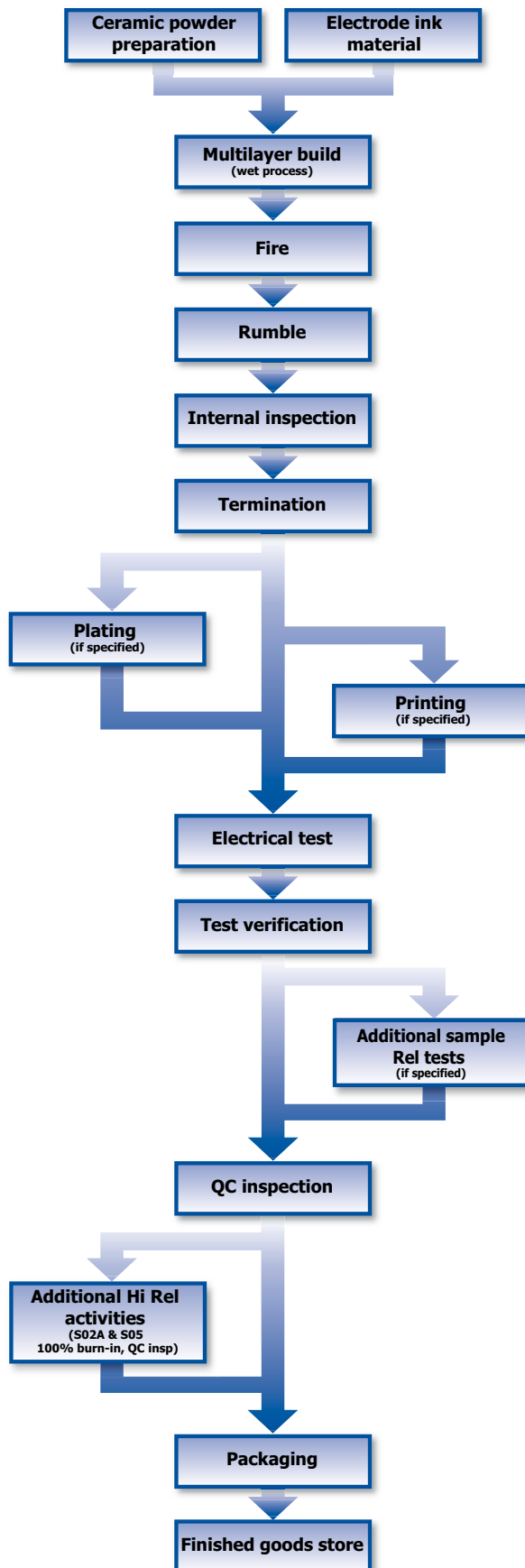
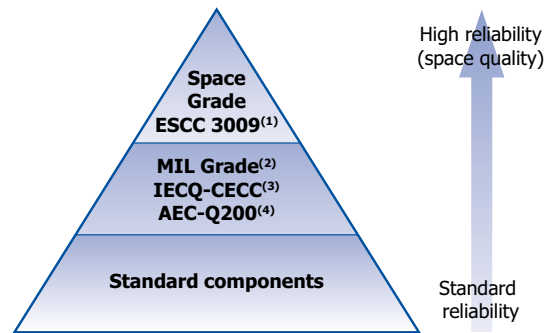


1.1 - Production process flowchart



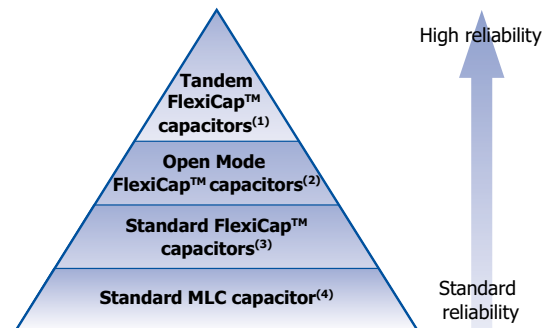
1.2 - Syfer reliability grades



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™

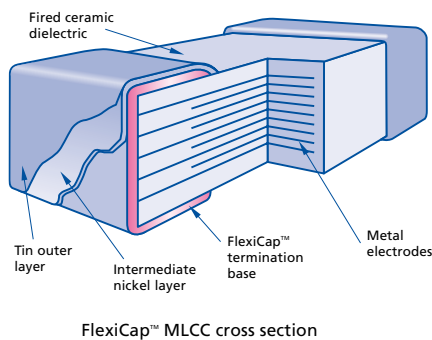
FlexiCap™ has been developed as a result of listening to customers' experiences of stress damage to MLCCs from many manufacturers, often caused by variations in production processes.

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

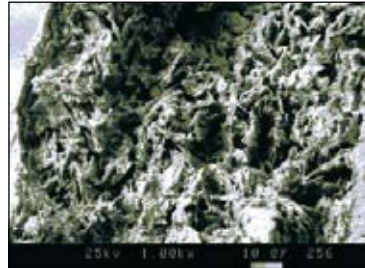
With traditional termination materials and assembly, the chain of materials from bare PCB to soldered termination, provides no flexibility. In circumstances where excessive stress is applied - the weakest link fails. This means the ceramic itself, which may fail short circuit.

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.



● 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
- 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 |
|----------------------|--|
| 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 | AEC-Q200 | MIL - PRF 55681 ⁽¹⁾ | S (space grade) High Rel | |
| | | | | | S05 | S02A ⁽³⁾ |
| Solderability | ● | ● | ● | ● | ● | ● |
| Resistance to soldering heat | ● | ● | ● | ● | ● | ● |
| Plating thickness verification (if plated) | ● | ● | ● | ● | ● | ● |
| Destructive Physical Analysis (DPA) | ● | ● | ● | ● | ● | ● |
| Voltage proof test (DWV / Flash) | ● | ● | ● | ● | ● | ● |
| Insulation Resistance | ● | ● | ● | ● | ● | ● |
| Capacitance test | ● | ● | ● | ● | ● | ● |
| Dissipation Factor test | ● | ● | ● | ● | ● | ● |
| 100% visual inspection | ○ | ○ | ● | ○ | ● | ● |
| 100% burn-in ⁽²⁾ . (2xRV @125°C for 100 hours) | ○ | ○ | ○ | ● | - | - |
| 100% burn-in ⁽²⁾ . (2xRV @125°C for 168 hours) | ○ | ○ | ○ | - | ● | ● |
| Load sample test @ 125°C. (Life at elevated temperature test). | ○ | ○ | ○ | ○ | ○ | 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.

Notes:

1) In accordance with MIL-PRF-55681 group A. Additional optional tests available.

2) Burn-in also referred to as Voltage conditioning.

3) In accordance with ESCC 3009.

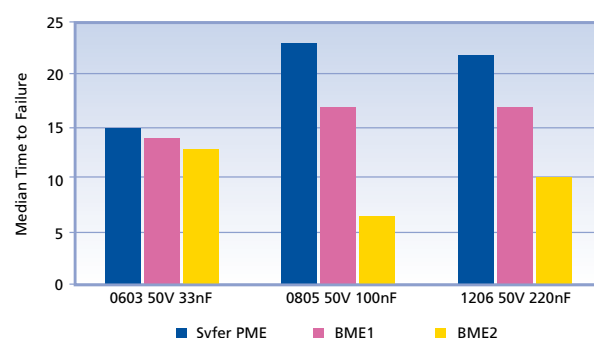
1.6 - Precious Metal Electrodes Vs. Base Metal Electrodes

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

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

1.8 - 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.

1.9 - Technical summary

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

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

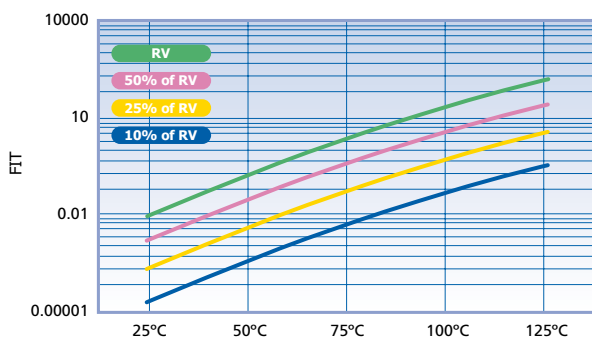
Standard Surface Mount Capacitors

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

- Load Test. 1000 hours @125°C. Applied voltage depends on components tested.
- Humidity Test. 168 hours @ 85°C/85%RH.
- Board Deflection (bend test).

Test results are available on request.

Example of FIT (Failure In Time) data available:



Component type: 0805 (COG/NP0 and X7R).

Testing location: Syfer reliability test department.

Results based on: 14,942,000 component test hours.

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.

1.10 - 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 | C0G/NP0: 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 | C0G/NP0: 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 | C0G/NP0: 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 | C0G/NP0: 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 | C0G/NP0: 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.

1.11

Surface mount capacitors

1.11 - Standard product ranges - 10V to 6kV ranges

Capacitance values F.

 = X5R Range

| | | 0603 | 0805 | 1206 | 1210 | 1808 | 1812 | 1825 | 2220 | 2225 | 3640 | 5550 | 8060 |
|----------|---------|------------|-----------|-----------|-----------|------------|------------|------------|------------|------------|-----------|-----------|-----------|
| 10V | COG/NP0 | 0.47p-3.9n | 1.0p-15n | 1.0p-47n | 3.9p-100n | 4.7p-100n | 10p-220n | 10p-470n | 10p-470n | 10p-560n | n/a | n/a | n/a |
| | X7R | 100p-100n | 100p-330n | 100p-1.0μ | 330p-1.5μ | 100p-1.5μ | 150n-3.3μ | 220n-4.7μ | 220n-5.6μ | 330n-6.8μ | n/a | n/a | n/a |
| | X5R | 120n-150n | 390n-680n | 100p-1.5μ | 330p-3.3μ | 100p-2.7μ | 150p-10μ | 220p-15μ | 220p-18μ | 330p-22μ | n/a | n/a | n/a |
| 16V | COG/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 | 330p-1.5μ | 100p-1.5μ | 150p-3.3μ | 220p-4.7μ | 220p-5.6μ | 330p-6.8μ | n/a | n/a | n/a |
| | X5R | 100p-120n | 100p-470n | 100p-1.2μ | 330p-2.7μ | 100p-2.2μ | 150p-6.8μ | 220p-12μ | 220p-12μ | 330p-15μ | n/a | n/a | n/a |
| 25V | COG/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 | n/a | n/a | n/a |
| | X7R | 100p-100n | 100p-220n | 100p-820n | 330p-1.2μ | 100p-1.2μ | 150p-2.2μ | 220p-3.9μ | 220p-4.7μ | 330p-5.6μ | n/a | n/a | n/a |
| | X5R | 100p-100n | 100p-390n | 100p-1.0μ | 330p-2.2μ | 100p-1.5μ | 150p-4.7μ | 220p-10μ | 220p-10μ | 330p-12μ | n/a | n/a | n/a |
| 50/63V | COG/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-1.0μ |
| | X7R | 100p-47n | 100p-220n | 100p-470n | 330p-1.0μ | 100p-680n | 150p-2.2μ | 220p-1.8μ | 220p-3.3μ | 330p-3.3μ | 470p-10μ | 1.0n-15μ | 2.2n-22μ |
| | X5R | 100p-68n | 100p-330n | 100p-680n | 330p-1.5μ | 100p-1.0μ | 150p-3.3μ | 220p-6.8μ | 220p-6.8μ | 330p-10μ | n/a | n/a | n/a |
| 100V | COG/NP0 | 0.47p-470p | 1.0p-2.2n | 1.0p-8.2n | 3.9p-18n | 4.7p-18n | 10p-47n | 10p-68n | 10p-68n | 10p-82n | 10p-270n | 390p-470n | 680p-680n |
| | X7R | 100p-33n | 100p-100n | 100p-330n | 330p-680n | 100p-560n | 150p-1.5μ | 220p-1.5μ | 220p-2.2μ | 330p-2.7μ | 470p-5.6μ | 1n-10μ | 2.2n-15μ |
| 200/250V | COG/NP0 | 0.47p-150p | 1.0p-820p | 1.0p-2.7n | 3.9p-6.8n | 4.7p-6.8n | 10p-15n | 10p-27n | 10p-27n | 10p-39n | 10p-100n | 390p-220n | 680p-330n |
| | X7R | 100p-10n | 100p-56n | 100p-150n | 330p-330n | 100p-270n | 150p-680n | 220p-1.0μ | 220p-1.0μ | 330p-1.5μ | 470p-3.3μ | 1.0n-5.6μ | 2.2n-10μ |
| 500V | COG/NP0 | 0.47p-68p* | 1.0p-390p | 1.0p-1.5n | 3.9p-4.7n | 4.7p-3.9n | 10p-10n | 10p-18n | 10p-15n | 10p-22n | 10p-68n | 390p-150n | 680p-220n |
| | X7R | 100p-1.5n* | 100p-10n | 100p-47n | 330p-120n | 100p-120n | 150p-330n | 220p-560n | 220p-560n | 330p-820n | 470p-1.0μ | 1.0n-1.8μ | 2.2n-3.3μ |
| 630V | COG/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 | 100p-6.8n | 100p-33n | 330p-47n | 100p-68n | 150p-180n | 220p-180n | 220p-330n | 330p-390n | 470p-680n | 1.0n-1.2μ | 2.2n-2.2μ |
| 1kV | COG/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 | 100p-4.7n | 100p-27n | 330p-33n | 100p-47n | 150p-100n | 220p-120n | 220p-120n | 330p-150n | 470p-180n | 1.0n-390n | 2.2n-1.0μ |
| 1.2kV | COG/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 | 100p-15n | 330p-10n | 100p-10n | 150p-33n | 220p-68n | 220p-82n | 330p-100n | 470p-150n | 1.0n-220n | 2.2n-470n |
| 1.5kV | COG/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 | 100p-10n | 330p-6.8n | 100p-6.8n | 150p-22n | 220p-47n | 220p-47n | 330p-68n | 470p-100n | 1.0n-150n | 2.2n-330n |
| 2kV | COG/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 | 100p-2.2n | 330p-4.7n | 100p-4.7n | 150p-10n | 220p-10n | 220p-27n | 330p-33n | 470p-47n | 1.0n-82n | 2.2n-150n |
| 2.5kV | COG/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 | 100p-1.5n | 150p-3.3n | 220p-6.8n | 220p-8.2n | 330p-12n | 470p-33n | 1.0n-68n | 2.2n-100n |
| 3kV | COG/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 | 100p-1.2n | 150p-2.7n | 220p-3.9n | 220p-6.8n | 330p-8.2n | 470p-22n | 1.0n-47n | 2.2n-82n |
| 4kV | COG/NP0 | n/a | n/a | n/a | n/a | 4.7p-150p* | 10p-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* | 150p-2.2n* | 220p-2.2n* | 220p-4.7n* | 330p-5.6n* | 470p-6.8n | 1.0n-15n | 2.2n-33n |
| 5kV | COG/NP0 | n/a | n/a | n/a | n/a | 4.7p-82p* | 10p-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* | 150p-1.2n* | 220p-1.8n* | 220p-3.9n* | 330p-4.7n* | n/a | 1.0n-10n | 2.2n-22n |
| 6kV | COG/NP0 | n/a | n/a | n/a | n/a | 4.7p-56p* | 10p-220p* | 10p-330p* | 10p-470p* | 10p-560p* | n/a | n/a | n/a |
| | X7R | n/a | n/a | n/a | n/a | 100p-390p* | 150p-1.0n* | 220p-1.5n* | 220p-2.2n* | 330p-2.7n* | n/a | n/a | n/a |
| | | 0603 | 0805 | 1206 | 1210 | 1808 | 1812 | 1825 | 2220 | 2225 | 3640 | 5550 | 8060 |

Note: * Indicates components that require conformal coating post soldering.

1.11 - IECQ-CECC

Maximum capacitance values.

| | | 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 |
| 200V | 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 |

1.11 - S05, S02A⁽¹⁾ Space Grade and MIL-PRF-55681⁽²⁾ ranges

Maximum capacitance values.

| | | 0603 | 0805 | 1206 | 1210 | 1812 | 2220 | 2225 |
|--------|---------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| 16V | COG/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 | COG/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 | COG/NP0 | 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/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 |
| 200V | COG/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 |

Notes:

1) In accordance with ESCC 3009.

2) In accordance with MIL-PRF-55681 Group A tests.

1.11 - AEC-Q200 Rev C ranges

Maximum capacitance values.

| | | 0603 | 0805 | 1206 | 1210 | 1812 |
|--------|---------|-------|-------|-------|-------|-------|
| 50/63V | COG/NP0 | 470pF | 2.7nF | 10nF | 18nF | 39nF |
| | X7R | 33nF | 150nF | 330nF | 680nF | 1.5µF |
| 100V | COG/NP0 | 330pF | 1.8nF | 6.8nF | 12nF | 27nF |
| | X7R | 10nF | 47nF | 150nF | 470nF | 1µF |
| 200V | COG/NP0 | 100pF | 680pF | 2.2nF | 4.7nF | 12nF |
| | X7R | 5.6nF | 27nF | 100nF | 220nF | 470nF |
| 500V | COG/NP0 | n/a | 330pF | 1.5nF | 3.9nF | 10nF |
| | X7R | n/a | 8.2nF | 33nF | 100nF | 270nF |
| 630V | COG/NP0 | n/a | n/a | 1.0nF | 1.8nF | 5.6nF |
| | X7R | n/a | n/a | 10nF | 27nF | 150nF |
| 1kV | COG/NP0 | n/a | n/a | 470pF | 1nF | 3.3nF |
| | X7R | n/a | n/a | 4.7nF | 15nF | 56nF |

1.12 - Termination types available

| | Syfer reliability SM product group | | | | | |
|---|------------------------------------|-----------|-------------------------|------------------------------|--------------------------|------|
| | Standard SM capacitors | IECQ-CECC | AEC-Q200 | MIL-PRF 55681 ⁽¹⁾ | S (space grade) High Rel | |
| | | | | | S05 | S02A |
| F = Silver Palladium. RoHS compliant. | ■ | ■ | - | ■ | ■ | ■ |
| J = Silver base with nickel barrier (100% matte tin plating). RoHS compliant. | ■ | ■ | COG/NP0 dielectric only | ■ | □ | □ |
| A = Silver base with nickel barrier (Tin/lead plating with min. 10% lead). | ■ | ■ | - | ■ | ■ | ■ |
| Y = FlexiCap™ termination base with Ni barrier (100% matte tin plating). RoHS compliant. | ■ | ■ | ■ | ■ | □ | □ |
| H = FlexiCap™ termination base with Ni 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.

Notes:

1) In accordance with MIL-PRF-55681 group A. Additional optional tests available.

1.13 - Ordering information**Standard product code construction**

| 1210 | Y | 100 | 0103 | J | X | T | --- |
|-----------|--|--|---|---|---|--|---|
| 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. H = FlexiCap™ termination base with Ni 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). | 010 = 10V 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 = COG/NP0 (1B) X = X7R (2R1) | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs | Used for specific customer requirements |

1.13 - IECQ-CECC product code construction

| 1210 | Y | 100 | 0103 | J | D | T | --- |
|-----------|--|---|---|---|---|--|---|
| Chip size | Termination | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric Release codes ⁽¹⁾ | Packaging | Suffix code |
| | Y = FlexiCap™ termination base with Ni barrier (100% matte tin plating). RoHS compliant. H = FlexiCap™ termination base with Ni 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 | 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 = COG/NP0 (1B/NP0) with IECQ-CECC release B = 2X1/BX released in accordance with IECQ-CECC R = 2C1/BZ released in accordance with IECQ-CECC | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs | Used for specific customer requirements |

1.13 - S05 and S02A product code construction

| 1210 | A | 100 | 0103 | J | X | T | --- |
|-----------|---|--|---|---|---|--|---|
| Chip size | Termination | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric Rel Release codes | Packaging | Suffix code |
| | 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 | 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/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 S05 = S (Space Grade) High Rel S02A = ⁽²⁾ S (Space Grade) High Rel |

1.13 - Ordering information

AEC-Q200 product code construction

| 1210 | Y | 100 | 0103 | J | E | T | --- |
|-----------|--|---|---|---|---|--|---|
| 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 063 = 63V 100 = 100V 200 = 200V 250 = 250V 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% | A = COG/NP0 (1B) E = X7R (2R1) | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs | Used for specific customer requirements |

Notes:

- 1) 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 @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.

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Knowles:](#)

[2220Y5000105KXTWS2](#) [0805Y1000103MET](#) [0603Y0500103KET](#) [0603Y0500471KET](#) [0603Y0500102KET](#)
[0603Y0250104KETFB6](#) [0603Y0500104KETFB6](#) [0603Y0500473KET](#) [0603Y1000223KET](#) [0603Y1000473KET](#)
[0805Y0500103KST](#) [0805Y1000103KST](#) [0805Y1000223KST](#) [1206Y1000224KET](#) [1210J6300682JKTAG1](#)
[0805Y1000104KST](#) [0805Y1K00102KST](#) [0805Y1K00472KST](#) [1206Y2K00222KST](#) [1812Y2K00103KST](#)
[1812Y2K00222KST](#) [1812Y2K00472KST](#) [0805Y1000104KET](#) [2220Y4K00222KET](#) [1812Y4K00222KET](#)
[0805Y0500150KAT](#) [2220JA250221KXTB16](#) [0603Y0500104KET](#) [060330160104JXT](#) [0603J0503P30DAT](#)
[0603J0630271JAT](#) [0603J0630560JAT](#) [0603J0634P70DAT](#) [0603Y0500271JAT](#) [0603Y0500471KAT](#)
[0603Y0630120JAT](#) [0603Y2000182KET](#) [0805Y0630470KAT](#) [0805Y2001P20CAT](#) [0805Y5000151KET](#)
[1206J0630150JAT](#) [1206J0631P20CAT](#) [1206J2000220JAT](#) [1206Y0500390JAT](#) [1206Y0500561KAT](#)
[1206Y0630102JAT](#) [1206Y0630274JET](#) [1206Y0630681MET](#) [1206Y0638P20BAT](#) [1206Y2000333JET](#)
[1206Y5000560JAT](#) [1206Y6300121KET](#) [1210J0500153GAT](#) [1210J0630102FAT](#) [1210J0630102KAT](#)
[1210J0630153KAT](#) [1210J1000181JAT](#) [1210J1K00680JAT](#) [1210J2000152JAT](#) [1210J2000272FAT](#)
[1210J6300122KAT](#) [1210J6300470KAT](#) [1210Y0500822KET](#) [1210Y0630120KAT](#) [1210Y0630181GAT](#)
[1210Y1000122MET](#) [1210Y1000471GAT](#) [1210Y2000122MET](#) [1210Y2000333JET](#) [1210Y5000103JET](#)
[1210Y5000471JET](#) [1210Y5000821MET](#) [1210Y6300681KAT](#) [1812J0630103GAT](#) [1812J0630392FAT](#)
[1812J0630472KAT](#) [1812J1K00152GAT](#) [1812J1K00821JAT](#) [1812J5000180KAT](#) [1812J5000560KAT](#)
[1812J6300122GAT](#) [1812Y0500125MET](#) [1812Y0500471GAT](#) [1812Y0630563KET](#) [1812Y1K00183JET](#)
[1812Y1K00561KAT](#) [1812Y2000184JET](#) [1812Y5000104KET](#) [1812Y5000562MET](#) [1812Y6300122JET](#)
[1812Y6300271JAT](#) [1812Y6300473KET](#) [0805Y0500151KAT](#) [0603J1000121GAT](#) [0603J1000271GAT](#)
[0603J2000270KAT](#) [0603Y0630330GAT](#) [0603Y1006P80CAT](#) [0805J0630330JAT](#) [0805J2006P80DAT](#)