



Hi-Rel Products

IECQ-CECC qualified surface mount capacitors

AEC-Q200 qualified surface mount capacitors

Space grade surface mount capacitors

MIL grade surface mount capacitors

Radial capacitors

Planar arrays and discoids

EMI Filter products



Introduction

Syfer Technology Ltd manufactures quality multilayer ceramic components supplied to a worldwide customer base.

Customers utilise Syfer's components in all types of applications including telecoms, industrial, automotive, military, aerospace, space and medical.

Different applications require corresponding reliability grade components. The purpose of this document is to provide a guide to the different reliability grades of multilayer ceramic components offered by Syfer.

Syfer's state-of-the-art manufacturing and test equipment in the Norwich, England facility is supported by an integrated management system approved by BSI to ISO 9001, ISO 14001 and OHSAS 18001.



Customers are encouraged to visit Syfer and review / audit our facilities and systems.



Syfer - Hi-Rel Products



IECQ-CECC, AEC-Q200 and Space grade - Surface mount capacitors

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Planar arrays and discoidals

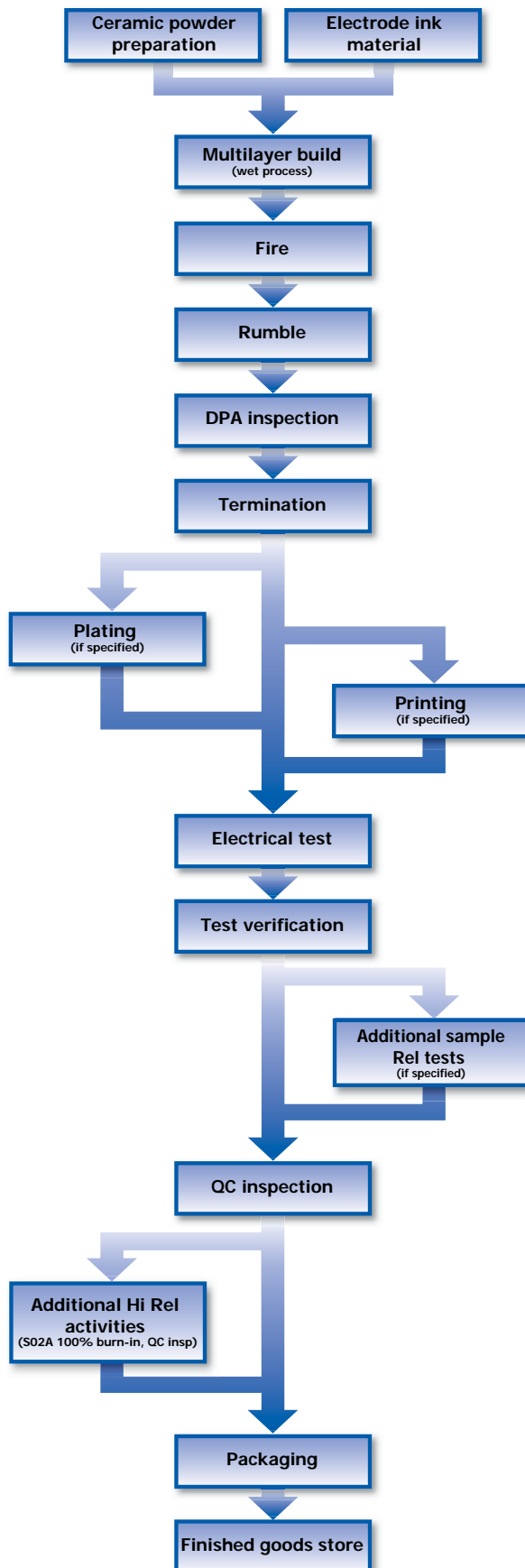
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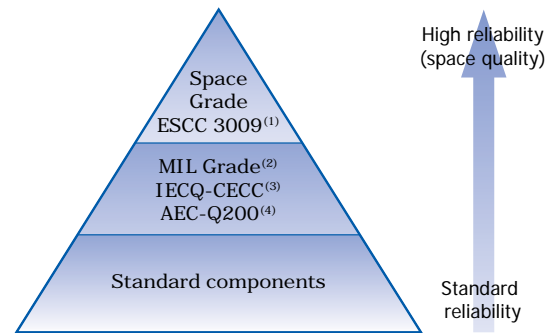
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1.1 - Production process flowchart



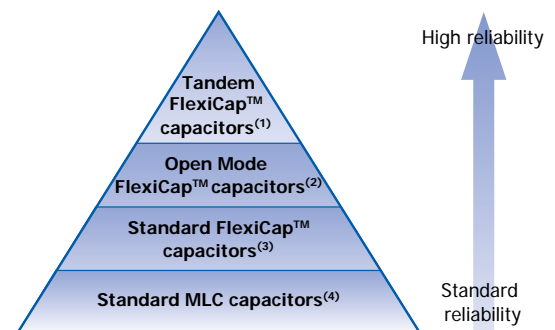
1.2 - Syfer reliability grades



Notes:

- (1) Space grade tested in accordance with ESCC 3009. Refer to Syfer specification S02A 0100.
- (2) MIL Grade. Released in accordance with US standards available on request.
- (3) 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> or at www.syfer.com
- (4) AEC-Q200. Automotive Electronics Council Stress Test Qualification For Passive Components. Refer to Syfer application note reference AN0009.

1.3 - Syfer reliability surface mount product groups



Notes:

- (1) "Tandem" construction capacitors, 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. Also available qualified to AEC-Q200.
- (2) "Open Mode" capacitors with FlexiCap™ termination also reduce the possibility of a short circuit by utilising inset electrode margins. Refer to application note AN0022. Also available qualified to AEC-Q200.
- (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™.

1.4 - FlexiCap™ termination

MLCCs 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™

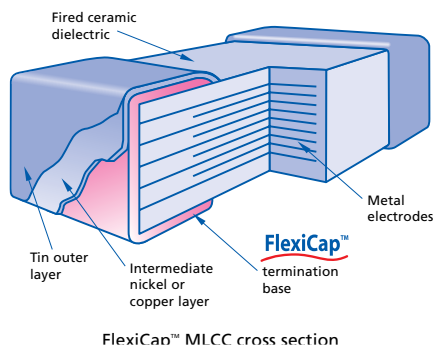
FlexiCap™ has been developed as a result of listening to customers' experiences of stress damage to MLCCs from many manufacturers, often caused by variations in production processes.

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. FlexiCap™ capacitors enable the board to be bent almost twice as much before mechanical cracking occurs. Refer to application note AN0002.

FlexiCap™ is also suitable for Space applications having passed thermal vacuum outgassing tests. Refer to Syfer application note reference AN0026.



FlexiCap™ benefits

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.

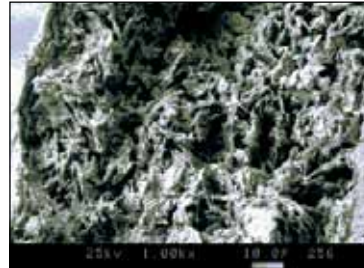
The benefit to the user is to facilitate a wider process window - giving a greater safety margin and substantially reducing the typical root causes of mechanical stress cracking.

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.

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

FlexiCap™ termination has no adverse effect on any electrical parameters, nor affects the operation of the MLCC in any way.



● 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:

- All High Reliability ranges
- Standard and High Voltage chips
- Safety Certified 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
Standard termination	2mm to 3mm
FlexiCap™	Typically 8mm to 10mm

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 FlexiCap™ 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™

1.5 - Tests conducted during batch manufacture

	Syfer reliability SM product group			
	Standard SM capacitors	IECQ-CECC / MIL grade	AEC-Q200	S (Space grade) High Rel 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 @125°C for 168 hours)	○	○	○	●
Load sample test @ 125°C	○	○	○	LAT1 & LAT2 (1000 hours)*
Humidity sample test. 85°C/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.

* ESCC 3009 & LAT 1, 2 & 3 qualifications currently being updated, please contact the factory for latest information.

1.6 - Precious Metal Electrodes Vs. Base Metal Electrodes

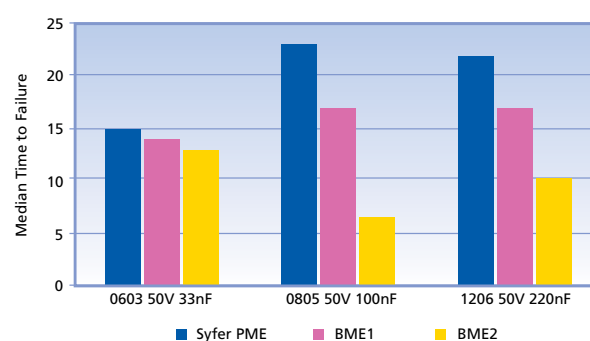
Multilayer ceramic capacitors typically require sintering temperatures in excess of 1000°C, which presents no problems to capacitors that employ a Precious Metal Electrode (PME) system. However, for Base Metal Electrode (BME) systems additional processes are required, including the use of a reducing atmosphere to prevent oxidation of the electrodes.

Despite the manufacturing problems, BME multilayer ceramic capacitors have proven to be a good choice for commercial products as they have reasonable electrical properties and life expectancy and can be used for some high reliability applications when properly qualified and screened.

At Syfer Technology we have been developing PME systems for over thirty years and use them exclusively for all our product lines. It produces capacitors to the highest reliability that can be used in all applications including the very demanding space requirements.

A recent Highly Accelerated Life Test (HALT) programme was undertaken to compare Syfer PME with equivalent BME capacitors. Capacitors rated at 50 volts were tested at 400 volts and at a

temperature of 180°C. The programme used three capacitor types from Syfer and two BME manufacturers.



In all cases the Syfer PME parts out-performed the BME capacitors suggesting that the long term reliability of PME systems is superior to BME, and PME parts should be regarded as the component of choice for high reliability applications.

1.7 - RoHS compliance

Syfer routinely monitors world wide material restrictions (e.g. EU / China & Korea RoHS mandates) and is actively involved in shaping future legislation.

All standard Syfer MLCC products are compliant with the EU RoHS directive (see below for special exceptions) and those with plated terminations are suitable for soldering using common Pb free solder alloys (refer to 'Soldering Information' for more details on soldering limitations). Compliance with EU RoHS directive automatically signifies compliance with some other legislation (e.g. Korea RoHS). Please refer to Syfer for details of compliance with other materials legislation.

Breakdown of material content, SGS analysis reports and tin whisker test results are available on request.

Most Syfer MLCC components are available with non RoHS compliant tin lead (SnPb) solderable termination finish by special request for exempt applications and where pure tin is not acceptable. Other tin free termination finishes may also be available – please refer to Syfer for further details.

Radial components have tin plated leads as standard, but tin/lead is available as a special option. Please refer to the radial section of the catalogue for further details.

1.8 - Release documentation

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

- Release documentation supplied as standard.
○ Optional documentation.

1.9 - Technical Summary

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

1.10 - 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 @125°C (150°C for X8R). Applied voltage depends on component rating.
- Humidity Test. 168 hours @ 85°C/85%RH.
- Board Deflection (bend test).

Test results are available on request.

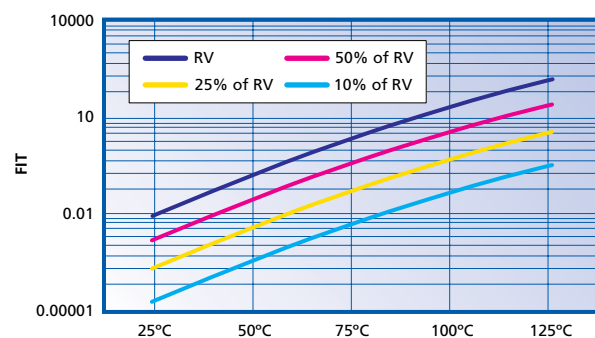
Conversion factors

From	To	Operation
FITS	MTBF (hours)	$10^9 \div \text{FITS}$
FITS	MTBF (years)	$10^9 \div (\text{FITS} \times 8760)$

FITS = Failures in 10^9 hours.

MTBF = Mean time between failures.

Example of FIT (Failure In Time) data available:



Component type: 0805 (COG/NPO and X7R).

Testing location: Syfer reliability test department.

Results based on: 16,622,000 component test hours.

See MLCC catalogue or website for standard MLCC ranges

1.11 - Periodic tests conducted for IECQ-CECC and AEC-Q200

Test ref	Test	Termination type	D or ND	Additional requirements	Sample acceptance			Reference
					P	n	c	
P1	High temperature exposure (storage)	All types	D	Un-powered. 1000 hours @ T=150°C. Measurement at 24 ± 2 hours after test conclusion	12	77	0	MIL-STD-202 Method 108
P2	Temperature cycling	COG/NPO: All types X7R: Y and H only	D	1000 cycles -55°C to +125°C Measurement at 24 ± 2 hours after test conclusion	12	77	0	JESD22 Method JA-104
P3	Moisture resistance	All types	D	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	D	1000 hours 85°C/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	D	Condition D steady state TA=125°C 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	D	Note: Add aqueous wash chemical. Do not use banned solvents	12	5	0	MIL-STD-202 Method 215
P7	Mechanical shock	COG/NPO: All types X7R: Y and H only	D	Figure 1 of Method 213. Condition F	12	30	0	MIL-STD-202 Method 213
P8	Vibration	COG/NPO: All types X7R: Y and H only	D	5g 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 10-2000Hz	12	30	0	MIL-STD-202 Method 204
P9	Resistance to soldering heat	All types	D	Condition B, no pre-heat of samples: Single wave solder - Procedure 2	3	12	0	MIL-STD-202 Method 210
P10	Thermal shock	COG/NPO: All types X7R: Y and H only	D	-55°C/+125°C. 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	D	5N force applied for 10s, -55°C/ +125°C for 5 cycles, damp heat cycles	12	27	0	BS EN132100 Clause 4.8, 4.12 and 4.13
P12	Board flex	COG/NPO: All types X7R: Y and H only	D	3mm deflection Class I 2mm deflection Class II	12	30	0	AEC-Q200-005
P13		X7R: A, F and J only	D	1mm deflection.	12	12	0	BS EN132100 Clause 4.9
P14	Terminal strength	All types	D	Force of 1.8kg for 60 seconds	12	30	0	AEC-Q200-006
P15	Beam load test	All types	D	-	12	30	0	AEC-Q200-003
P16	Damp heat steady state	All types	D	56 days, 40°C/93%RH, 15 x no volts, 15 x 5Vdc, 15 x rated voltage or 50V whichever is the less	12	45	0	BS EN132100 Clause 4.14

Test results are available on request.

P = Period in months.

N = Sample size.

C = Acceptance criteria.

1.12 - IECQ-CECC ranges

Maximum capacitance values (1B and 2R1 classifications).

		0603	0805	1206	1210	1808	1812	2220	2225
16V	COG/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	COG/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	COG/NP0	470pF	2.7nF	10nF	18nF	18nF	33nF	68nF	100nF
	X7R	47nF	220nF	470nF	1.0µF	680nF	1.5µF	2.2µF	3.3µF
100V	COG/NP0	330pF	1.8nF	6.8nF	12nF	12nF	27nF	47nF	68nF
	X7R	10nF	47nF	150nF	470nF	330nF	1.0µF	1.5µF	1.5µF
250V	COG/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	COG/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	COG/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

Ordering information - IECQ-CECC ranges

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

1.13 -AEC-Q200 ranges

Maximum capacitance values.

		0603	0805	1206	1210	1812
50/63V	COG/NPO	470pF	2.7nF	10nF	18nF	39nF
	X7R	33nF	150nF	330nF	680nF	1.5μF
100V	COG/NPO	330pF	1.8nF	6.8nF	12nF	27nF
	X7R	10nF	47nF	150nF	470nF	1μF
200V	COG/NPO	100pF	680pF	2.2nF	4.7nF	12nF
	X7R	5.6nF	27nF	100nF	220nF	470nF
500V	COG/NPO	n/a	330pF	1.5nF	3.9nF	10nF
	X7R	n/a	8.2nF	33nF	100nF	270nF
630V	COG/NPO	n/a	n/a	1.0nF	1.8nF	5.6nF
	X7R	n/a	n/a	10nF	27nF	150nF
1kV	COG/NPO	n/a	n/a	470pF	1nF	3.3nF
	X7R	n/a	n/a	4.7nF	15nF	56nF

Ordering information - AEC-Q200 ranges

1210	Y	100	0103	J	E	T	---
Chip size	Termination	Voltage	Capacitance in picofarads (pF)	Capacitance tolerance	Dielectric Release codes	Packaging	Suffix code
	Y = FlexiCap™ termination base with Ni barrier (100% matte tin plating). RoHS compliant. J = Silver base with nickel barrier (100% matte tin plating). RoHS compliant.	050 = 50V 063 = 63V 100 = 100V 200 = 200V 500 = 500V 630 = 630V 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%	E = X7R (2R1) AEC-Q200 A = COG/NPO (1B/NPO) AEC-Q200	T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs	Used for specific customer requirements

1.14 - S02A Space ranges

Maximum capacitance values

		0603	0805	1206	1210	1812	2220	2225
16V	COG/ NPO	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	COG/ NPO	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	COG/ NPO	0.5pF - 470pF	1pF - 2.7nF	1pF - 10nF	10pF - 18nF	220pF - 39nF	470pF - 68nF	560pF - 100nF
	X7R	330pF - 47nF	100pF - 220nF	680pF - 470nF	1.0nF - 1.0μF	3.9nF - 2.2μF	10nF - 3.3μF	18nF - 3.3μF
100V	COG/ NPO	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
200V	COG/ NPO	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	COG/ NPO	-	1pF - 270pF	1pF - 1.2nF	10pF - 2.7nF	180pF - 6.8nF	390pF - 15nF	4.7nF - 18nF
	X7R	-	10pF - 8.2nF	180pF - 33nF	390pF - 100nF	390pF - 270nF	1nF - 560nF	15nF - 820nF

Note: In accordance with ESCC 3009.

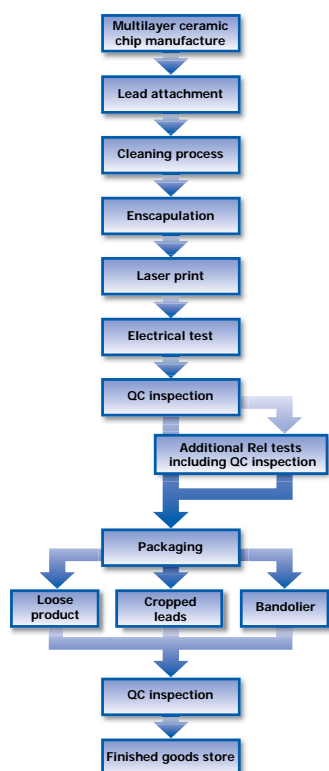
Ordering information - S02A Space grade ranges product code construction

1210	A	100	0103	J	X	T	---
Chip size	Termination ⁽¹⁾	Voltage	Capacitance in picofarads (pF)	Capacitance tolerance	Dielectric Rel Release codes	Packaging	Suffix code
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. H = FlexiCap™ termination base with Ni barrier (Tin/lead plating with min. 10% lead).	016 = 16V 025 = 25V 050 = 50V 063 = 63V 100 = 100V 200 = 200V 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 = COG/NPO (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 (Space Grade) High Rel

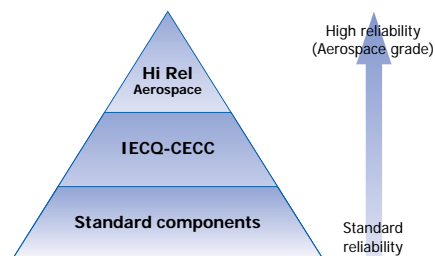
Notes:

- Termination **A**, **H** & **F** available for Space applications. If another termination type is required then contact Syfer Sales.
- Please include Lot Acceptance Test requirement (LAT1, LAT2 or LAT3) on purchase order against each line item.
Tests conducted after 100% Burn-In (2xRV @125°C 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.

2.1 - Production process flowchart



2.2 - Syfer Radial reliability product groups



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> or at www.syfer.com

2.3 - Tests conducted during batch manufacture

The following tests are in addition to the tests conducted as part of the multilayer ceramic chip manufacturing process:

	Standard Products	IECQ-CECC	High Rel Aerospace Grade
Solderability	●	●	●
Voltage proof test (DWV / Flash)	●	●	●
Insulation Resistance	●	●	●
Capacitance test	●	●	●
Dissipation Factor test	●	●	●
100% Burn-In 125°C, RV for 96 hours unless otherwise specified	○	○	●
100% visual inspection	○	○	○
Breakdown voltage sample test	○	○	○
Load sample test @ 125°C	○	○	○
Humidity sample test. 85°C/85%RH	○	○	○

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

2.4 - Additional options available

	Standard Products	IECQ-CECC	High Rel Aerospace Grade
Different lead length and lead forms available	○	○	○
Tin/Lead (Sn/Pb) coated leads (not RoHS compliant)	○	○	○
Different packaging methods (loose or bandolier)	○	○	○

2.5 - Release documentation

	Standard Products	IECQ-CECC	Hi Rel Aerospace Grade
Certificate of Conformance	●	○	●
IECQ-CECC Release Certificate of Conformity	○	●	○
Batch Electrical Test Report	○	○	○

- Release documentation supplied as standard.
- Optional documentation.

2.6 - RoHS compliance

All standard Syfer radial capacitors are compliant with the EU RoHS directive. Breakdown of materials content is available on request. All Syfer radial capacitors can be supplied with SnPb coated leads for RoHS exempt applications. Special suffix codes are applied for clear identification.

2.7 - Periodic tests conducted and reliability data availability

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

- Load test. 1000 hours @ 125°C. Applied voltage depends on components tested.
- Humidity test. 168 hours @ 85°C/85%RH.

Test results are available on request.

Periodic tests conducted for IECQ-CECC

Tests are detailed in the following CECC specifications:

- CECC 30 601 008. Dipped radial COG/NPO capacitors.
- CECC 30 701 013. Dipped radial X7R capacitors.

CECC Specification Sub-Group	Test	Sample acceptance		
		P	n	c
C1a	ROT (Robustness of Terminations) RTSH (Resistance to Soldering Heat)	12	9	1
C1b	RTC (Rapid Change of Temperature) Vibration Bump	12	18	1
C1	Climatic sequence (conducted on sample from C1a and C1b tests)	12	27	2
C2	Damp heat steady state (21 days)	12	15	1
C3	Endurance test (1000 hours)	3	15	1
C4	Temperature characteristic of capacitance	12	9	1

P = Period in months. N = Sample size. C = Acceptance criteria.

See MLCC catalogue or website for standard Radial ranges

2.8 - IECQ-CECC approved product ranges

Dielectric CECC Specification: **COG/NP0** - CECC 30 601 008. **X7R**

Maximum capacitance values shown:

CECC CASE SIZE		8111M	8121N	8131M
50/63V	COG/NP0	4.7nF	18nF	27nF
	X7R	4.7nF	1.0µF	1.0µF
100V	COG/NP0	12nF	12nF	27nF
	X7R	470nF	470nF	1.0µF
200V	COG/NP0	4.7nF	4.7nF	27nF
	X7R	220nF	220nF	1.0µF

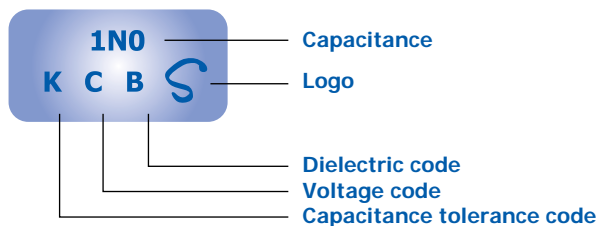
Minimum capacitance values for all IECQ-CECC ranges: COG/NP0 = 3.9pF. X7R = 100pF.

2.9 - Dimensions - Radial Leaded Capacitors

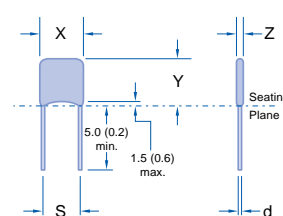
	CECC		Width	Height	Thickness	Lead Space	Lead Diameter
	Case reference	Pattern	(X) max. mm (inches)	(Y) max. mm (inches)	(Z) max. mm (inches)	(S) mm (inches)	(d) mm (inches)
8111M	A	A	3.81 (0.15)	5.31 (0.21)	2.54 (0.10)	2.54 ±0.4 (0.1 ±0.016)	0.5 ±0.05 (0.02 ±0.002)
8111N	F	B	3.81 (0.15)	5.31 (0.21)	2.54 (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)	3.81/6.30 (0.15/0.25)	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)	5.08/6.30 (0.20/0.25)	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)	6.00/7.00 (0.24/0.28)	14.5 ±0.5 (0.57 ±0.02)	0.6 ±0.05 (0.025 ±0.002)
8165M	-	A	19.00 (0.75)	19.00 (0.75)	4.25 (0.17)	17.5 ±0.5 (0.67 ±0.02)	0.6 ±0.05 (0.025 ±0.002)
8171M	-	A	25.00 (0.98)	20.00 (0.79)	6.00/7.00 (0.24/0.28)	20.5 ±0.5 (0.81 ±0.02)	0.6 ±0.05 (0.025 ±0.002)

2.10 - Marking information

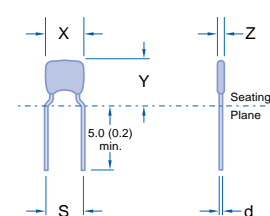
All encapsulated capacitors are marked with:- Capacitance value, tolerance, rated d.c. voltage, dielectric, and where size permits the Syfer Technology 'S' logo.

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

Pattern A



Pattern B



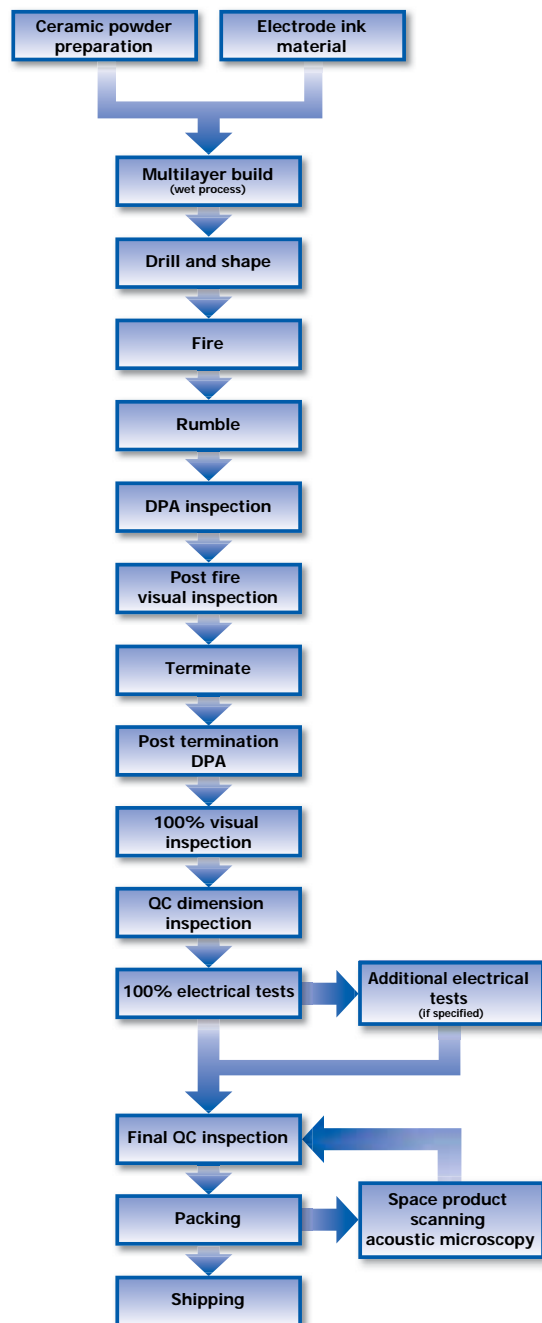
Note: Pattern A may be substituted with Pattern B at Syfer's discretion.

2.11 - Ordering information - Radial Leaded capacitors

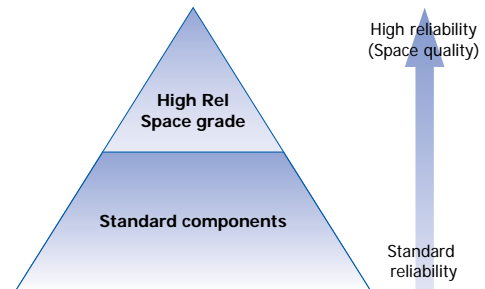
8111M	100	0102	J	C	□□□	□□□
Type No./ Size ref	Voltage d.c. (marking code)	Capacitance in picofarads (pF)	Capacitance tolerance	Dielectric Rel Release codes	Suffix	Suffix
8111M 8111N 8121M 8121N 8121T 8131M 8131T 8141M 8151M 8161M 8165M 8171M	050 = 50V (C) 063 = 63V (D) 100 = 100V (E) 200 = 200V (F) 250 = 250V 500 = 500V (O) 630 = 630V 1K0 = 1kV (Z) 1K2 = 1.2kV (O) 1K5 = 1.5kV (T) 2K0 = 2kV (M) 2K5 = 2.5kV 3K0 = 3kV (P) 4K0 = 4kV (S) 5K0 = 5kV (2) 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: 8P20 = 8.2pF	<10pF D: ± 0.5pF F: ± 1.0pF >10pF J: ± 5% K: ± 10% M: ± 20% >27pF G: ± 2% (COG/NP0 only).	C = COG/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. Suffix A97 for 8111 to 8141 & A31 for 8151, 8161, 8171.

Notes: The voltage code may be replaced with the complete voltage (e.g. 1500V = 1K5V) at Syfer's discretion.
Marking may be over both sides of the component as necessary.

3.1 - Production process flowchart



3.2 - Syfer planar array and discoidal reliability product groups



3.3 - Tests conducted during batch manufacture

	Standard Products	High Rel Space Grade
Solderability	●	●
Resistance to soldering heat	●	●
Plating thickness verification (if plated)	●	●
Plating adhesion (if plated)	●	●
Destructive Physical Analysis (DPA)	●	●
Voltage proof test (DWV / Flash)	●	●
Insulation Resistance	●	●
Capacitance test	●	●
Dissipation Factor test	●	●
100% visual inspection	●	●
Crosstalk sample test (if applicable)	●	●
Groundplane resistance sample test (if applicable)	●	●
Breakdown voltage sample test	○	○
Additional production screening (QP14 Section 6)	N/A	●
SAM (Scanning Acoustic Microscopy)	N/A	○
Load sample test @ 125°C	○	○
Electrical impulse sample test	○	○
Humidity sample test 85°C/85%RH	○	○

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

3.4 - Options available

	Standard Products	High Rel Space Grade
Palladium silver termination	○	○
Platinum silver termination	○	○
Platinum/Palladium silver	○	○
Gold flash over nickel termination	○	○
Lacquer (standard for components >750Vdc DWV)	○	○
Matched pairs	○	○
Spring clips fitted	○	○

3.5 - Release documentation

	Standard Products	High Rel Space Grade
Certificate of Conformance	●	●
Batch Test Report	●	●
FAIRs (AS9102)	○	○

- Release documentation supplied as standard.
- Optional documentation.

3.6 - RoHS compliance

All planar arrays and discoidal products are compliant with the EU RoHS directive.

Breakdown of materials content is available on request.

3.7 - Special soldering and handling rules

Special Soldering and Handling Rules can apply to through hole disc and planar products. Refer to AN0011 and AN0028 for more information.

3.8 - Periodic tests conducted and reliability data availability

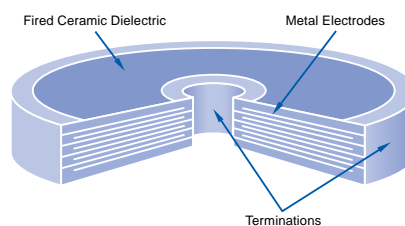
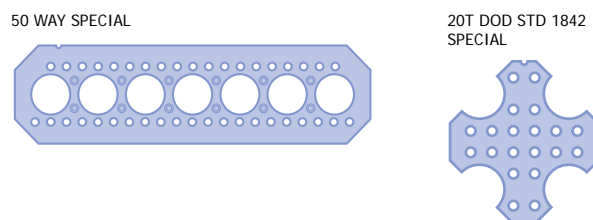
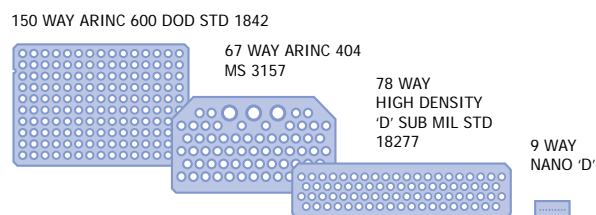
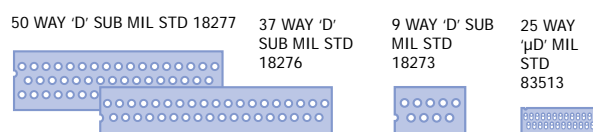
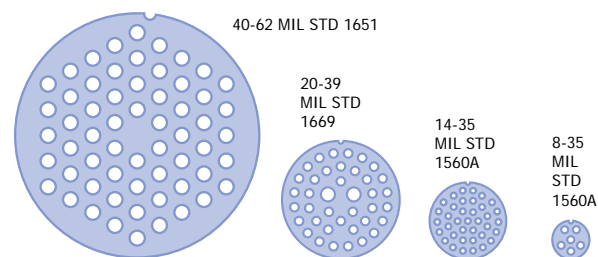
Components are randomly selected on a sample basis and the following routine tests are conducted:

- Load test. 1000 hours @ 125°C. Applied voltage depends on components tested.

Test results are available on request.

3.9 - Planar array outlines

Examples of outlines.

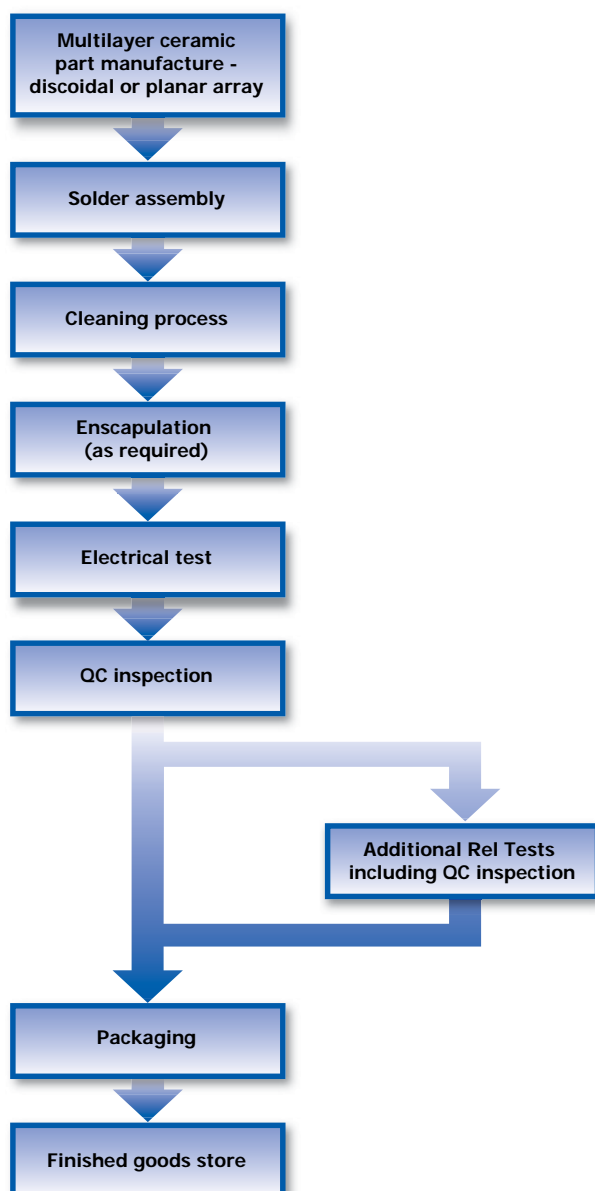


Typical discoidal capacitor construction

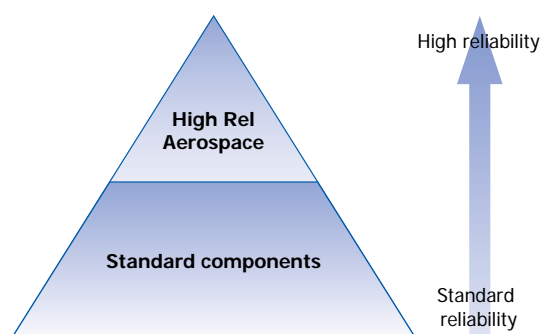
3.10 - Ordering information

For ordering information, and to discuss specific applications, please contact the Syfer sales department.

4.1 - Production process flowchart



4.2 - Syfer filter reliability product groups



4.3 - Tests conducted during batch manufacture

	Standard products	High Rel aerospace grade
Solderability	●	●
Voltage proof test (DWV / Flash)	●	●
Insulation Resistance	●	●
Capacitance test	●	●
Dissipation Factor test	●	●
100% visual inspection	●	●
Sample inductance presence	●	●
Sample insertion loss (depends on product)	●	●
100% Burn-in 125°C, RV for 96 hours unless otherwise specified	-	○
Breakdown voltage sample test	-	○
Load sample test @ 125°C	-	○
Humidity sample test. 85°C/85%RH - ESCC 3008	-	○

● Test conducted as standard.

○ Optional test, depending on product. Please discuss with Syfer Sales.

4.4 - Additional options available

	Custom specific
Special testing in accordance with the general requirements of MIL-PRF-28861, MIL-PRF-15733, ESCC 3008	○
Cropped axial Leads	○
Special plating finishes	○
Special electrical testing (e.g. 500Vac)	○
Lacquer / conformal coat	○
Matched pairs (balanced line products)	○
Unique custom designs	○

4.5 - Release documentation

	Standard products	Custom specific
Certificate of Conformance	●	●
Batch Electrical Test Report	○	○
FAIRS (AS9102)	○	○

● Test conducted as standard.

○ Optional test. Please discuss with Syfer Sales.

4.6 - RoHS compliance

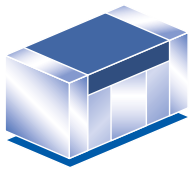
All standard Syfer filters are compliant with the EU RoHS directive. Breakdown of materials content is available on request.

4.7 - Periodic tests conducted and reliability data availability

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

- Sample Insertion Loss.
- Load Test. 168/1000 hours @125°C. Applied voltage/test duration depends on component type.

Test results are available on request.

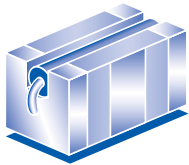


4.8 - SBSP Ordering Information

SBS	P	P	100	0153	M	X	T
Type	Size	Configuration	Voltage	Capacitance in picofarads (pF)	Tolerance	Dielectric	Packaging
Surface mount board filter	P = 1206	P = Pi Section	025 = 25Vdc 050 = 50Vdc 100 = 100Vdc	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0153=15nF.	M = ±20%	C=COG/NPO X=X7R	T=178mm (7") reel R=330mm (13") reel B = Bulk

Reeled quantities

178mm (7") reel	1206 1500	330mm (13") reel	1206 6000
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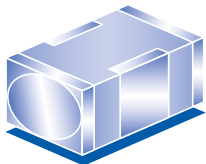


4.9 - SBSG Ordering Information

SBS	G	P	500	0473	M	X	T
Type	Size	Configuration	Voltage	Capacitance in picofarads (pF)	Tolerance	Dielectric	Packaging
Surface mount board filter	G = 1812	C = C Section P = Pi Section	050 = 50Vdc 100 = 100Vdc 200 = 200Vdc 500 = 500Vdc	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0473=47nF.	M = ±20%	X=X7R	T=178mm (7") reel R=330mm (13") reel B = Bulk

Reeled quantities

178mm (7") reel	1812 500	330mm (13") reel	1812 2000
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4.10 - SBSM Ordering Information

SBS	M	P	050	0474	M	X	T
Type	Size	Configuration	Voltage	Capacitance in picofarads (pF)	Tolerance	Dielectric	Packaging
Surface mount board filter	M = 2220	C = C Section P = Pi Section	050 = 50Vdc 100 = 100Vdc 200 = 200Vdc 500 = 500Vdc	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0474=47nF.	M = ±20%	X=X7R	T=178mm (7") reel R=330mm (13") reel B = Bulk

Reeled quantities

178mm (7") reel	2220 500	330mm (13") reel	2220 2000
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4.11 - SFS Ordering Information

Solder-in types Note: Ordering code can have up to 4 additional digits on the end to denote special requirements.

SFS	T	C	500	0223	M	X	0
Type	Case dia.	Electrical configuration	Voltage	Capacitance in picofarads (pF)	Capacitance tolerance	Dielectric	Nuts & washers
Solder-in panel mount filter	S = Special (no case) Contact Sales Office for full part number R = 2.8mm T = 3.25mm U = 5.6mm	C = C section	050 = 50Vdc 100 = 100Vdc 200 = 200Vdc 300 = 300Vdc 500 = 500Vdc 1K0 = 1kVdc 2K0 = 2kVdc 3K0 = 3kVdc	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0223=22nF	M = ±20% (Standard) P = -0 +100% S = -20%+50% Z = -20%+80%	C = COG/NPO X = X7R	0 = Without

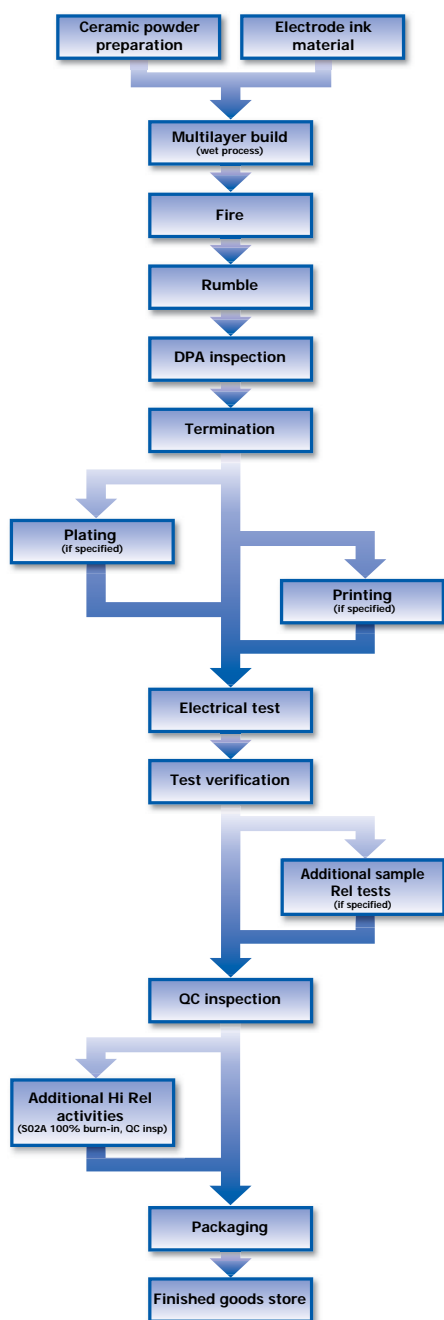
4.12 - SF Ordering Information

Threaded types Note: Ordering code can have up to 4 additional digits on the end to denote special requirements.

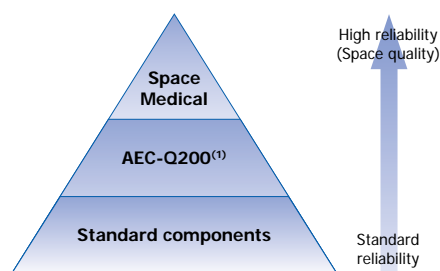
SF	J	E	L	050	0335	M	X	1
Type	Case style * = Low Profile	Thread	Electrical configuration	Voltage or varistor maximum continuous working voltage	Capacitance in picofarads (pF)	Capacitance tolerance	Dielectric	Nuts & washers
Screw mount filter	A = 4mm A/F B = 4.75mm A/F C = 6.35mm A/F D = 10mm A/F J = 9.8mm O.D. K = 4.4mm O.D. L = 6mm O.D. M = 6.35mm O.D. N = 3.5mm O.D. T = 6.35mm A/F * U = 6mm O.D. *	A = 4-40 UNC B = 6-32 UNC C = 8-32 UNC D = 12-32 UNEF E = 1/4-28 UNF G = 1/4-28 UNF I = 2BA J = M3 K = M3.5 L = M4 M = M5 N = M6 O = M2.5 P = M8	C = C section L = L-C section P = Pi section T = T section B = Balanced line filter V = Varistor EMI filter	050 = 50Vdc 100 = 100Vdc 200 = 200Vdc 300 = 300Vdc 500 = 500Vdc 1K0 = 1kVdc 2K0 = 2kVdc 3K0 = 3kVdc	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0335=3.3µF 13N6=13.6nF	M = ±20% (Standard) P = -0 +100% S = -20%+50% Z = -20%+80%	C = COG/NPO X = X7R M = MOV (varistor material)	0 = Without 1 = With

Other variants and fully custom parts are also available - please refer to main catalogue or www.syfer.com
To discuss specific applications, please contact the Syfer sales department.

4.13 - Production process flowchart



4.14 - Syfer reliability grades



Note:

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

4.15 - Tests conducted during batch manufacture

	Syfer reliability SM product group		
	Std SM caps	AEC-Q200	High Rel
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 @125°C for 168 hours)	○	○	●
Load sample test @ 125°C	○	○	LAT1 & LAT2 (1000 hours)
Humidity sample test. 85°C/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 & 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.

4.16 - RoHS compliance

Syfer routinely monitors world wide material restrictions (e.g. EU / China & Korea RoHS mandates) and is actively involved in shaping future legislation.

All standard Syfer MLCC products are compliant with the EU RoHS directive (see below for special exceptions) and those with plated terminations are suitable for soldering using common Pb free solder alloys (refer to 'Soldering Information' for more details on soldering limitations). Compliance with EU RoHS directive automatically signifies compliance with some other legislation (e.g. Korea RoHS). Please refer to Syfer for details of compliance with other materials legislation.

Breakdown of material content, SGS analysis reports and tin whisker test results are available on request.

Most Syfer MLCC components are available with non RoHS compliant tin lead (SnPb) solderable termination finish by special request for exempt applications and where pure tin is not acceptable. Other tin free termination finishes may also be available – please refer to Syfer for further details.

Radial components have tin plated leads as standard, but tin/lead is available as a special option. Please refer to the radial section of the catalogue for further details.

4.17 - AEC-Q200 range (E03) - capacitance values

Chip size		0805	1206	1410	1812
Rated Voltage	Dielectric	Minimum and maximum capacitance values			
50Vdc	COG/NPO	390pF - 470pF	1.2nF - 1.5nF	4.7nF - 5.6nF	8.2nF - 10nF
	X7R	18nF - 33nF	56nF - 150nF	180nF - 330nF	390nF - 560nF
100Vdc	COG/NPO	10pF - 330pF	22pF - 1.0nF	100pF - 3.9nF	820pF - 6.8nF
	X7R	470pF - 15nF	1.5nF - 47nF	4.7nF - 150nF	8.2nF - 330nF

Note: 1) For some lower capacitance parts, higher voltage rated parts may be supplied.
 2) Bypass filtering only - no current limit.

4.18 - 3 Terminal EMI Components (E01) - capacitance values (300mA rating)

Chip Size		0805	1206	1806
Rated Voltage	Dielectric	Minimum and maximum capacitance values		
50Vdc	COG/NPO	22pF - 820pF	22pF - 3.3nF	22pF - 3.9nF
	X7R	560pF - 68nF	4.7nF - 220nF	3.3nF - 330nF
100Vdc	COG/NPO	22pF - 560pF	22pF - 2.2nF	22pF - 3.3nF
	X7R	560pF - 27nF	1.8nF - 100nF	3.3nF - 180nF

Note: For some lower capacitance parts, higher voltage rated parts may be supplied.

4.19 - Ordering information**AEC-Q200 product code construction**

1206	Y	100	0103	M	E	T	E01
Chip size	Termination	Voltage	Capacitance in picofarads (pF)	Capacitance tolerance	Dielectric Rel Release codes	Packaging	Suffix code
	Y = FlexiCap™ termination base with Ni 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 100 = 100V	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	M = ±20%	A = COG/NPO AEC-Q200 E = X7R AEC-Q200	T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs	E01 = EMI Chip E03 = X2Y Integrated Passive Components

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