prevent impact or abrasion damage during transportation.

Storage

Incorrect storage of surface mount MLC's can lead to problems for the user.

Rapid tarnishing of the terminations, with an associated degradation of solderability, will occur if the product comes into contact with industrial gases such as sulphur dioxide and chlorine. Storage in free air, particularly moist air, can result in termination oxidation.

Packaging should not be opened until the MLC's are required for use. If opened, the pack should be re-sealed as soon as is practicable. Alternatively, the contents could be kept in a sealed container with an environmental control agent.

Long term storage conditions, ideally, should be temperature controlled between -5 and +40°C and humidity controlled between 40 and 60% R.H.

Taped product should be stored out of direct sunlight, which might promote a deterioration in tape or adhesive performance.

Product, stored under the conditions recommended above, in its "as received" packaging, has a minimum shelf life of 2 years.

Mechanical considerations for mounted ceramic chip capacitors

Due to their brittle nature, ceramic chip capacitors are more prone to excesses of mechanical stress than other components used in surface mounting.

One of the most common causes of failure is directly attributable to bending the printed circuit board after solder attachment. The excessive or sudden movement of the flexible circuit board stresses the inflexible ceramic block causing a crack to appear at the weakest point, usually the ceramic/termination interface. The crack may initially be quite small and not penetrate into the inner electrodes; however, subsequent handling and rapid changes in temperature will cause the crack to enlarge.

This mode of failure is often invisible to normal inspection techniques as the resultant cracks usually lie under the capacitor terminations and if left, can lead to catastrophic failure. More importantly, mechanical cracks, unless they are severe will not be detected by normal electrical testing of the completed circuit, failure only occuring at some later stage after moisture ingression.

The degree of mechanical stress generated on the printed circuit board is dependent upon several factors including the board material and thickness, the amount of solder and land pattern. The amount of solder applied is important, as an excessive amount reduces the chip's resistance to cracking.

As to where board flexing occurs sufficiently to produce mechanical stress cracks, it is Syfer's experience that more than 90% are due to board depanelisation, a process where two or more circuit boards are separated after soldering is complete. Other manufacturing stages that should be reviewed include:-

1) Attaching rigid components such as connectors, relays, display panels, heat sinks etc.
2) Fitting conventional leaded components. Special care must be exercised when rigid terminals, as found on large can electrolytic capacitors, are inserted.
3) Storage of boards in such a manner which allows warping.
4) Automatic test equipment, particularly the type employing "bed of nails" and support pillars.
5) Positioning the circuit board in its enclosure especially where this is a "snap-fit".
6) FlexiCap™ is available as a termination option. This is designed to reduce the instances of mechanical cracking.

Further information regarding the mechanical stressing of ceramic multilayer chip capacitors is available on request from our sales office.

Recommended process temperature - time

The various methods of attachment of chips onto substrates invariably involve thermal cycling and the components may be thermally sensitive. This is particularly true of MLC's. Any temperature steps employed must, in broad terms, be kept below 120°C (248°F) and steps of no more than 70°C (158°F) to 80°C (176°F) are preferred when MLC's, size 1812 and above, are used on the substrate. Ideally the pre-heat zone should elevate the substrate from room temperature to solder operations temperature - in practice, constraints are in place as a result of required process throughput, equipment capability and material properties.

The pre-heat temperature rise of the MLC's should be kept to around 2°C (3.6°F) per second and should be reduced below this when larger chip planforms are used. In practice, successful ranges tend to lie in the area 1.5 to 4°C (2.7 to 7.2°F) per second dependent upon substrate and components.

Actual component temperatures may be verified at various points on the board, by the attachment of fine thermocouples with a bead diameter of no more than 0.25mm. This may be effected using a thermally conductive adhesive. The attachment points should be the upper surface of a component termination for Wave soldering (for re-flow methods, attachment should be made to the component footprint). Use of thru' holes for fixing thermocouples should be avoided.

The introduction of a soak, at the end of the pre-heat, is useful, when larger components are used, as this allows temperature uniformity to be established across the substrate. Soldering a 'cool' substrate may induce substrate warpage. The magnitude or direction of the warpage may change on cooling imposing damaging stresses upon the SMD components.

Solder time should be minimised. The maximum permissible solder time that a surface mounted multilayer ceramic capacitor can be subjected to is dependent upon the termination material and the process temperature characteristics.

For chip sizes 1812 and above, cooling to ambient temperature should be allowed to occur naturally. Natural cooling allows a gradual relaxation of thermal mismatch stresses in the solder joints, very important for large chips. Draughts should be avoided. Forced air cooling can induce thermal breakage, and cleaning with cold fluids immediately after a soldering process may result in cracked MLC capacitors.

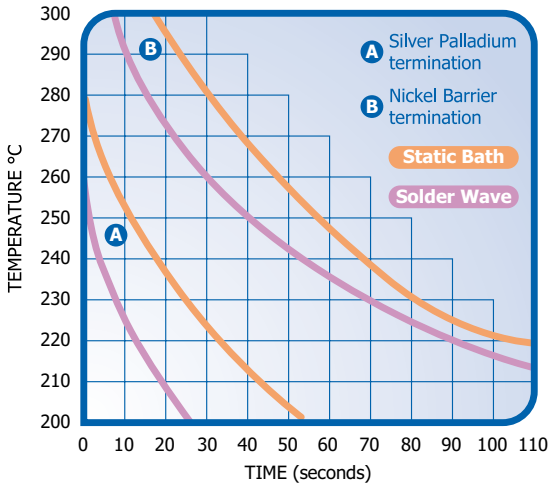
Solder time (see Fig 1)

Solder melting time should be minimised. The maximum permissible solder time that a surface mounted multilayer ceramic capacitor can be subjected to is dependent upon the termination material and process temperature/time.

Fig 1 shows Comparative Temperature/Time data for silver palladium and nickel barrier terminations to meet the "Solderability Test" as specified for both a static solder bath and a solder wave. These curves should not be exceeded in terms of the maximum exposure time.

Solder time temperature curves (Fig 1)

Recommended maximum exposure time as a function of temperature.



Successive soldering cycles (including rework) are cumulative in terms of temperature and percentage of time in affecting the capacitor in terms of solderability and resistance to soldering heat.

Important notes:

1. FlexiCap™ terminations can be processed in the same way as standard nickel barrier types. This is a fully lead free termination.
2. All standard chip capacitors are compatible with lead-free soldering.
3. For RoHS and WEEE status of product, see RoHS compliance section.

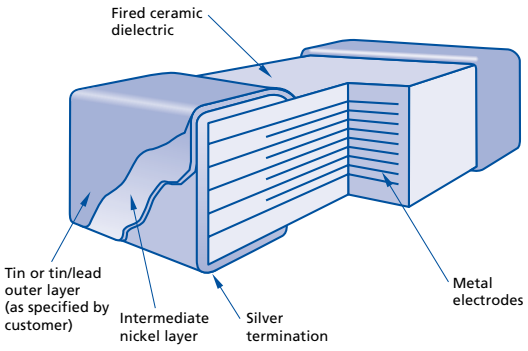
Leaching

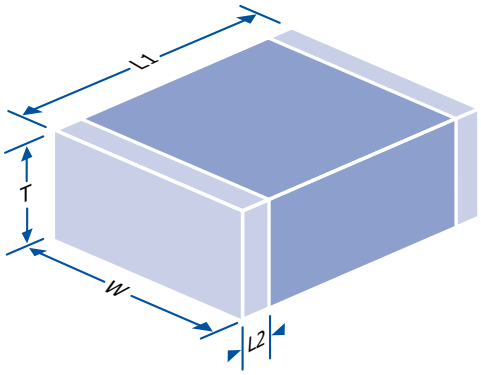
Leaching is the term for the dissolution of silver into the solder during the soldering operation. This weakens the terminations leading to an increase in equivalent series resistance (ESR), tan δ and open circuit faults as well as the possibility of the chip becoming detached from the substrate.

To prevent leaching, the following should be observed:-

1. Prework should be kept to a minimum.
2. An adequate preheat period is essential.
3. Solder temperature should be held at the lower end of the normal range.
4. Dwell time should be kept to a minimum.
5. Use ceramic chip capacitors with an "anti-leaching layer". We incorporate a "barrier layer" of nickel in the end terminations to prevent leaching.

Multilayer ceramic chip - with nickel barrier termination





Dimensions

Size	Length (L1) mm inches	Width (W) mm inches	Max. Thickness (T) mm inches	Termination Band L2 mm inches	
				min	max
0505	1.4 ± 0.38 0.055 ± 0.015	1.4 ± 0.25 0.055 ± 0.010	1.27 0.050	0.13 0.005	0.5 0.020
0603	1.6 ± 0.2 0.063 ± 0.008	0.8 ± 0.2 0.031 ± 0.008	0.8 0.031	0.1 0.004	0.4 0.015
0805	2.0 ± 0.3 0.08 ± 0.012	1.25 ± 0.2 0.05 ± 0.008	1.3 0.051	0.13 0.005	0.75 0.03
1111	2.79 + 0.51 - 0.25 0.110 + 0.020 - 0.010	2.79 ± 0.38 0.110 ± 0.015	2.54 0.100	0.13 0.005	0.63 0.025
1206	3.2 ± 0.3 0.126 ± 0.012	1.6 ± 0.2 0.063 ± 0.008	1.6 0.063	0.25 0.01	0.75 0.03
1210	3.2 ± 0.3 0.126 ± 0.012	2.5 ± 0.3 0.1 ± 0.012	2.0 0.08	0.25 0.01	0.75 0.03
1410	3.6 ± 0.3 0.14 ± 0.012	2.5 ± 0.3 0.1 ± 0.012	2.0 0.08	0.25 0.01	0.75 0.03
1806	4.5 ± 0.35 0.177 ± 0.012	1.6 ± 0.2 0.063 ± 0.008	1.3 0.051	0.25 0.01	0.75 0.03
1808	4.5 ± 0.35 0.18 ± 0.014	2.0 ± 0.3 0.08 ± 0.012	2.0 0.08	0.25 0.01	1.0 0.04
1812	4.5 ± 0.35 0.18 ± 0.014	3.2 ± 0.3 0.126 ± 0.012	2.5 0.1	0.25 0.01	1.0 0.04
1825	4.5 ± 0.35 0.18 ± 0.014	6.30 ± 0.4 0.25 ± 0.016	2.5 0.1	0.25 0.01	1.0 0.04
2211	5.7 ± 0.4 0.225 ± 0.016	2.79 ± 0.3 0.11 ± 0.012	2.5 0.1	0.25 0.01	0.8 0.03
2215	5.7 ± 0.4 0.225 ± 0.016	3.31 ± 0.35 0.15 ± 0.014	2.5 0.1	0.25 0.01	0.8 0.03
2220	5.7 ± 0.4 0.225 ± 0.016	5.0 ± 0.4 0.197 ± 0.016	2.5 0.1	0.25 0.01	1.0 0.04
2225	5.7 ± 0.4 0.225 ± 0.016	6.3 ± 0.4 0.25 ± 0.016	2.5 0.1	0.25 0.01	1.0 0.04
3640	9.2 ± 0.5 0.36 ± 0.02	10.16 ± 0.5 0.4 ± 0.02	2.5 0.1	0.5 0.02	1.5 0.06
5550	14.0 ± 0.5 0.55 ± 0.02	12.7 ± 0.5 0.5 ± 0.02	2.5 0.1	0.5 0.02	1.5 0.06
8060	20.3 ± 0.5 0.8 ± 0.02	15.24 ± 0.5 0.6 ± 0.02	2.5 0.1	0.5 0.02	1.5 0.06

Max thickness stated applies to standard components. Thicker parts can be supplied on customer request.

Standard range - 10V to 250Vdc

Capacitance values.

= New Ranges

		0603	0805	1206	1210	1808	1812	1825	2220	2225	3640	5550	8060
10V	C0G/NP0	0.47p-3.9n	1.0p-15n	1.0p-47n	3.9p-100n	15p-100n	10p-220n	10p-470n	10p-470n	10p-560n	n/a	n/a	n/a
	X7R	100p-100n	100p-330n	100p-1.0µ	1.0n-1.5µ	15p-1.5µ	3.9n-3.3µ	10n-4.7µ	10n-5.6µ	18n-6.8µ	n/a	n/a	n/a
	X5R	120n-150n	390n-680n	1.2µ-1.5µ	1.8µ-3.3µ	1.8µ-2.7µ	3.9µ-10µ	5.6µ-15µ	6.8µ-18µ	8.2µ-22µ	n/a	n/a	n/a
16V	C0G/NP0	0.47p-2.7n	1.0p-12n	1.0p-33n	3.9p-68n	4.7p-68n	10p-180n	10p-330n	10p-330n	10p-470n	n/a	n/a	n/a
	X7R	100p-100n	100p-330n	100p-1.0µ	1.0n-1.5µ	15p-1.5µ	3.9n-3.3µ	10n-4.7µ	10n-5.6µ	18n-6.8µ	n/a	n/a	n/a
	X5R	120n	390n-470n	1.2µ	1.8µ-2.7µ	1.8µ-2.2µ	3.9µ-6.8µ	5.6µ-12µ	6.8µ-12µ	8.2µ-15µ	n/a	n/a	n/a
25V	C0G/NP0	0.47p-2.2n	1.0p-10n	1.0p-27n	3.9p-56n	4.7p-47n	10p-150n	10p-220n	10p-220n	10p-330n	10p-330n	390p-680n	680p-1µ
	X7R	100p-56n	100p-220n	100p-820n	1.0n-1.2µ	15p-1.2µ	3.9n-2.2µ	10n-3.9µ	10n-4.7µ	18n-5.6µ	n/a	n/a	n/a
	X5R	68n-100n	270n-390n	1.0µ	1.5µ-2.2µ	1.5µ	2.7µ-4.7µ	4.7µ-10µ	5.6µ-10µ	6.8µ-12µ	n/a	n/a	n/a
50/63V	C0G/NP0	0.47p-1.5n	1.0p-5.6n	1.0p-22n	3.9p-33n	4.7p-33n	10p-100n	10p-150n	10p-150n	10p-220n	10p-330n	390p-680n	680p-1µ
	X7R	100p-47n	100p-220n	100p-470n	1.0n-1.0µ	15p-680n	3.9n-2.2µ	10n-1.8µ	10n-3.3µ	18n-3.3µ	390p-10µ	560p-15µ	10n-22µ
	X5R	56n-68n	270n-330n	560n-680n	1.2µ-1.5µ	820n-1.0µ	2.7µ-3.3µ	2.2µ-6.8µ	3.9µ-6.8µ	3.9µ-10µ	n/a	n/a	n/a
100V	C0G/NP0	0.47p-470p	1.0p-2.2n	1.0p-8.2n	4.7p-18n	4.7p-18n	10p-47n	10p-68n	10p-68n	10p-82n	10p-270n	390p-470n	680p-680n
	X7R	100p-15n	100p-68n	100p-220n	15p-560n	15p-470n	3.9n-1.0µ	10n-1.5µ	10n-2.2µ	18n-2.7µ	390p-5.6µ	560p-10µ	10n-15µ
200/250V	C0G/NP0	0.47p-150p	1.0p-820p	1.0p-2.7n	3.9p-4.7n	4.7p-6.8n	10p-15n	10p-27n	10p-27n	10p-39n	10p-100n	390p-220n	680p-330n
	X7R	100p-6.8n	100p-33n	100p-120n	1.0n-220n	15p-220n	3.9n-560n	10n-1.0µ	10n-1.0µ	18n-1.5µ	390p-3.3µ	560p-5.6µ	10n-10µ
		0603	0805	1206	1210	1808	1812	1825	2220	2225	3640	5550	8060

Ordering information - Standard and High Voltage ranges

1210	Y	100	0103	J	X	T	_ _ _
Chip size	**Termination**	**Voltage**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric**	**Packaging**	**Suffix**
0603 0805 1206 1210 1808 1812 1825 2220 2225 3640 5550 8060	**Y** = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant. **H** = FlexiCap™ termination base with nickel barrier (Tin/lead plating with min. 10% lead). **F** = Silver Palladium. RoHS compliant. **J** = Silver base with nickel barrier (100% matte tin plating). RoHS compliant. **A** = Silver base with nickel barrier (Tin/lead plating with min. 10% lead).	016 = 16V 025 = 25V 050 = 50V 063 = 63V 100 = 100V 200 = 200V 250 = 250V 500 = 500V 630 = 630V 1K0 = 1kV 1K2 = 1.2kV 1K5 = 1.5kV 2K0 = 2kV 2K5 = 2.5kV 3K0 = 3kV 4K0 = 4kV 5K0 = 5kV 6K0 = 6kV	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0103 = 10nF	<10pF B = ±0.1pF C = ±0.25pF D = ±0.5pF ≥ 10pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	**C** = C0G/NP0 (1B) **X** = X7R (2R1) **P** = X5R	**T** = 178mm (7") reel **R** = 330mm (13") reel **B** = Bulk pack - tubs	Used for specific customer require-ments

High Voltage range - 500V to 6kVdc

Capacitance values.

= New Ranges

		0603	0805	1206	1210	1808	1812	1825	2220	2225	3640	5550	8060
500V	C0G/NP0	0.47p-68p*	1.0p-390p	1.0p-1.5n	4.7p-4.7n	15p-3.9n	10p-10n	10p-18n	10p-15n	10p-22n	10p-68n	390p-150n	680p-220n
	X7R	100p-1.5n*	10p-10n	10p-47n	15p-120n	15p-120n	22p-330n	180p-560n	180p-560n	180p-820n	390p-1.0µ	560p-1.8µ	10n-3.3µ
630V	C0G/NP0	n/a	1.0p-180p	1.0p-1.0n	3.9p-1.8n	4.7p-2.2n	10p-5.6n	10p-10n	10p-10n	10p-15n	10p-39n	390p-68n	680p-150n
	X7R	n/a	10p-6.8n	10p-33n	15p-47n	15p-68n	22p-180n	180p-180n	180p-330n	180p-390n	390p-680n	560p-1.2µ	10n-2.2µ
1kV	C0G/NP0	n/a	1.0p-100p	1.0p-470p	3.9p-1.2n	4.7p-1.2n	10p-3.3n	10p-6.8n	10p-8.2n	10p-10n	10p-22n	390p-39n	680p-68n
	X7R	n/a	10p-4.7n	10p-27n	15p-33n	15p-47n	22p-100n	180p-120n	180p-120n	180p-150n	390p-180n	560p-390n	10n-1.0µ
1.2kV	C0G/NP0	n/a	n/a	1.0p-220p	3.9p-680p	4.7p-1.0n	10p-2.2n	10p-3.9n	10p-4.7n	10p-6.8n	10p-18n	390p-33n	680p-47n
	X7R	n/a	n/a	10p-15n	15p-10n	15p-10n	22p-33n	180p-68n	180p-82n	180p-100n	390p-150n	560p-220n	10n-470n
1.5kV	C0G/NP0	n/a	n/a	1.0p-180p	3.9p-470p	4.7p-680p	10p-1.5n	10p-2.7n	10p-3.3n	10p-4.7n	10p-12n	390p-22n	680p-33n
	X7R	n/a	n/a	10p-10n	15p-6.8n	15p-6.8n	22p-22n	180p-47n	180p-47n	180p-68n	390p-100n	560p-150n	10n-330n
2kV	C0G/NP0	n/a	n/a	1.0p-150p	3.9p-220p	4.7p-270p	10p-820p	10p-1.2n	10p-1.8n	10p-2.2n	10p-5.6n	390p-10n	680p-18n
	X7R	n/a	n/a	10p-2.2n	15p-4.7n	15p-4.7n	22p-10n	180p-10n	180p-27n	180p-33n	390p-47n	560p-82n	10n-150n
2.5kV	C0G/NP0	n/a	n/a	n/a	n/a	4.7p-220p	10p-680p	10p-1.0n	10p-1.5n	10p-1.8n	10p-4.7n	390p-6.8n	680p-12n
	X7R	n/a	n/a	n/a	n/a	15p-1.5n	22p-3.3n	180p-6.8n	180p-8.2n	180p-12n	390p-33n	560p-68n	10n-100n
3kV	C0G/NP0	n/a	n/a	n/a	n/a	4.7p-180p	10p-470p	10p-820p	10p-1.2n	10p-1.5n	10p-3.3n	390p-6.8n	680p-10n
	X7R	n/a	n/a	n/a	n/a	15p-1.2n	22p-2.7n	180p-3.9n	180p-6.8n	180p-8.2n	390p-22n	560p-47n	10n-82n
4kV	C0G/NP0	n/a	n/a	n/a	n/a	1.0p-150p*	2.2-390p*	10p-680p*	10p-1.0n*	10p-1.2n*	10p-1.5n	390p-4.7n	680p-6.8n
	X7R	n/a	n/a	n/a	n/a	100p-1.0n*	100p-2.2n*	100p-2.2n*	100p-4.7n*	100p-5.6n*	390p-6.8n	560p-15n	10n-33n
5kV	C0G/NP0	n/a	n/a	n/a	n/a	1.0p-82p*	2.2p-270p*	10p-470p*	10p-680p*	10p-820p*	10p-1.0n	390p-2.2n	680p-3.9n
	X7R	n/a	n/a	n/a	n/a	100p-680p*	100p-1.2n*	100p-1.8n*	100p-3.9n*	100p-4.7n*	n/a	560p-10n	10n-22n
6kV	C0G/NP0	n/a	n/a	n/a	n/a	1.0p-56p*	2.2p-220p*	10p-330p*	10p-470p*	10p-560p*	n/a	n/a	n/a
	X7R	n/a	n/a	n/a	n/a	68p-390p*	100p-1.0n*	100p-1.5n*	100p-2.2n*	100p-2.7n*	n/a	n/a	n/a
		0603	0805	1206	1210	1808	1812	1825	2220	2225	3640	5550	8060

N.B. Capacitance in F. * These parts may require conformal coating post soldering.

IECQ-CECC and MIL grade ranges

IECQ-CECC and MIL grade ranges

Maximum capacitance values.

		0603	0805	1206	1210	1808	1812	2220	2225
16V	C0G/NP0	1.5nF	6.8nF	22nF	33nF	33nF	100nF	150nF	220nF
	X7R	100nF	330nF	1.0µF	1.5µF	1.5µF	3.3µF	5.6µF	6.8µF
25V	C0G/NP0	1.0nF	4.7nF	15nF	22nF	27nF	68nF	100nF	150nF
	X7R	56nF	220nF	820nF	1.2µF	1.2µF	2.2µF	4.7µF	5.6µF
50/63V	C0G/NP0	470pF	2.7nF	10nF	18nF	18nF	33nF	68nF	100nF
	X7R	47nF	220nF	470nF	1.0µF	680nF	1.5µF	2.2µF	3.3µF
100V	C0G/NP0	330pF	1.8nF	6.8nF	12nF	12nF	27nF	47nF	68nF
	X7R	10nF	47nF	150nF	470nF	330nF	1.0µF	1.5µF	1.5µF
200V	C0G/NP0	100pF	680pF	2.2nF	4.7nF	4.7nF	12nF	22nF	27nF
	X7R	5.6nF	27nF	100nF	220nF	180nF	470nF	1.0µF	1.0µF
500V	C0G/NP0	n/a	330pF	1.5nF	3.3nF	3.3nF	10nF	15nF	22nF
	X7R	n/a	8.2nF	33nF	100nF	100nF	270nF	560nF	820nF
1kV	C0G/NP0	n/a	n/a	470pF	1.0nF	1.2nF	3.3nF	8.2nF	10nF
	X7R	n/a	n/a	4.7nF	15nF	18nF	56nF	120nF	150nF
		0603	0805	1206	1210	1808	1812	2220	2225

Ordering information - IECQ-CECC and MIL grade

1210	Y	100	0103	J	D	T	_ _ _
Chip size	**Termination**	**Voltage**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric reliability release codes**	**Packaging**	**Suffix code**
0603 0805 1206 1210 1808 1812 2220 2225	**Y** = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant. **H** = FlexiCap™ termination base with nickel barrier (Tin/lead plating with min. 10% lead). **F** = Silver Palladium. RoHS compliant. **J** = Silver base with nickel barrier (100% matte tin plating). RoHS compliant. **A** = Silver base with nickel barrier (Tin/lead plating with min. 10% lead).	016 = 16V 025 = 25V 050 = 50V 063 = 63V 100 = 100V 200 = 200V 250 = 250V 500 = 500V 1K0 = 1kV	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0103 = 10nF	<10pF B = ±0.1pF C = ±0.25pF D = ±0.5pF ≥ 10pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	**D** = X7R (2R1) with IECQ-CECC release **F** = C0G/NP0 (1B/NP0) with IECQ-CECC release **B** = 2X1/BX released in accordance with QC 32100 **R** = 2C1/BZ released in accordance with QC 32100	**T** = 178mm (7") reel **R** = 330mm (13") reel **B** = Bulk pack - tubs	Used for specific customer require-ments

* For product tested in accordance with MIL requirement contact the Sales Office.

AEC-Q200 Rev C ranges

Maximum capacitance values.

		0603	0805	1206	1210	1812
50/63V	C0G/NP0	470pF	2.7nF	10nF	18nF	39nF
	X7R	33nF	150nF	330nF	680nF	1.5µF
100V	C0G/NP0	330pF	1.8nF	6.8nF	12nF	27nF
	X7R	10nF	47nF	150nF	470nF	1µF
200V	C0G/NP0	100pF	680pF	2.2nF	4.7nF	12nF
	X7R	5.6nF	27nF	100nF	220nF	470nF
500V	C0G/NP0	n/a	330pF	1.5nF	3.9nF	10nF
	X7R	n/a	8.2nF	33nF	100nF	270nF
1kV	C0G/NP0	n/a	n/a	470pF	1nF	3.3nF
	X7R	n/a	n/a	4.7nF	15nF	56nF
		0603	0805	1206	1210	1812

Ordering information - AEC-Q200 Rev C

1210	Y	100	0103	J	E	T	_ _ _
Chip size	**Termination**	**Voltage**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric reliability release codes**	**Packaging**	**Suffix code**
0603 0805 1206 1210 1812	**Y** = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant. **J** = Silver base with nickel barrier (100% matte tin plating). RoHS compliant. (J termination not available with X7R products).	050 = 50V 063 = 63V 100 = 100V 200 = 200V 500 = 500V 1K0 = 1kV	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0103 = 10nF	<10pF B = ±0.1pF C = ±0.25pF D = ±0.5pF ≥ 10pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	**A** = C0G/NP0 (1B) **E** = X7R (2R1)	**T** = 178mm (7") reel **R** = 330mm (13") reel **B** = Bulk pack - tubs	Used for specific customer require-ments

S02A and S05 Space ranges

S02A and S05 Space ranges

Capacitance values.

		0603	0805	1206	1210	1812	2220	2225
16V	C0G/NP0	390pF - 1.5nF	1pF - 6.8nF	1pF - 22nF	10pF - 33nF	220pF - 100nF	470pF - 150nF	560pF - 220nF
	X7R	330pF - 100nF	100pF - 330nF	680pF - 1.0µF	1.0nF - 1.5µF	3.9nF - 3.3µF	10nF - 5.6µF	18nF - 6.8µF
25V	C0G/NP0	390pF - 1.0nF	1pF - 4.7nF	1pF - 15nF	10pF - 22nF	220pF - 68nF	470pF - 100nF	560pF - 150nF
	X7R	330pF - 56nF	100pF - 220nF	680pF - 820nF	1.0nF - 1.2µF	3.9nF - 2.2µF	10nF - 4.7µF	18nF - 5.6µF
50/63V	C0G/NP0	0.5pF - 470pF	1pF - 2.7nF	1pF - 10nF	10pF - 18nF	220pF - 39nF	470pF - 68nF	560nF - 100nF
	X7R	330pF - 47nF	100pF - 220nF	680pF - 470nF	1.0nF - 1.0µF	3.9nF - 2.2µF	10nF - 3.3µF	18nF - 3.3µF
100V	C0G/NP0	1pF - 330pF	1pF - 1.8nF	1pF - 6.8nF	10pF - 12nF	220pF - 27nF	470pF - 47nF	560pF - 68nF
	X7R	100pF - 10nF	100pF - 47nF	100pF - 150nF	1.0nF - 470nF	3.9nF - 1.0µF	10nF - 1.5µF	18nF - 1.5µF
200/250V	C0G/NP0	1pF - 100pF	1pF - 680pF	1pF - 2.2nF	10pF - 4.7nF	220pF - 12nF	470pF - 22nF	560pF - 27nF
	X7R	100pF - 5.6nF	100pF - 27nF	100pF - 100nF	1.0nF - 220nF	3.9nF - 470nF	10nF - 1.0µF	18nF - 1.0µF
500V	C0G/NP0	n/a	1pF - 270pF	1pF - 1.2nF	10pF - 2.7nF	180pF - 6.8nF	390pF - 15nF	4.7nF - 18nF
	X7R	n/a	10pF - 8.2nF	180pF - 33nF	390pF - 100nF	390pF - 270nF	1.0nF - 560nF	15nF - 820nF
		0603	0805	1206	1210	1812	2220	2225

Ordering information - S02A and S05 Space ranges

1210	A	100	0103	J	X	T	_ _ _
Chip size	**Termination** [1]	**Voltage**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric codes**	**Packaging**	**Suffix**
0603 0805 1206 1210 1812 2220 2225	**A** = Silver base with nickel barrier (Tin/ lead plating with min. 10% lead). **F** = Silver Palladium. RoHS compliant.	016 = 16V 025 = 25V 050 = 50V 063 = 63V 100 = 100V 200 = 200V 250 = 250V 500 = 500V	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0103 = 10nF	<10pF B = ±0.1pF C = ±0.25pF D = ±0.5pF ≥ 10pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	**C** = C0G/NP0 (1B) **X** = X7R (2R1)	**T** = 178mm (7") reel **R** = 330mm (13") reel **B** = Bulk pack - tubs **Q** = Waffle pack	Used for specific customer requirements **S02A** = S[2] (space grade) High Rel **S05** = S (space grade) High Rel

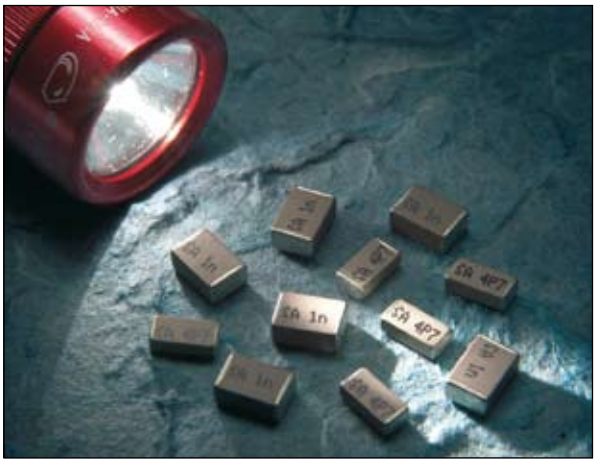
Notes:

(1) Termination **A** & **F** approved for Space applications. If another termination type is required then contact Syfer Sales.

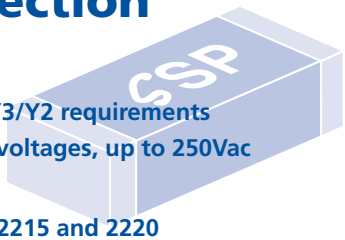
(2) Please include Lot Acceptance Test requirement (LAT1, LAT2 or LAT3) on purchase order against each line item.
Tests conducted after 100% Burn-In (2xRV @125ºC for 168 hours):
LAT1: 4 x adhesion, 8 x rapid temp change + LAT2 and LAT3.
LAT2: 20 x 1000 hour life test + LAT3.
LAT3: 6 x TC and 4 x solderability.

Syfer Technology's Surge Protection and Safety capacitors comply with international UL and TÜV specifications to offer designers the option of using a surface mount ceramic multilayer capacitor to replace leaded film types. Offering the benefits of simple pick-and-place assembly, reduced board space required and lower profile, they are also available in a FlexiCap™ version to reduce the risk of mechanical cracking.

Syfer's high voltage capacitor expertise means the range offers among the highest range available of capacitance values in certain case sizes. Applications include: modems, AC-DC power supplies and where lightning strike or other voltage transients represent a threat to electronic equipment.



Surge Protection capacitors



Meet Class X2/X1 and Y3/Y2 requirements

Approved for mains ac voltages, up to 250Vac

Approved by UL, TÜV

Sizes 1808, 1812, 2211, 2215 and 2220

- 1808 Y2 type available up to 1nF
- Suitable for use in equipment certified to EN 60950
- Surface mount package
- Reduces board area, including height restrictions
- Reduces assembly costs over conventional through-hole components
- FlexiCap™ option available (TÜV approved versions)

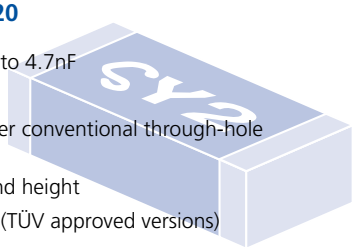
Safety capacitors

Class Y2/X1 and X2 surface mount multilayer ceramic safety capacitors

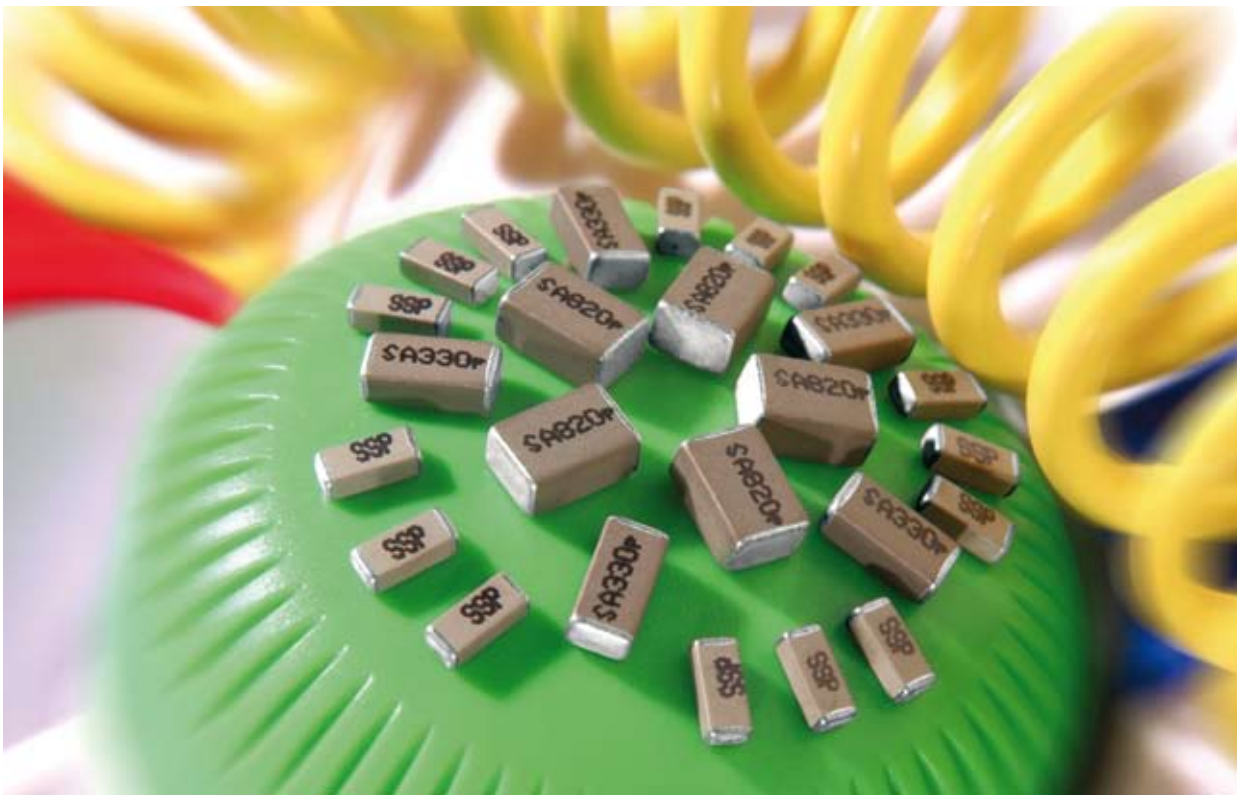
Approved for mains ac voltages, up to 250Vac

Approved by UL, TÜV

Sizes 2211, 2215 and 2220



- 2220 Y2 type available up to 4.7nF
- Surface mount package
- Reduces assembly costs over conventional through-hole components
- Also reduces board area and height
- FlexiCap™ option available (TÜV approved versions)



Surge Protection and Safety capacitors classification and approval specification.

	SAFETY CLASSIFICATION	SYFER PRODUCT			APPROVAL SPECIFICATION	APPROVAL BODY	FlexiCap™ OPTION (TÜV only)
		CHIP SIZE	DIELECTRIC	CAP RANGE			
SURGE PROTECTION	Y2/X1** PY2	1808	C0G/NP0	4.7pF to 220pF	IEC60384-14:2005	TÜV	✓
	Y2/X1** PY2	1808	X7R	150pF to 1nF	IEC60384-14:2005	TÜV	✓
	Y3/X2* SP	1808	C0G/NP0	4.7pF to 1.0nF	IEC60384-14:2005 / UL60950***	TÜV / UL	✓
	Y3/X2* SP	1808	X7R	150pF to 2.2nF / 150pF to 1nF	IEC60384-14:2005 / UL60950***	TÜV / UL	✓
	Y2/X1** PY2	1812	C0G/NP0	4.7pF to 470pF	IEC60384-14:1993 EN132400:1994	TÜV	✓
	Y2/X1** PY2	1812	X7R	150pF to 1.0nF	IEC60384-14:1993 EN132400:1994	TÜV	✓
SAFETY	Y2/X1** SP	2211	C0G/NP0	4.7pF to 680pF	IEC60384-14:2005 / UL60950***	TÜV / UL	✓
	Y2/X1** SP	2211	X7R	100pF to 1.0nF	IEC60384-14:2005 / UL60950***	TÜV / UL	✓
	Y2/X1** SP	2215	C0G/NP0	820pF to 1.0nF	IEC60384-14:2005 / UL60950***	TÜV / UL	✓
	Y2/X1 B16	2220	X7R	150pF to 4.7nF	IEC60384-14:2005 / UL1414: 6th Edition	TÜV / UL	✓
	X2 B17	2220	X7R	150pF to 10.0nF	IEC60384-14:2005	TÜV	✓

* Only approved for use in equipment certified to IEC60950:1992 edition
** Approved for use in equipment certified to IEC60950:2000 edition
*** Formerly UL1950
Note 1. Certificates of approval are available on Syfer's web site.
Note 2. Range extensions are currently being introduced. Please see Syfer's web site for further details.

Ordering information - Surge Protection capacitors - Class SPU/SP ranges

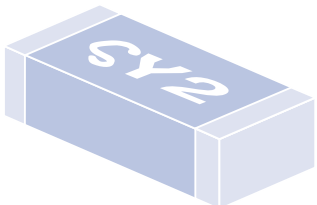
1808	J	A25	0102	J	C	T	SP
Chip size	**Termination**	**Voltage**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric codes**	**Packaging**	Suffix
1808 2211 2215	**J** = Nickel barrier **Y** = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant.	A25 = 250Vac	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following. Example: 0102 = 1.0nF	<10pF C = ±0.25pF D = ±0.5pF ≥ 10pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	**C** = C0G/NP0 **X** = X7R	**T** = 178mm (7") reel **R** = 330mm (13") reel **B** = Bulk pack - tubs	**SP** = Surge Protection capacitors (marked and approved) **SPU** = Surge Protection capacitors (un-marked parts are in accordance with, but not certified)

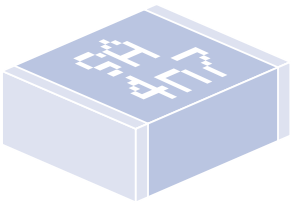
Ordering information - Safety capacitors - Class PY2/SY2

1808	J	A25	0102	J	X	T	PY2
Chip size	**Termination**	**Voltage**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric codes**	**Packaging**	Suffix
1808 1812	**J** = Nickel barrier **Y** = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant.	A25 = 250Vac	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following. Example: 0102 = 1.0nF	<10pF C = ±0.25pF D = ±0.5pF ≥ 10pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%	**C** = C0G/NP0 **X** = X7R	**T** = 178mm (7") reel **R** = 330mm (13") reel **B** = Bulk pack - tubs	**PY2** = Safety tested Surge Protection capacitors (marked and approved) **SY2** = Surge Protection capacitors (un-marked parts are in accordance with, but not certified)

Ordering information - Safety capacitors - Class B16/B17 ranges

2220	J	A25	0102	J	X	T	B16
Chip size	**Termination**	**Voltage**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric codes**	**Packaging**	Suffix
2220	**J** = Nickel barrier **Y** = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant. **A** = Silver base with nickel barrier (Tin/lead plating with min. 10% lead). **H** = FlexiCap™ termination base with Ni barrier (Tin/lead plating with min. 10% lead).	A25 = 250Vac	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following. Example: 0471 = 470pF	J = ±5% K = ±10% M = ±20%	**X** = X7R	**T** = 178mm (7") reel 1000 pieces **R** = 330mm (13") reel 4000 pieces **B** = Bulk	**B16** = Type A: X1/Y2 **B17** = Type B: X2

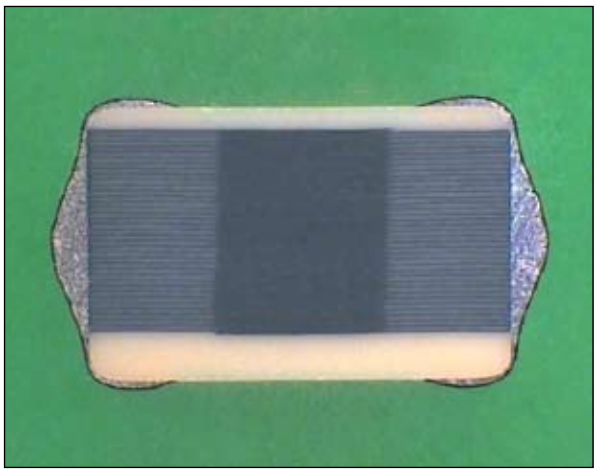




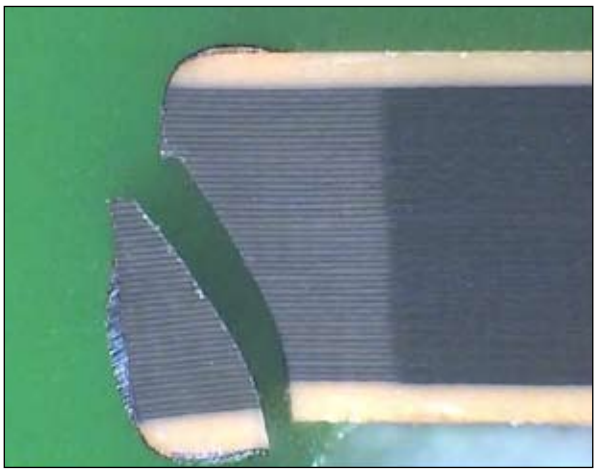
Open Mode capacitors X7R

Open Mode capacitors have been designed specifically for use in applications where mechanical cracking is a severe problem and short circuits due to cracking are unacceptable. Open mode capacitors use inset electrode margins, which prevent any mechanical cracks which may form during board assembly from connecting to the internal electrodes.

When combined with Syfer's FlexiCap™ termination, Syfer Open Mode capacitors provide a robust component with the assurance that if a part becomes cracked, the crack will be unlikely to result in short circuit failure.



Open Mode capacitor - Untested



Open Mode capacitor - Qualification included cracking the components by severe bend tests. Following the bend tests cracked components were subjected to endurance / humidity tests, with no failures evident due to short circuits.
Note: Depending on the severity of the crack, capacitance loss was between 0% and 70%.

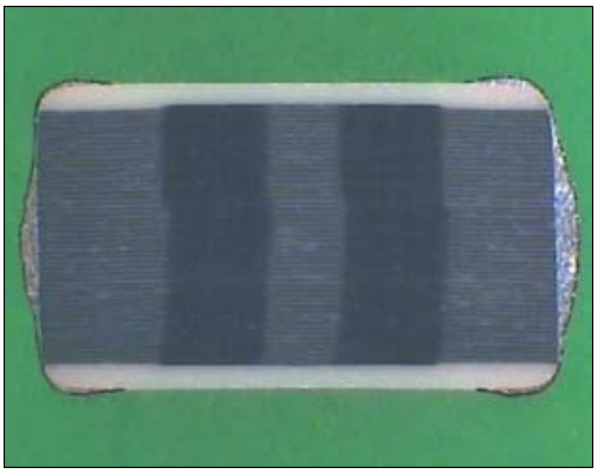
Max capacitance in nF (X7R only)

	0603	0805	1206	1210	1812	2220	2225
16V	39	150	470	680	1500	3300	4700
25V	33	120	330	560	1200	2200	3900
50/63V	22	100	220	470	1000	1500	2700
100V	6.8	27	100	220	680	1000	1800
200/250V	2.7	15	68	100	330	680	1000

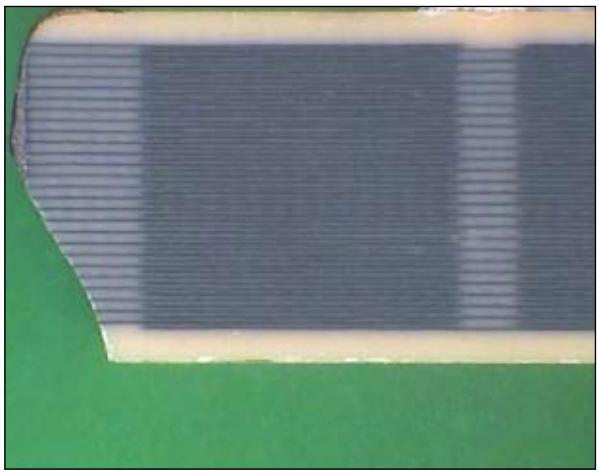
Ordering information - Open Mode capacitors

1206	Y	050	0224	K	X	T	M01
Chip size	**Termination**	**Voltage**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric codes**	**Packaging**	Suffix
0603 0805 1206 1210 1812 2220 2225	**Y** = Polymer Termination FlexiCap™	016 = 16V 025 = 25V 050 = 50V 063 = 63V 100 = 100V 200 = 200V 250 = 250V	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following. Example: 0224 = 220000pF	K = ±10%	**X** = X7R **E** = X7R (AEC-Q200 product)	**T** = 178mm (7") reel **R** = 330mm (13") reel	Syfer Open Mode capacitor

Tandem Capacitors have been designed as a fail safe range using a series section internal design, for use in any application where short circuits would be unacceptable. When combined with Syfer FlexiCap™ termination, Syfer Tandem capacitors provide an ultra robust and reliable component, for use in the most demanding applications.



Tandem capacitor - Untested



Tandem capacitor - Qualification included cracking the components by severe bend tests. Following the bend tests cracked components were subjected to endurance / humidity tests, with no failures evident due to short circuits.
Note: Depending on the severity of the crack, capacitance loss was between 0% and 50%.

Max capacitance in nF (X7R only)

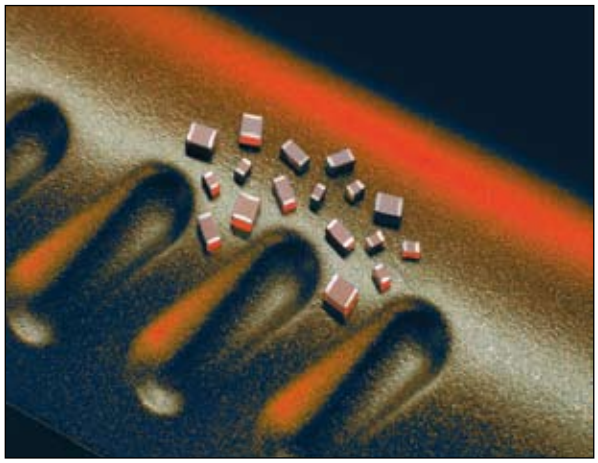
	0603	0805	1206	1210	1812	2220	2225
16V	12	47	150	270	560	1200	1500
25V	10	39	120	220	470	1000	1200
50/63V	6.8	33	100	180	390	680	1000
100V	2.2	10	47	82	220	470	680
200/250V	1.0	4.7	22	47	100	220	330

Ordering information - Tandem capacitors

1206	Y	050	0104	K	E	T	T01
Chip size	**Termination**	**Voltage**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric codes**	**Packaging**	Suffix
0603 0805 1206 1210 1812 2220 2225	**Y** = Polymer Termination FlexiCap™	016 = 16V 025 = 25V 050 = 50V 063 = 63V 100 = 100V 200 = 200V 250 = 250V	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following. Example: 0104 = 100000pF	K = ±10%	**X** = X7R **E** = X7R (AEC-Q200 product)	**T** = 178mm (7") reel **R** = 330mm (13") reel	Syfer Tandem capacitor

High Temperature capacitors X8R

The X8R dielectric will operate from -55°C to +150°C, with a maximum capacitance change ±15% (without applied voltage).
The devices are available in sizes 0805 to 2225, with voltage ranges from 25V to 200V and capacitance values from 1nF to 1.8µF.
The capacitors have been developed by Syfer to meet demand from various applications in the automotive and industrial markets and in other electronic equipment exposed to high temperatures. The increased use of electronics in automotive "under the hood" applications has created demand for this product range.
The X8R range incorporates a specially formulated termination with a nickel barrier finish that has been designed to enhance the mechanical performance of these SMD chip capacitors in harsh environments typically present in automotive applications.



Capacitance Range
1.0nF to 1.8µF

Temperature Coefficient of Capacitance (TCC)
± 15% from -55°C to +150°C

Dissipation Factor (DF)
≤ 0.025

Insulation Resistance (IR)
100G Ω or 1000secs (whichever is the less).

Dielectric Withstand Voltage (DWV)
2.5 x rated voltage for 5±1 seconds,
50 mAmps charging current maximum.

Ageing Rate
1% per decade (typical)

Max cap. values according to the rated d.c. voltage

		0805	1206	1210	1812	2220	2225
Min Cap. value		1.0nF	2.2nF	4.7nF	6.8nF	10nF	10nF
Max. cap value according to the rated dc voltage	**25V**	56nF	180nF	330nF	680nF	1.5µF	1.8µF
	50V	33nF	120nF	220nF	470nF	680nF	1.0µF
	100V	15nF	56nF	120nF	220nF	470nF	560nF
	200/250V	10nF	33nF	68nF	120nF	220nF	330nF

Ordering information - High Temperature capacitors

1206	Y	100	0473	K	N	T
Chip size	**Termination**	**Voltage d.c.**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric codes**	**Packaging**
0805 1206 1210 1812 2220 2225	**Y** = Nickel barrier with polymeric silver termination	025 = 25V 050 = 50V 100 = 100V 200 = 200V 250 = 250V	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following. Example: 0473 = 47000pF = 47nF	J = ±5% K = ±10% M = ±20%	**N** = X8R	**T** = 178mm (7") reel **R** = 330mm (13") reel **B** = Bulk pack - tubs

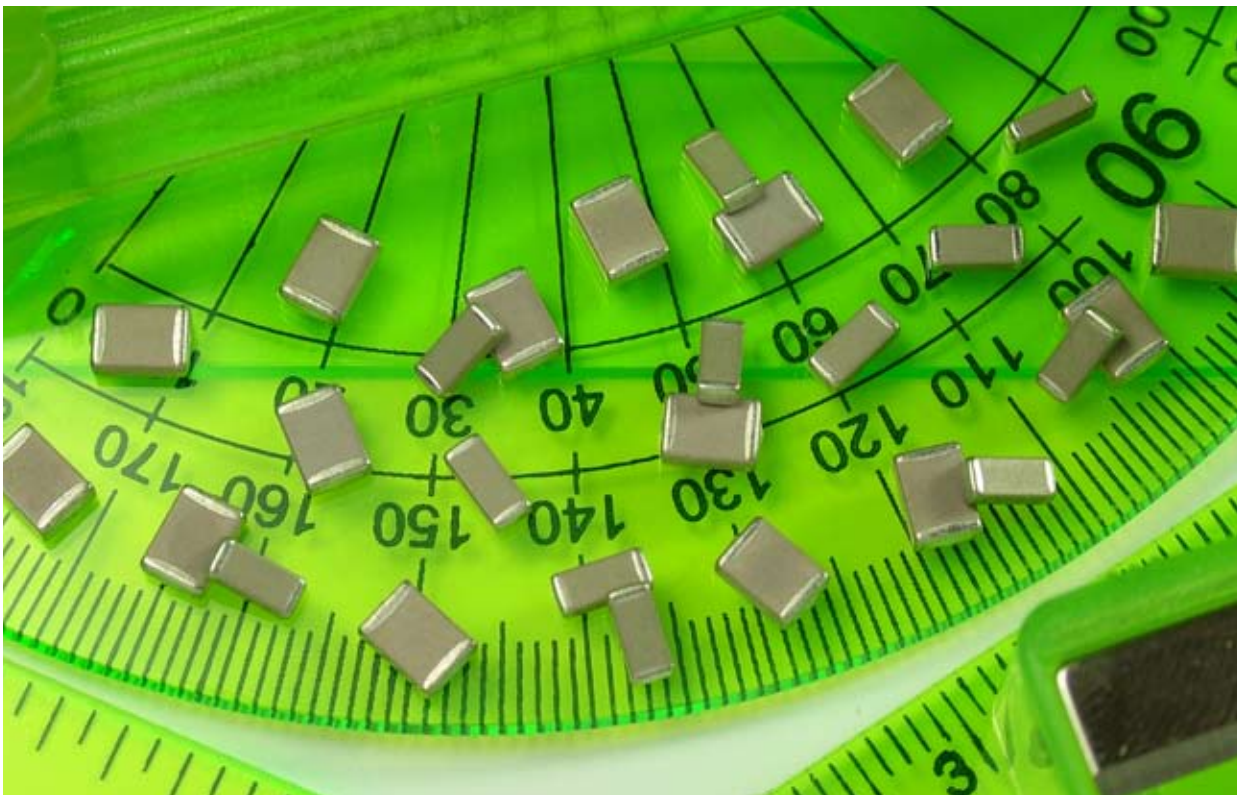
Syfer Technology has developed a range of surface mount multilayer ceramic capacitors aimed specifically at the LCD inverter market. The advantage gained over standard product is a reduced susceptibility to surface arcing which allows for the replacement of leaded components. The improved properties are achieved by the utililisation of a unique C0G/NP0 dielectric material.
Parts for these applications are identified with the suffix code FB9.
Users should carefully consider solder pad design as this can influence arcing voltage.

Capacitance range

	1808	1812
5kV	1.5pF - 22pF	3.9pF - 68pF
6kV	1.5pF - 12pF	3.9pF - 33pF

Ordering information - LCD Inverter range

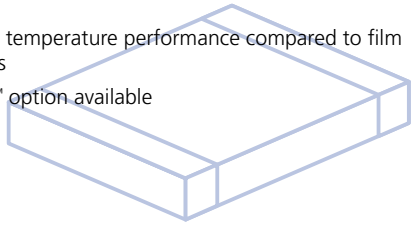
1808	Y	5K0	0680	D	C	T	FB9
Chip size	**Termination**	**Voltage d.c.**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric codes**	**Packaging**	**Suffix**
1808 1812	**Y** = Nickel barrier with polymeric silver termination.	5K0 = 5kV 6K0 = 6kV	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following. Example: 0680 = 68pF	<10pF B = ±0.1pF C = ±0.25pF D = ±0.5pF ≥ 10pF F = ±1% G = ±2% J = ±5% K = ±10%	**C** = C0G/NP0	**T** = 178mm (7") reel **R** = 330mm (13") reel **B** = Bulk pack - tubs	LCD Inverter range

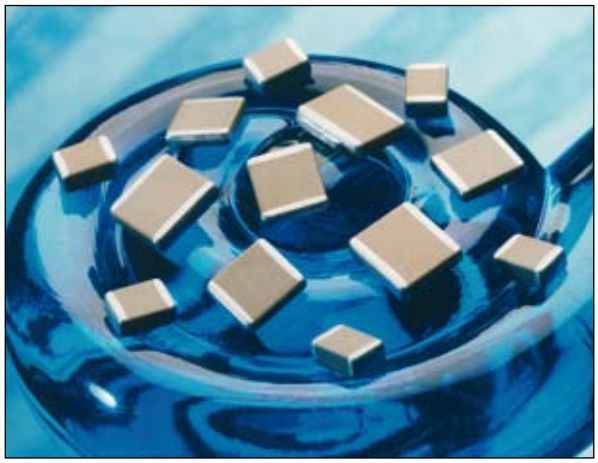


Tip & Ring/Ring Detect capacitors

Syfer's range of 250Vdc chip capacitors is ideal for telephone line filtering (Tip & Ring/Ring Detect) applications.

- Small surface mount package compared to traditional through hole capacitors
- Suitable as replacements for high voltage leaded film capacitors, thereby saving pcb board space and weight
- Low ESR
- Improved temperature performance compared to film capacitors
- FlexiCap™ option available





Capacitance range

	1812	2220	2225
250Vdc	100 - 470nF	180 - 820nF	560nF - 1.0µF

Ordering information - Tip & Ring/Ring Detect capacitors

1812	J	250	0474	K	X	T
Chip size	**Termination**	**Voltage d.c.**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric codes**	**Packaging**
1812 2220 2225	**J** = Nickel barrier **Y** = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant.	250 = 250V	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following. Example: 0474 = 470,000pF = 470nF	J = ±5% K = ±10% M = ±20%	**X** = X7R	**T** = 178mm (7") reel **R** = 330mm (13") reel **B** = Bulk pack - tubs

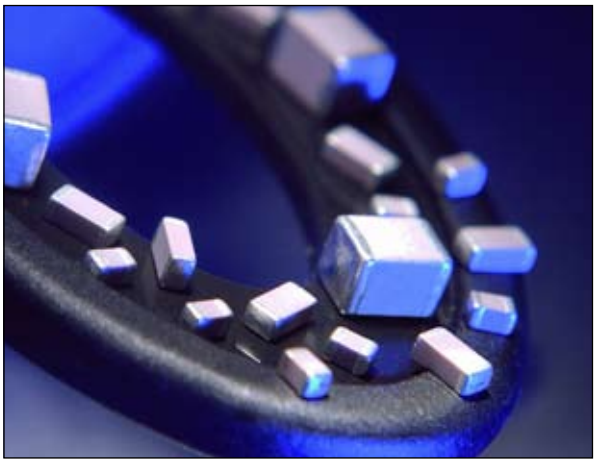
Defined Temperature / Voltage Coefficient of Capacitance

X7R capacitors are available from Syfer with a defined capacitance variation under applied dc voltage, across the full operating temperature range. Whilst the capacitance of C0G/NP0 chips does not vary with applied voltage, standard X7R capacitors exhibit capacitance fluctuation, but with no specified limit. For applications where a limit is required, Syfer is able to offer either a "B" code dielectric (conforms to MIL "BX" dielectric and IECQ-CECC "2X1") or "R" code dielectric (conforms to MIL "BZ" dielectric and IECQ-CECC "2C1").

	X7R		
Dielectric characteristics	Stable		
IECQ-CECC	2C1	2R1	2X1
EIA	-	X7R	-
MIL	BZ	-	BX
Rated temperature range	-55ºC to +125ºC		
Maximum capacitance charge over temperature range			
No DC voltage applied	±20%	±15%	±15%
Rated DC voltage applied	+20-30%	-	+15-25%
Syfer dielectric ordering code	R	X	B

For part numbering, the "X" denoting the X7R dielectric code needs to be replaced by either "B" or "R". Please contact the Sales Office for full range information.

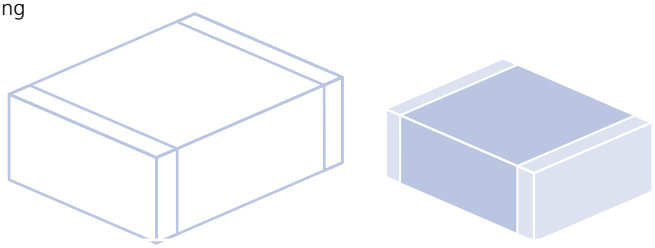
High Dielectric Withstand Voltage capacitors (DWV range)



The Syfer DWV range is specifically designed for use in applications where a high Dielectric Withstand Voltage (DWV) is required.

These parts have a continuous rated voltage of 500Vdc/250Vac, and are 100% DWV tested at the specified voltages to ensure Flashover (arcing) across the surface does not occur.

- High dielectric withstand voltages (DWV) of 1.5kV and 2.5kV
- These ratings are based on an application of the DWV voltage for a period of up to 60 seconds (where the charging current is limited to 50mA)
- Case sizes 1206 to 2225
- C0G/NP0 and X7R dielectrics
- Capacitance values from 4.7pF to 120nF
- For full range information please see Syfer web site, or contact our Sales Office.



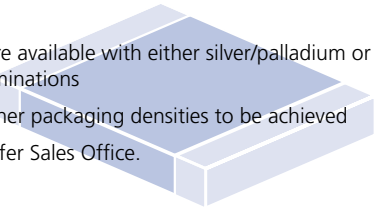
Ordering information - DWV capacitors

1812	J	1K5	0820	K	C	T	DWV
Chip size	Termination	Voltage	Capacitance in picofarads (pF)	Capacitance tolerance	Dielectric codes	Packaging	Suffix
1206 1210 1808 1812 2220 2225	**J** = Nickel barrier	1K5 = 1500V 2K5 = 2500V	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following. Example: 0820 = 82pF	J = ±5% K = ±10% M = ±20%	**C** = C0G/NP0 **X** = X7R	**T** = 178mm (7") reel **R** = 330mm (13") reel **B** = Bulk pack - tubs	Dielectric Withstand Voltage

Low Profile capacitors

Available in three maximum thicknesses of 0.50mm, 0.60mm and 0.65mm.

They are ideal for use in smart cards, sensors or for mounting underneath components where space is restricted.



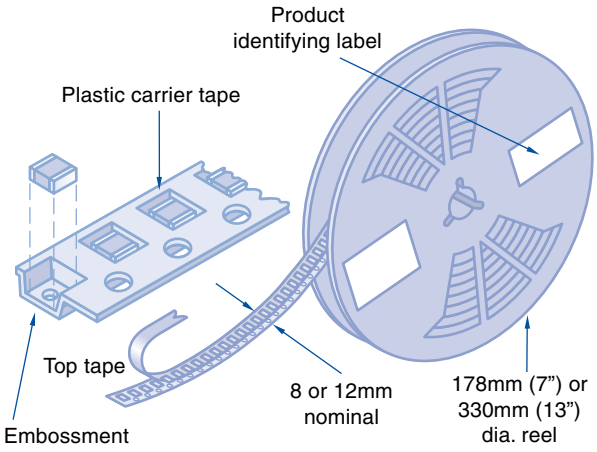
- All types are available with either silver/palladium or nickel barrier terminations
- Allows higher packaging densities to be achieved

Refer to Syfer Sales Office.

Tight Tolerance capacitors

One of Syfer's strengths is being able to offer capacitors with tight tolerances. The accuracy of the printing screens used in the fully computer controlled "wet process" manufacture allows for tolerances as close as +/-1% on C0G/NP0 parts greater than or equal to 10pF. For values below 10pF tolerances can be as tight as +/-0.05pF.

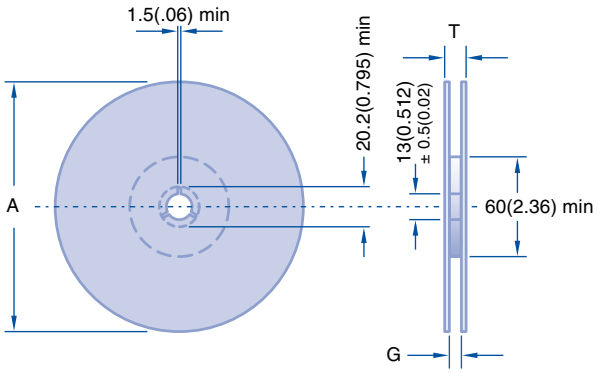
Tape and reel packing of surface mounting chip capacitors for automatic placement are in accordance with IEC60286-3.



Peel force

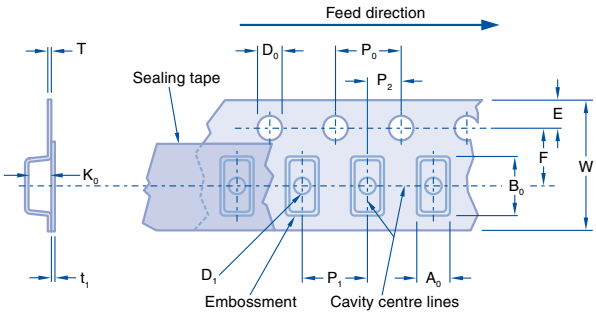
The peel force of the top sealing tape is between 0.2 and 1.0 Newton at 180°. The breaking force of the carrier and sealing tape in the direction of unreeling is greater than 10 Newtons.

Reel dimensions mm (inches)



Symbol	Description	178mm reel	330mm reel
A	Reel diameter	178 (7)	330 (13)
G	Reel inside width	8.4 (0.33)	12.4 (0.49)
T	Reel outside width	14.4 (0.56) max	18.4 (0.72) max

Tape dimensions



		Dimensions mm (inches)	
Symbol	Description	8mm tape	12mm tape
A_0 B_0 K_0	Width of cavity Length of cavity Depth of cavity	Dependent on chip size to minimize rotation	
W	Width of tape	8.0 (0.315)	12.0 (0.472)
F	Distance between drive hole centres and cavity centres	3.5 (0.138)	5.5 (0.213)
E	Distance between drive hole centres and tape edge	1.75 (0.069)	
P_1	Distance between cavity centres	4.0 (0.156)	8.0 (0.315)
P_2	Axial distance between drive hole centres and cavity centres	2.0 (0.079)	
P_0	Axial distance between drive hole centres	4.0 (0.156)	
D_0	Drive hole diameter	1.5 (0.059)	
D_1	Diameter of cavity piercing	1.0 (0.039)	1.5 (0.059)
XT	Carrier tape thickness	0.3 (0.012) ±0.1 (0.004)	0.4 (0.016) ±0.1 (0.004)
Xt_1	Top tape thickness	0.1 (0.004) max	

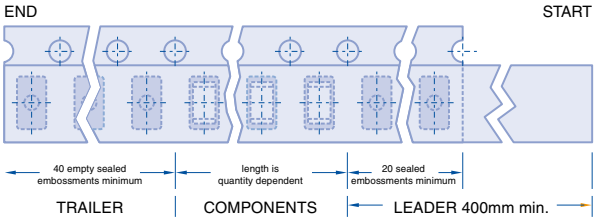
Missing components

The number of missing components in the tape may not exceed 0.25% of the total quantity with not more than three consecutive components missing. This must be followed by at least six properly placed components.

Identification

Each reel is labelled with the following information: manufacturer, chip size, capacitance, tolerance, rated voltage, dielectric type, batch number, date code and quantity of components.

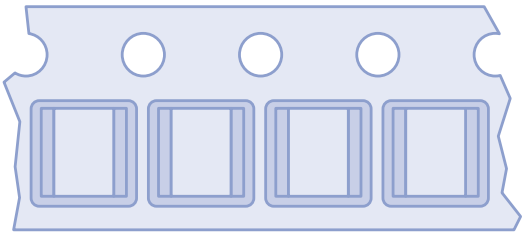
Leader and Trailer



Component orientation

Tape and reeling is in accordance with IEC 60286 part 3, which defines the packaging specifications of leadless components on continuous tapes.

NOTES: 1) IED60286 stats Ao ≤ Bo (see Tape Dimensions above).
2) Regarding the orientation of 1825 & 2225 components, the termination bands are right to left, NOT front to back. Please see diagram.

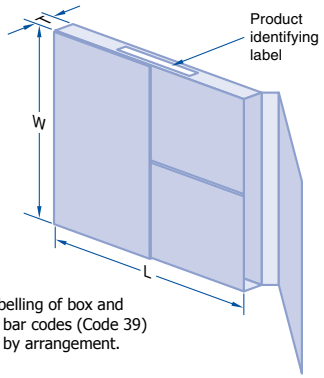


Orientation of 1825 & 2225 components

Outer Packaging

Outer Carton Dimensions mm (inches) max.

Reel Size	No. of reels	L	W	T
178 (7.0)	1	185 (7.28)	185 (7.28)	25 (0.98)
178 (7.0)	4	190 (7.48)	195 (7.76)	75 (2.95)
330 (13.0)	1	335 (13.19)	335 (13.19)	25 (0.98)



Note: Labelling of box and reel with bar codes (Code 39) available by arrangement.

Reel quantities

Chip size		0402	0505	0603	0805	1111	1206	1210	1410	1808	1812	1825	2211	2215	2220	2225
Max. chip thickness		0.5mm	1.3mm	0.8mm	1.3mm	2.0mm	1.6mm	2.0mm	2.0mm	2.0mm	2.5mm	2.5mm	2.5mm	2.5mm	2.5mm	2.5mm
		0.02"	0.05"	0.03"	0.05"	0.08"	0.06"	0.08"	0.08"	0.08"	0.1"	0.1"	0.1"	0.1"	0.1"	0.1"
Reel quanti-ties	178mm (7")	12000	3000	4000	3000	2000	2500	2000	2000	2000	500	500	500	500	500	500
	330mm (13")	50000	13000	16000	12000	8000	10000	8000	8000	8000	3000	3000	3000	3000	3000	3000

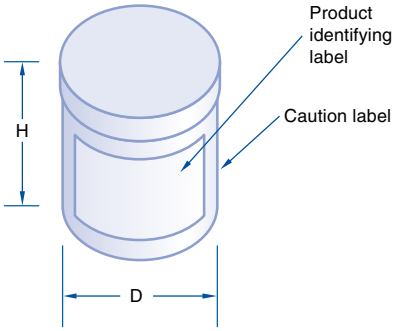
Note: The above quantities per reel are for the maximum manufactured chip thickness. Thinner chips can be taped in larger quantities per reel.

Bulk packing - tubs

Chips are supplied in rigid re-sealable plastic tubs together with impact cushioning wadding. Tubs are labelled with the details: chip size, capacitance, tolerance, rated voltage, dielectric type, batch number, date code and quantity of components.

Dimensions mm (inches)

H	60 (2.36)
D	50 (1.97)



Radial Leaded Capacitors

Syfer Technology produces a wide range of dipped radial leaded capacitors. These are available in rated voltages of 50V up to 5kV. Although our catalogue range extends to 5kV, we are able to offer a capability for specials up to 10kV. Our larger case sizes and high voltage versions are particularly in demand, especially for mil/aero and medical power supply applications. Please contact our Sales Office to discuss any special requirements. IECQ-CECC approved parts are also included within the ranges.

- High working voltage - up to 10kVdc
- Large case sizes
- RoHS compliant versions
- Tin-lead plated wire option to reduce tin whiskers

		8111M	8111N	8121M	8121N	8121T	8131M	8131T	8141M	8151M	8161M	8171M
50/63V	C0G/NP0	4.7nF	4.7nF	18nF	18nF	18nF	100nF	33nF	150nF	220nF	390nF	680nF
	X7R	220nF	220nF	1.0µF	1.0µF	1.0µF	3.3µF	1.5µF	4.7µF	4.7µF	8.2µF	15µF
100V	C0G/NP0	2.7nF	2.7nF	12nF	12nF	12nF	68nF	27nF	100nF	180nF	330nF	560nF
	X7R	100nF	100nF	470nF	470nF	470nF	1.5µF	1.0µF	2.2µF	3.3µF	6.8µF	10µF
200/250V	C0G/NP0	1.0nF	1.0nF	4.7nF	4.7nF	4.7nF	27nF	12nF	47nF	82nF	120nF	270nF
	X7R	56nF	56nF	220nF	220nF	220nF	1.0µF	470nF	1.0µF	1.5µF	3.9µF	8.2µF
500V	C0G/NP0	470pF	470pF	3.3nF	3.3nF	3.3nF	22nF	10nF	33nF	56nF	100nF	180nF
	X7R	8.2nF	8.2nF	100nF	100nF	100nF	820nF	270nF	680nF	1.0µF	1.8µF	3.3µF
630V	C0G/NP0	270pF	270pF	1.8nF	1.8nF	1.8nF	15nF	5.6nF	22nF	39nF	68nF	150nF
	X7R	-	-	27nF	27nF	27nF	390nF	150nF	470nF	680nF	1.2µF	2.2µF
1kV	C0G/NP0	-	-	1.0nF	1.0nF	1.0nF	10nF	3.3nF	15nF	22nF	39nF	68nF
	X7R	-	-	15nF	15nF	15nF	150nF	56nF	150nF	180nF	390nF	1.0µF
2kV	C0G/NP0	-	-	-	-	-	2.2nF	820pF	3.3nF	5.6nF	10nF	18nF
	X7R	-	-	-	-	-	33nF	10nF	47nF	47nF	82nF	150nF
3kV	C0G/NP0	-	-	-	-	-	1.5nF	470pF	1.0nF	2.2nF	4.7nF	8.2nF
	X7R	-	-	-	-	-	6.8nF	2.7nF	10nF	18nF	39nF	68nF
4kV	C0G/NP0	-	-	-	-	-	1.2nF	-	680pF	1.0nF	2.2nF	4.7nF
	X7R	-	-	-	-	-	5.6nF	-	5.6nF	6.8nF	15nF	33nF
5kV	C0G/NP0	-	-	-	-	-	-	-	470pF	560pF	1.5nF	3.3nF
	X7R	-	-	-	-	-	-	-	3.3nF	3.9nF	8.2nF	18nF

Fixed Multilayer Ceramic Radial Capacitor IECQ-CECC Approvals

	Dipped
Climatic category:	55/125/21
Capacitance tolerances:	C0G/NP0 - 5%, 10% & 20%
	X7R - 10% & 20%
Approved Rated Voltages:	50V/63V, 100V & 200V

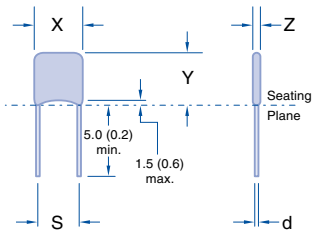
Dipped Product Approval Range

CECC Case Size	Syfer Product Code	
A	8111M	
F	8111N	
B	8121M	
C	8121N	
D	8131M	
Dielectric	**Capacitance Range**	**CECC Specification**
C0G/NP0	3.9pF to 27nF	CECC 30 601 008
X7R	100pF to 1.0uF	CECC 30 701 013

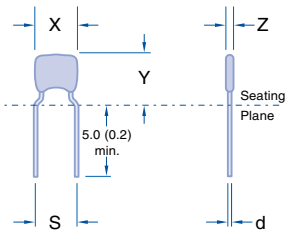
Dimensions - Dipped Radial

	CECC		Width	Height	Thickness	Lead Space	Lead Diameter
	Case reference	Pattern	(X) max. mm inches	(Y) max. mm inches	(Z) max. mm inches	(S) mm inches	(d) mm inches
8111M	A	A	3.81 0.15	5.31 0.21	2.54 0.10	2.54±0.4 0.1±.0.016	0.5±0.05 0.02±0.002
8111N	F	B	3.81 0.15	5.31 0.21	2.54 0.10	5.08±0.4 0.2±0.016	0.5±0.05 0.02±0.002
8121M	B	A	5.08 0.20	6.58 0.26	3.18 0.125	2.54±0.4 0.1±0.016	0.5±0.05 0.02±0.002
8121N	C	B	5.08 0.20	6.58 0.26	3.18 0.125	5.08±0.4 0.2±0.016	0.5±0.05 0.02±0.002
8121T		B	10.16 0.40	5.80 0.23	4.50 0.18	7.62±0.4 0.30±0.016	0.5±0.05 0.02±0.002
8131M	D	A	7.62 0.30	9.12 0.36	3.81 0.15	5.08±0.4 0.2±0.016	0.5±0.05 0.02±0.002
8131T		B	10.16 0.40	9.12 0.36	4.50 0.18	7.62±0.4 0.30±0.016	0.5±0.05 0.02±0.002
8141M		A	10.16 0.40	11.66 0.46	3.81 0.15	5.08±0.4 0.2±0.016	0.5±0.05 0.02±0.002
8151M		A	12.70 0.50	14.20 0.56	5.08 0.20	10.1±0.4 0.4±0.016	0.6±0.05 0.025±0.002
8161M		A	18.50 0.73	16.50 0.65	6.00 0.24	14.5±0.5 0.57±0.02	0.6±0.05 0.025±0.002
8171M		A	25.00 0.98	20.00 0.79	6.00 0.24	20.5±0.5 0.81±0.02	0.6±0.05 0.025±0.002

Pattern A



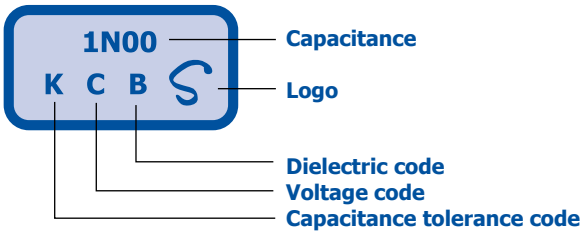
Pattern B



Marking information

All encapsulated capacitors are marked with:- Capacitance value, tolerance, rated d.c. voltage, dielectric, and where size permits the Syfer Technology 'S' logo.

Example: 1000pF ±10% 50V 2X1 dielectric



Ordering information - Radial Leaded capacitors

8111M	100	0102	J	C	□□□
Type No./ Size ref	**Voltage d.c. (marking code)**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric Rel Release codes**	**Suffix**
8111M 8111N 8121M 8121N 8121T 8131M 8131T 8141M 8151M 8161M 8171M	050 = 50V 063 = 63V 100 = 100V 200 = 200V 500 = 500V 1K0 = 1kV 2K0 = 2kV 3K0 = 3kV 4K0 = 4kV 5K0 = 5kV	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following. Example: 8P20 = 8.2pF	**Ultra stable dielectric** D: ± 0.47pF (Cr < 47pF) F: ± ±1% (Cr ≥ 47pF) G: ± 2% (Cr ≥ 27pF) J: ± 5% (Cr ≥ 10pF) K: ± 10% (Cr ≥ 10pF) **Stable dielectric** J: ± 5% (Cr ≥ 10pF) K: ± 10% (Cr ≥ 10pF) M: ± 20% (Cr ≥ 10pF)	**C** = C0G/NP0 (1B/CG; CG/BP) **X** = X7R (2R1) To Special Order **B** = 2X1 (BX) **R** = 2C1 (BZ)	Used for specific customer requirements. "C42" denotes RoHS compliant. A31 or A97 denote non-RoHS tin/lead wires. Contact Sales Office for appropriate non-RoHS code.

Cropped Leads

Cropped leads between 4.0 (0.157) and 30.0 (1.18) are available to special order. Some of the preferred codes are listed below, together with the appropriate suffix code. Dimensions as for standard product except as specified.

Suffix code - AE3 All radial ranges	Suffix code - AE4 All radial ranges	Suffix code - AD7 All radial ranges	Suffix code - AD5 All radial ranges
Lead length (L) 6 ±1 (0.236 ±0.04) from seating plane	**Lead length (L)** 4 ± 1 (0.162 ±0.04) from seating plane	**Lead length (L)** 5 ± 1 (0.2 ±0.04) from seating plane	**Lead length (L)** 10 ± 1 (0.4 ±0.04) from seating plane

Dimensions mm (inches)

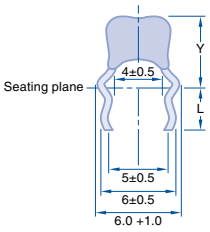
Snap in leads

Various forms of snap in leads (preformed) are available to special order, some of the preferred suffix codes are listed below. Dimensions as for standard product except as specified.

Suffix code - AD1

For PCB holes 0.9mm diameter
Types 8121N and 8131M

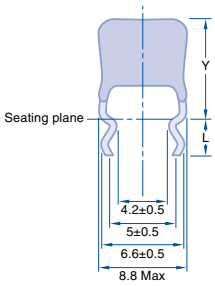
Dimensions
Y = 8121N 8 (0.315) Max
8131M 10 (0.394) Max
L = Min: 2.75 (0.108)
Max: 3.50 (0.138)



Suffix code - AD2

For PCB holes 1.2mm diameter
Types 8131M

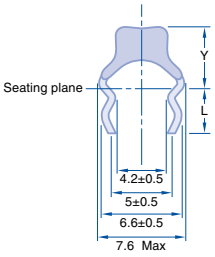
Dimensions
Y = 10 (0.294) Max
L = Min: 2.75 (0.108)
Max: 3.50 (0.138)



Suffix code - AD3

For PCB holes 1.2mm diameter
Types 8121N

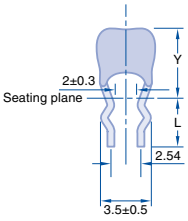
Dimensions
Y = 8 (0.315) Max
L = Min: 2.75 (0.108)
Max: 3.50 (0.138)



Suffix code - AO7

For PCB holes 0.8 to 0.97mm diameter
Types 8121M

Dimensions
Y = 6.58 (0.259) Max
L = Min: 2.75 (0.108)
Max: 3.50 (0.138)

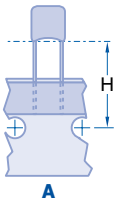


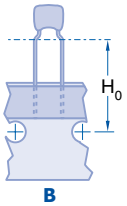
Bandoliered suffix codes

Dipped radial leaded with 2.54 and 5.08mm lead spacing can be supplied bandoliered on reels or in ammo boxes to special order. Some of the preferred suffix codes for bandoliered products are given below.

For bandoliered products the minimum order quantity, pieces, is specified in the tables below, larger orders must be in multiples of this quantity.

Dipped – straight and formed leads

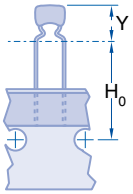




					Suffix code		
					Reel	AMMO pack	
Product code	Lead style	Diagram	H	H_0	2500pcs	1000pcs	2000pcs
8111M	Straight 2.54 crs	A	19±1	–	C01	C02	C11
8111M	Straight 2.54 crs	A	16±0.5	–	C30	C31	C32
8111N	Formed 5.08 crs	B	–	16±0.5	C01	C02	C11
8121M	Straight 2.54 crs	A	19±1	–	C01	C02	C11
8121M	Straight 2.54 crs	A	16±0.5	–	C30	C31	C32
8121N	Formed 5.08 crs	B	–	16±0.5	C01	C02	C11
8131M	Straight 5.08 crs	A	19±1	–	C01	C02	C11
8131M	Straight 5.08 crs	A	16±0.5	–	C30	C31	C32

8121T and 8131T available in bulk packaging only.

Dipped – stand-off lead form



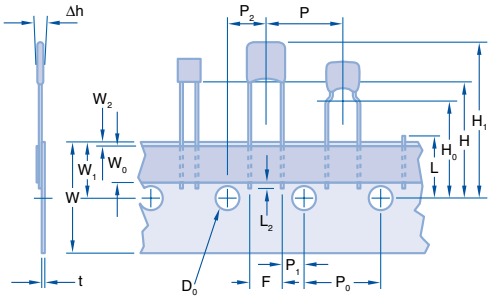
This style has been developed to provide a meniscus-free seating plane with a stress relieving form for auto-insertion.

Product code	Lead style	Y max	H_0	2500pcs	1000pcs	2000pcs
8111N	Formed 5.08 crs	7.5	16±0.5	C12	C23	C22
8111N	Formed 5.08 crs	7.5	19±1	C13	C25	C24
8121N	Formed 5.08 crs	8.5	16±0.5	C12	C23	C22
8121N	Formed 5.08 crs	8.5	19±1	C13	C25	C24

A maximum of 3 consecutive components may be missing from the bandolier, followed by at least 6 filled positions. Components missing from the bandolier are included in the total quantity, whereby the number of missing components may not exceed 0.25% of this total per packing module.
At the beginning and end of a reel the bandolier will exhibit at least 10 blank positions.

Minimum pull strength of product from tape = 5N.

Each reel/carton is provided with a label showing the:
Manufacturer, product style, batch identification, quantity and date code.
Labelling with bar codes (code 39) is available on request.

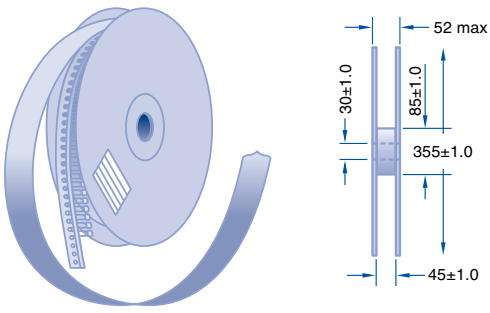


In accordance with IEC 60286 part 2

Dimensions mm (inches)

Description	Symbol	2.5mm lead space	5mm lead space	Tolerance
Lead wire diameter	d	0.5 (0.02) 0.6 (0.025)	0.5 (0.02) 0.6 (0.025)	±0.05 (0.002)
Component pitch	P	12.7 (0.5)	12.7 (0.5)	1.00 (0.04)
Feed hole pitch	P_0	12.7 (0.5)	12.7 (0.5)	±0.30 (0.01)
Feed hole centre to lead	P_1	5.08 (0.2)	3.81 (0.15)	±0.70 (0.03)
Feed hole centre to component	P_2	6.35 (0.25)	6.35 (0.25)	±0.70 (0.03)
Lead spacing	F	2.54 (0.10)	5.08 (0.20)	+0.6 (0.02) -0.1 (0.004)
Component alignment	Δh	0	0	±2.00(0.08)
Tape width	W	18.0 (0.70)	18.0 (0.70)	+1.00 (0.04) -0.50 (0.02)
Hold down tape width	W_0	6.0 (0.23)	6.0 (0.23)	±0.30 (0.01)
Hole position	W_1	9.0 (0.35)	9.0 (0.35)	±0.50 (0.02)
Hold down tape position	W_2	0.50 (0.02)	0.50 (0.02)	Max
Height to seating plane from tape centre (straight leads) (2)	H	16 (0.63) to 20 (0.79)	16 (0.63) to 20 (0.79)	As required
Height to seating plane from tape centre (formed leads) (2)	H_0	16 (0.63) to 20 (0.79)	16 (0.63) to 20 (0.79)	As required
Height to top of component from tape centre	H_1	32.2 (1.26)	32.2 (1.26)	Max
Feed hole diameter	D_0	4.0 (0.16)	4.0 (0.16)	±0.20 (0.008)
Carrier tape plus adhesive tape thickness	t	0.7 (0.03)	0.7 (0.03)	±0.20 (0.008)
Carrier tape thickness	-	0.5 (0.02)	0.5 (0.02)	±0.10 (0.004)
Cut out component snipped lead length from tape centre	L	11.0 (0.43)	11.0 (0.43)	Max
Lead wire protusion from hold down	L_2	2.0 (0.08)	2.0 (0.08)	Max

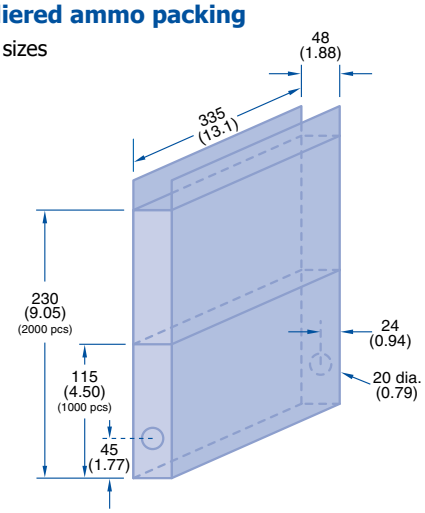
Bandoliered reels



The adhesive tape faces outwards. The dispensing direction is as shown. For the protection of the components a paper inlay is inserted between the windings of the bandolier. At the end of the bandolier this paper inlay continues for at least a further two rotations.

Bandoliered ammo packing

2 carton sizes



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