

Standard range - 10Vdc to 12kVdc

ProtectiCap™ capacitors

TCC/VCC capacitors

VC1 capacitors

PSL capacitors

High Q capacitors - MS range

Ultra-low ESR capacitors

StackiCap™ capacitors

Non-magnetic capacitors

X8R High Temperature capacitors

Open Mode and Tandem capacitors

IECO-CECC & AEC-Q200 ranges

S02A Space grade ranges

Safety Certified capacitors

250Vac Non Safety rated AC capacitors

115Vac 400Hz capable capacitors

High Dielectric Withstand Voltage ranges

E01 & E07 feedthrough chip capacitors

X2Y Integrated Passive Components

Radial Leaded capacitors

MLC Capacitors



Introduction to Syfer Technology

First in the market with flexible polymer terminations

- the revolutionary FlexiCap™ capacitors - our capacitor range also includes: ProtectiCap™, high voltage capacitors, X8R high temperature types, High Q capacitors 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 12kV. This includes surface mount Class 'X' and 'Y' approved Safety Certified capacitors, 0603 chips with working voltages up to 500V and 0805 types up to 2kV.

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. This catalogue details the standard ranges but we can provide items such as tight tolerance, low profile and non standard sizes on request. 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 ISO 9001, environmental approval to ISO 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.

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
- ProtectiCap™ capacitors
- FlexiCap™ capacitors with flexible terminations
- StackiCap™ capacitors
- Class 'X' and 'Y' SMD Safety Certified capacitors
- Radial leaded capacitors
- AEC-Q200 qualified capacitors
- IECQ CECC approved capacitors
- Capacitors for space applications
- High Q capacitors
- Non-magnetic capacitors
- 3 terminal EMI chips
- X2Y Integrated Passive Components

Benefits

- High quality and reliability
- World-leading high voltage expertise
- Suitable for the most demanding applications including: automotive, aerospace, military, 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

Suffix code controlled items such as Low profile, defined thickness and custom lead forms available by special request.

Other Syfer products

- Surface mount Pi filters
- Panel mount threaded filters
- Panel mount solder-in filters
- Custom filter assembly capability
- Varistor filters
- Discoidal capacitors
- Planar capacitor and planar varistor arrays
- EMI Power Filters
- Hermetically sealed EMI filters



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Ceramic Chip capacitors

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Definitions of Ultra-Stable and Stable

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.

COG/NPO - Ultra Stable Class 1 Ceramic (EIA Class 1)

| Spec. | Classification | Temperature range °C | Maximum capacitance change @ rated DC volts | Syfer dielectric code |
|-------|----------------|----------------------|---|-----------------------|
| CECC | 1B/CG | -55 +125 | 0 ± 30ppm/°C | C |
| EIA | COG/NPO | -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:-

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

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

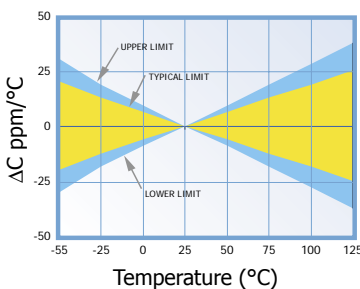
suppression with greater volumetric efficiency than Class I units, whilst maintaining stability within defined limits.

Capacitance and dissipation factor are affected by:-

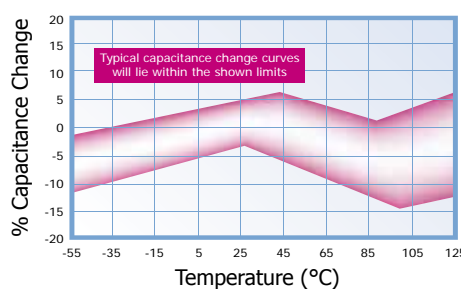
- Time (Ageing)
- Voltage (AC or DC)
- Frequency

Typical dielectric temperature characteristics

COG/NPO capacitance vs temperature

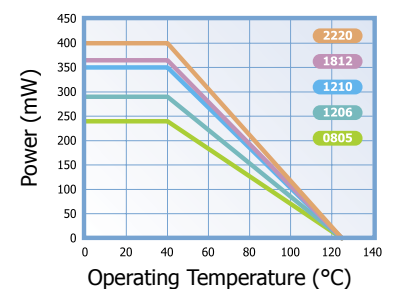


X7R capacitance vs temperature



Power ratings

COG/NPO and X7R



Dielectric characteristics

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 No DC voltage applied | 0 ± 30 ppm/°C | | | ± 15% | ± 20% | ± 15% | ± 15% | ± 15% |
| 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 $(\frac{15}{Cr} + 0.7)$ | | | ≤ 0.025 | ≤ 0.025 | | | ≤ 0.025 |
| 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 < 4.7pF | ± 0.05pF (H) ± 0.10pF (B) ± 0.25pF (C) ± 0.50pF (D) | | ± 5% (J) ± 10% (K) ± 20% (M) | ± 5% (J) ± 10% (K) ± 20% (M) | | ± 5% (J) ± 10% (K) ± 20% (M) | |
| | Cr < 10pF | ± 0.10pF (B) ± 0.25pF (C) ± 0.50pF (D) | | | | | | |
| | Cr ≥ 10pF | ± 1% (F) ± 2% (G) ± 5% (J) ± 10% (K) | | | | | | |
| Dielectric strength | Voltage applied for 5 seconds. Charging current limited to 50mA maximum. | | | | | | | |
| ≤ 200V | 2.5 times | | | 2.5 times | 2.5 times | | | 2.5 times |
| > 200V to < 500V | Rated voltage + 250V | | | - | Rated voltage + 250V | | | - |
| 500V to ≤ 1000V | 1.5 times | | | - | - | | | - |
| 500V to < 1000V | - | | | - | 1.5 times | | | - |
| > 1kV to ≤ 1200V | 1.25 times | | | - | - | | | - |
| > 1200V | 1.2 times | | | - | - | | | - |
| ≥ 1000V | - | | | - | 1.2 times | | | - |
| Climatic category (IEC) | | | | | | | | |
| Chip | 55/125/56 | | | 55/85/56 | 55/125/56 | | | 55/150/56 |
| Dipped | 55/125/21 | | | - | 55/125/21 | | | - |
| Discoidal | 55/125/56 | | | - | 55/125/56 | | | - |
| Ageing characteristic (Typical) | Zero | | | < 2% per time decade | < 2% per time decade | | | < 2% per time decade |

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

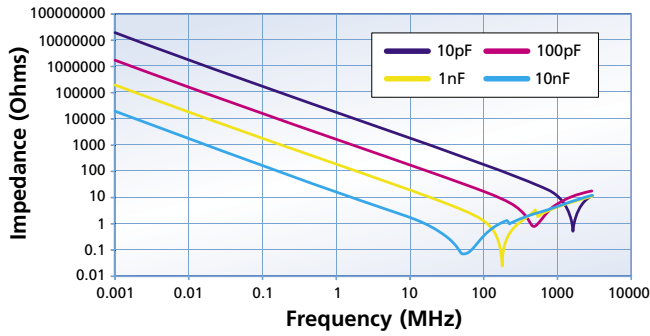
Approvals

| | | | | |
|------|----------|---|----------|---|
| Chip | QC-32100 | - | QC-32100 | - |
|------|----------|---|----------|---|

Capacitance, Impedance and E.S.R. vs Frequency

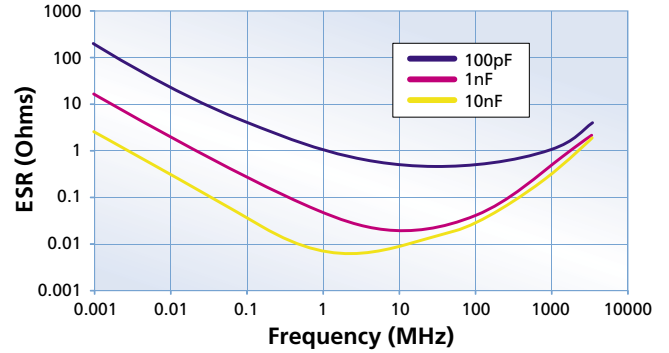
Impedance vs Frequency - chips

Ultra Stable C0G/NPO dielectric

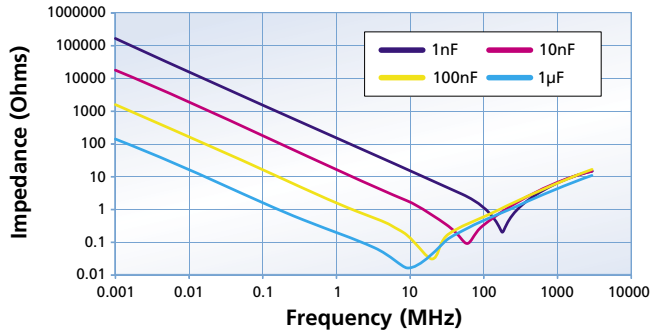


ESR vs Frequency - chips

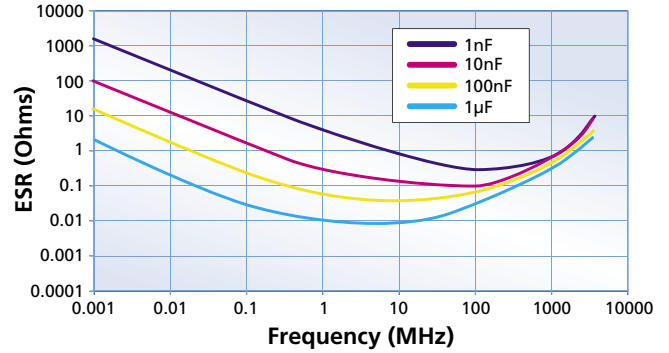
Ultra Stable C0G/NPO dielectric



Stable X7R dielectric

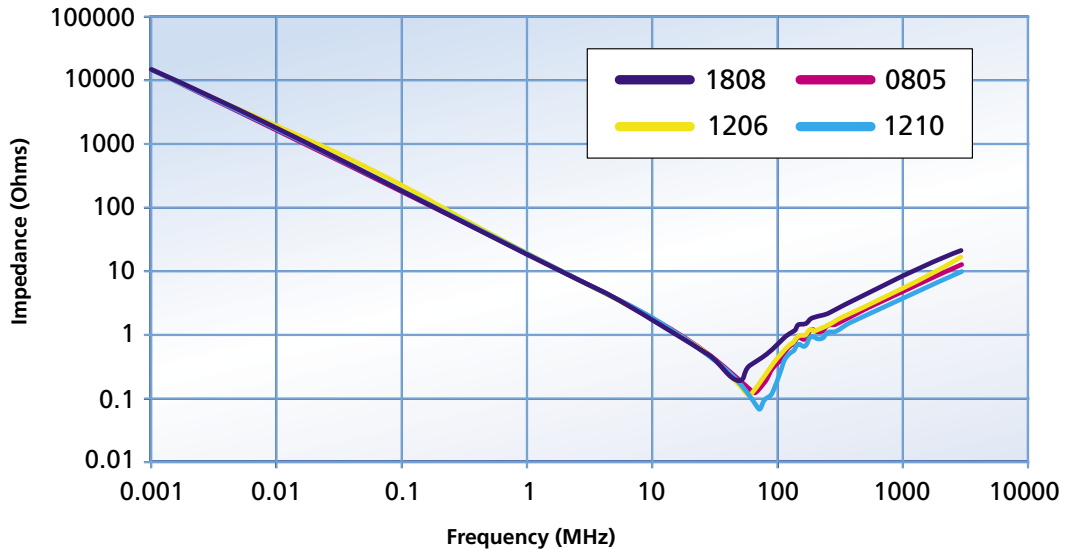


Stable X7R dielectric



Impedance vs Frequency - 10nF chips

Stable X7R dielectric



Ageing of ceramic capacitors

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 values |
|----------------------|--|
| Ultra Stable COG/NPO | Negligible capacitance loss through ageing |
| Stable X7R | <2 % per decade of time |

Capacitance measurements

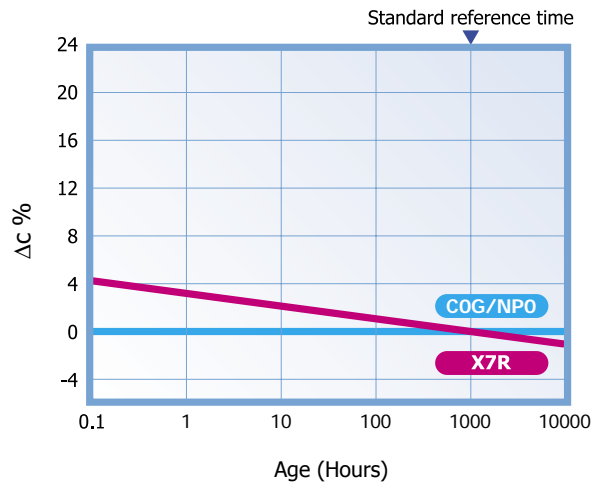
Because of ageing it is necessary to specify an age for reference measurements at which the capacitance shall be within the prescribed tolerance. This is fixed at 1000 hours, since for practical purposes there is not much further loss of capacitance after this time.

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 X7R @ <2% per decade)



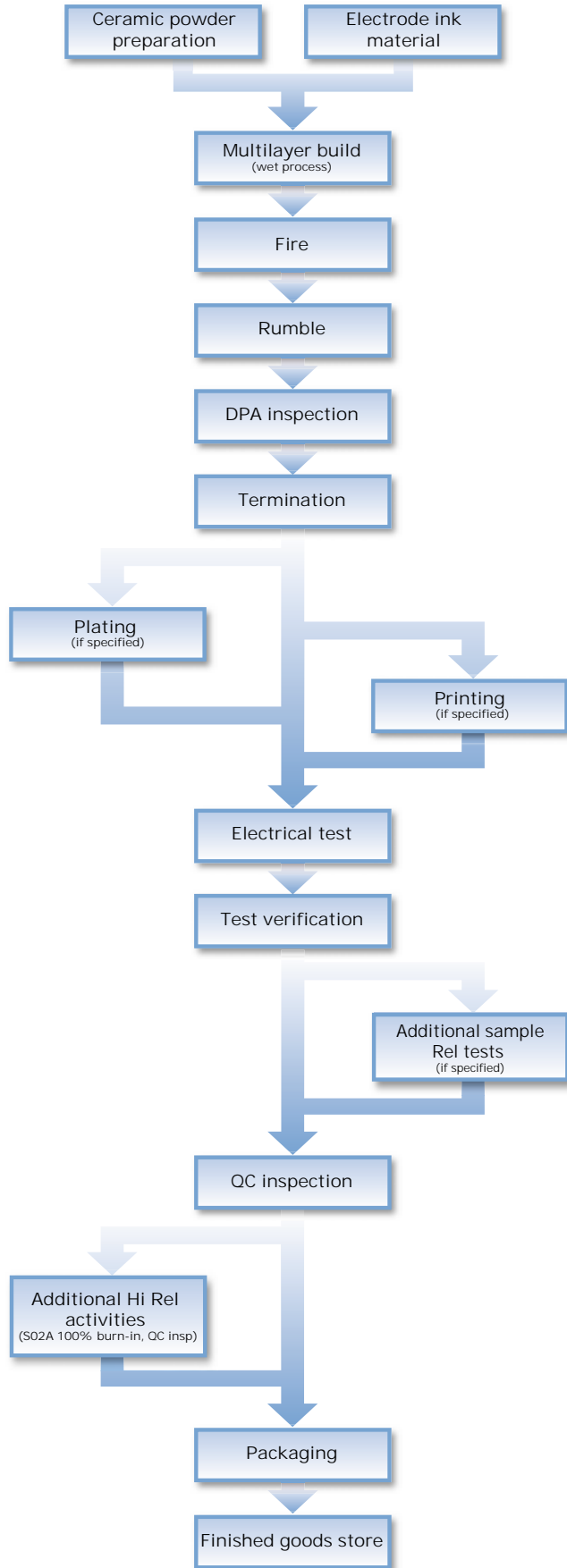
Tight tolerance

One of the advantages of Syfer's unique 'wet process' of manufacture is the ability to offer capacitors with exceptionally tight capacitance tolerances.

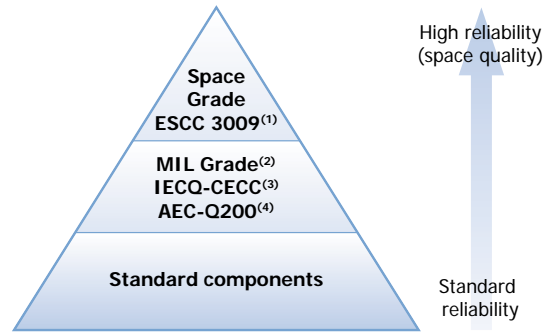
The accuracy of the printing screens used in the fully automated, computer controlled manufacturing process allows for tolerance as close as +/-1% on COG/NPO parts greater than or equal to 10pF. For capacitance values below <4.7pF, tolerances can be as tight as +/-0.05pF.

Production processes and reliability

Production process flowchart



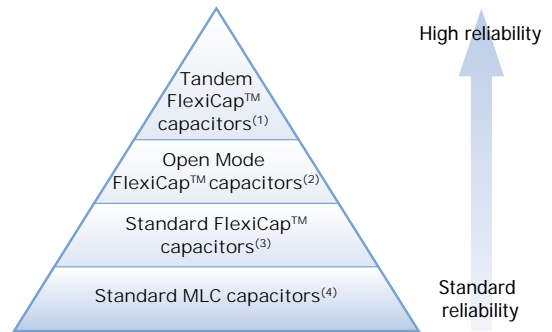
Syfer reliability grades



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.

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™.

FlexiCap™ overview

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™

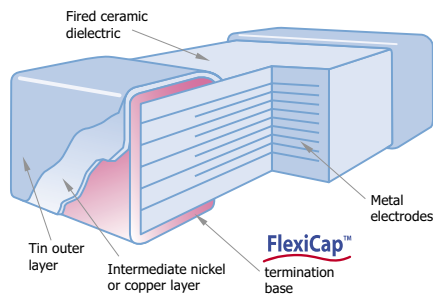
FlexiCap™ has been developed as a result of listening to customers' experiences of stress damage to MLCCs from many manufacturers, often caused by variations in production processes.

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

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™ MLCC cross section

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 including lead free 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
- Non-magnetic capacitors
- 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.



Testing and termination types

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 the sales office.

Termination types available

| | Syfer reliability SM product group | | | |
|--|------------------------------------|-----------------------|-------------------------|-------------------------------|
| | Standard SM capacitors | IECQ-CECC / MIL grade | AEC-Q200 | S (space grade) High Rel S02A |
| F: Silver palladium | ● | ● | - | ● |
| J: Silver base with nickel barrier (100% matte tin plating) | ● | ● | COG/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) | ● | ● | - | ○ |
| 2: Silver base with Non-magnetic Cu Barrier (100% matte tin plating) | ● ⁽¹⁾ | - | - | - |
| 3: FlexiCap™ with Non-magnetic Cu Barrier (100% matte tin plating) | ● ⁽²⁾ | - | - | - |

Notes:

(1) Available on COG/NP0 and High Q only.

(2) Available on all dielectrics.

● Termination available.

○ Termination available but generally not requested for space grade components.

Please discuss with the sales office.

Documentation and compliance

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

Test results are available on request.

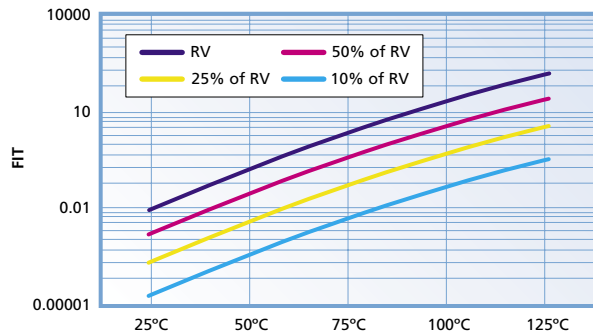
Conversion factors

| 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/NP0 and X7R).

Testing location: Syfer reliability test department.

Results based on: 16,622,000 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 the sales office at sales@syfer.co.uk

RoHS compliance

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

All standard COG/NP0, X7R, X5R and High Q 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 lead free solder alloys (refer to 'Soldering Information' for more details on soldering limitations). Compliance with the EU RoHS directive automatically signifies compliance with some other legislation (e.g. Korea RoHS). Please refer to the sales office 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 for exempt applications and where pure tin is not acceptable. Other tin free termination finishes may also be available – please refer to the sales office 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.

X8R ranges <250Vdc are not RoHS 2011/65/EU compliant. Check the website, www.syfer.com for latest RoHS update.

Export controls and dual-use regulations

Certain Syfer catalogue components are defined as 'dual-use' items under international export controls - those that can be used for civil or military purposes which meet certain specified technical standards.

The defining criteria for a dual-use component with respect to Syfer products is one with a voltage rating of >750V and a capacitance value >250nF and a series inductance <10nH.

Components defined as 'dual-use' under the above criteria automatically require a licence for export outside the EU, and may

require a licence for export within the EU.

The application for a licence is routine, but customers for these products will be asked to supply further information.

Please refer to the sales office if you require any further information on export restrictions.

Other special components may additionally need to comply with export regulations.

IECQ-CECC and AEC-Q200 - Periodic tests

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=150°C. Measurement at 24 ± 2 hours after test conclusion | 12 | 77 | 0 | MIL-STD-202 Method 108 |
| P2 | Temperature cycling | COG/NP0: All types X7R: Y and H only | 1,000 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 | 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 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 | 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 | Note: Add aqueous wash chemical. Do not use banned solvents | 12 | 5 | 0 | MIL-STD-202 Method 215 |
| P7 | Mechanical shock | COG/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 | COG/NP0: All types X7R: Y and H only | 5g'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 | COG/NP0: All types X7R: Y and H only | -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 | 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/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, 40°C / 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.

Handling notes

Detailed application notes intended to guide and assist our customers in using multilayer ceramic capacitors in surface mount technology are available on the Syfer website www.syfer.com

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

Components should never be handled with fingers; perspiration and skin oils can inhibit solderability and will aggravate cleaning.

Chip capacitors 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 types are readily available and recommended - these should be used with an absolute minimum of applied pressure.

Counting or visual inspection of chip capacitors is best performed on a clean glass or hard plastic surface.

If chips 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 components. 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 components 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 or polluted 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 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 may 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 but if left, can lead to catastrophic failure. More importantly, mechanical cracks, unless they are severe may not be detected by normal electrical testing of the completed circuit, failure only occurring at some later stage after moisture ingress.

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.

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".

Syfer were the first MLCC manufacturer to launch a flexible termination to significantly reduce the instances of mechanical cracking. FlexiCap™ termination introduces a certain amount of give into the termination layer absorbing damaging stress. Unlike similar systems, FlexiCap™ does not tear under tension, but absorbs the stress, so maintaining the characteristics of the MLCC.

SM Pad Design

Syfer conventional 2-terminal chip capacitors can generally be mounted using pad designs in accordance with IPC-7351, Generic Requirements for Surface Mount Design and Land Pattern Standards, but there are some other factors that have been shown to reduce mechanical stress, such as reducing the pad width to less than the chip width. In addition, the position of the chip on the board should also be considered.

3-Terminal components are not specifically covered by IPC-7351, but recommended pad dimensions are included in the Syfer catalogue / website for these components.

Soldering information

Soldering information

Syfer MLCCs are compatible with all recognised soldering/ mounting methods for chip capacitors. A detailed application note is available on-line at www.syfer.com

Reflow soldering surface mount chip capacitors

Syfer recommend reflow soldering as the preferred method for mounting MLCCs. Syfer MLCCs can be reflow soldered using a reflow profile generally as defined in IPC / JEDEC J-STD-020. Sn plated termination chip capacitors are compatible with both conventional and lead free soldering, with peak temperatures of 260°C to 270°C acceptable.

The heating ramp rate should be such that components see a temperature rise of 1.5°C to 4°C per seconds to maintain temperature uniformity through the MLCC.

The time for which the solder is molten should be maintained at a minimum, so as to prevent solder leaching. Extended times above 230°C can cause problems with oxidation of Sn plating. Use of inert atmosphere can help if this problem is encountered. PdAg terminations can be particularly susceptible to leaching with lead free, tin rich solders and trials are recommended for this combination.

Cooling to ambient temperature should be allowed to occur naturally, particularly if larger chip sizes are being soldered. Natural cooling allows a gradual relaxation of thermal mismatch stresses in the solder joints. Forced cooling should be avoided as this can induce thermal breakage.

Wave soldering Chip and Radial Leaded capacitors

Wave soldering is generally acceptable, but the thermal stresses caused by the wave have been shown to lead to potential problems with larger or thicker chips. Particular care should be taken when soldering SM chips larger than size 1210 and with a thickness greater than 1.0mm for this reason.

0402 size components are not suitable for wave soldering. 0402 size components can also be susceptible to termination leaching and reflow soldering is recommended for this size MLCC.

Maximum permissible wave temperature is 270°C for SM chips and 260°C for Radial Leaded capacitors.

The total immersion time in the solder should be kept to a minimum. It is strongly recommended that Sn/Ni plated terminations are specified for wave soldering applications. PdAg termination is particularly susceptible to leaching when subjected to lead free wave soldering and is not generally recommended for this application.

Total immersion exposure time for Sn/Ni terminations is 30s at a wave temperature of 260°C. Note that for multiple soldering operations, including the rework, the soldering time is cumulative.

The pre-heat ramp should be such that the components see a temperature rise of 1.5°C to 4°C per second as for reflow soldering. This is to maintain temperature uniformity through the MLCC and prevent the formation of thermal gradients within the ceramic. The preheat temperature should be within 120°C maximum (100°C preferred) of the maximum solder temperature to minimise thermal shock.

Cooling to ambient temperature should be allowed to occur naturally, particularly if larger chip sizes are being soldered. Natural cooling allows a gradual relaxation of thermal mismatch stresses in the solder joints. Forced cooling should be avoided as this can induce thermal breakage.

Rework of Chip capacitors

Syfer recommend hot air/ gas as the preferred method for applying heat for rework. Apply even heat surrounding the component to minimise internal thermal gradients. Soldering irons or other techniques that apply direct heat to the chip or surrounding area, should not be used as these can result in micro cracks being generated.

Minimise the rework heat duration and allow components to cool naturally after soldering.

Hand soldering Radial Leaded capacitors

Radial capacitors can be hand soldered into boards using soldering irons, provided care is taken not to touch the body of the capacitor with the iron tip. Soldering should be carried out from the opposite side of the board to the radial to minimise the risk of damage to the capacitor body. Where possible, a heat sink should be used between the solder joint and the body, especially if longer dwell times are required.

Use of silver loaded epoxy adhesives

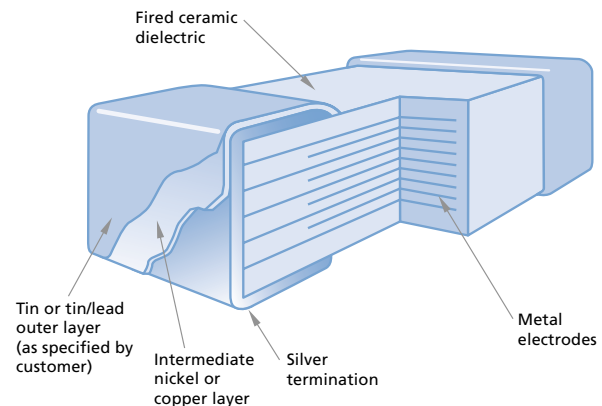
Chip capacitors can be mounted to circuit boards using silver loaded adhesive provided the termination material of the capacitor is selected to be compatible with the silver loaded adhesive. This is normally PdAg. Standard tin finishes are often not recommended for use with silver loaded epoxies as there can be electrical and mechanical issues with the joint integrity due to material mismatch.

Solder leaching

Leaching is the term for the dissolution of silver into the solder causing a failure of the termination system which causes increased ESR, $\tan \delta$ and open circuit faults, including ultimately the possibility of the chip becoming detached. Leaching occurs more readily with higher temperature solders and solders with a high tin content. Pb free solders can be very prone to leaching certain termination systems. To prevent leaching, exercise care when choosing solder alloys and minimize both maximum temperature and dwell time with the solder molten.

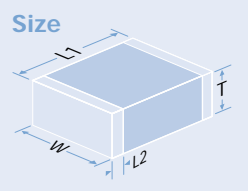
Plated terminations with nickel or copper anti leaching barrier layers are available in a range of top coat finishes to prevent leaching occurring. These finishes also include Syfer FlexiCap™ for improved stress resistance post soldering.

Multilayer ceramic chip - with nickel or copper barrier termination



Chip dimensions

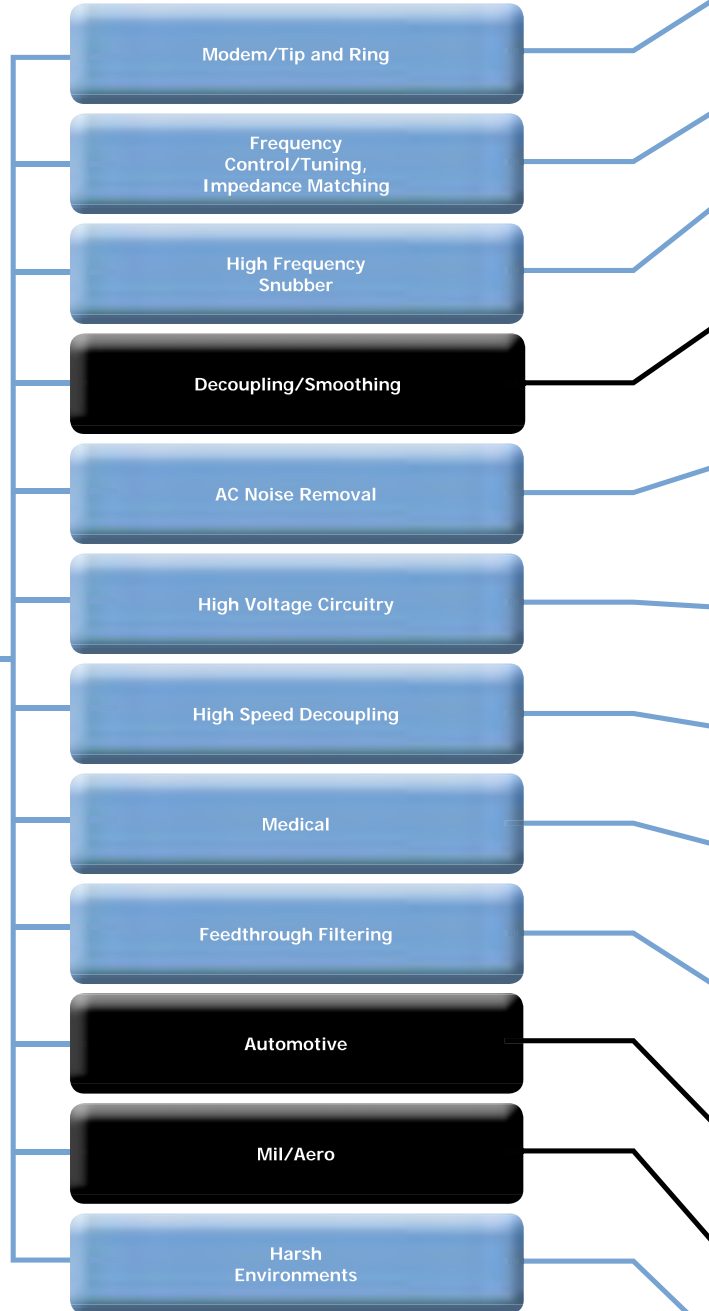
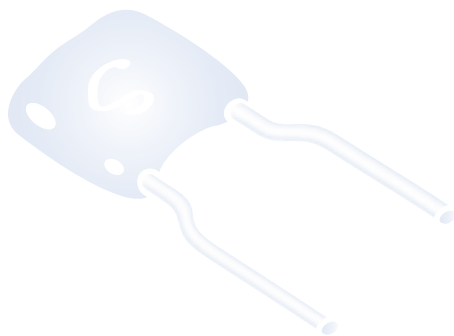
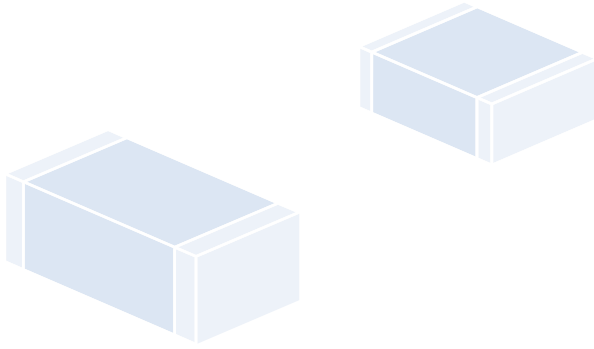
Dimensions



| Size | Length (L1) mm inches | Width (W) mm inches | Max. Thickness (T) mm inches | Termination Band L2 mm inches | |
|------|---|------------------------------|---------------------------------------|--|---------------|
| | | | | min | max |
| 0402 | 1.0 ± 0.10 0.04 ± 0.006 | 0.50 ± 0.10 0.02 ± 0.003 | 0.60 0.024 | 0.10 0.004 | 0.40 0.015 |
| 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 | 0.10 0.004 | 0.40 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 | 1.8 0.071 | 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 0.10 ± 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 0.10 ± 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 | 3.2 0.126 | 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 | 4.2 0.16 | 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 | 3.81 ± 0.35 0.35 ± 0.02 | 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 | 4.2 0.16 | 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 | 4.2 0.16 | 0.25 0.01 | 1.0 0.04 |
| 2520 | 6.30 ± 0.4 0.25 ± 0.016 | 5.0 ± 0.4 0.197 ± 0.016 | 4.2 0.16 | 0.25 0.01 | 1.0 0.04 |
| 3640 | 9.2 ± 0.5 0.36 ± 0.02 | 10.16 ± 0.5 0.40 ± 0.02 | 4.2 0.16 | 0.5 0.02 | 1.5 0.06 |
| 3820 | 9.65 ± 0.5 0.37 ± 0.02 | 5.0 ± 0.4 0.197 ± 0.016 | 4.2 0.16 | 0.5 0.02 | 1.5 0.06 |
| 3035 | 7.62 ± 0.4 0.30 ± 0.016 | 8.90 ± 0.5 0.35 ± 0.02 | 4.2 0.16 | 0.5 0.02 | 1.5 0.06 |
| 4045 | 10.2 ± 0.5 0.40 ± 0.02 | 11.5 ± 0.5 0.45 ± 0.02 | 4.2 0.16 | 0.5 0.02 | 1.5 0.06 |
| 4545 | 11.5 ± 0.5 0.45 ± 0.02 | 11.5 ± 0.5 0.45 ± 0.02 | 4.2 0.16 | 0.5 0.02 | 1.5 0.06 |
| 5550 | 14.0 ± 0.5 0.55 ± 0.02 | 12.7 ± 0.5 0.50 ± 0.02 | 4.2 0.16 | 0.5 0.02 | 1.5 0.06 |
| 5868 | 14.8 ± 0.5 0.58 ± 0.02 | 17.3 ± 0.5 0.68 ± 0.02 | 4.2 0.16 | 0.5 0.02 | 1.5 0.06 |
| 8040 | 20.3 ± 0.5 0.80 ± 0.02 | 10.16 ± 0.5 0.40 ± 0.02 | 4.2 0.16 | 0.5 0.02 | 1.5 0.06 |
| 8060 | 20.3 ± 0.5 0.80 ± 0.02 | 15.24 ± 0.5 0.60 ± 0.02 | 4.2 0.16 | 0.5 0.02 | 1.5 0.06 |

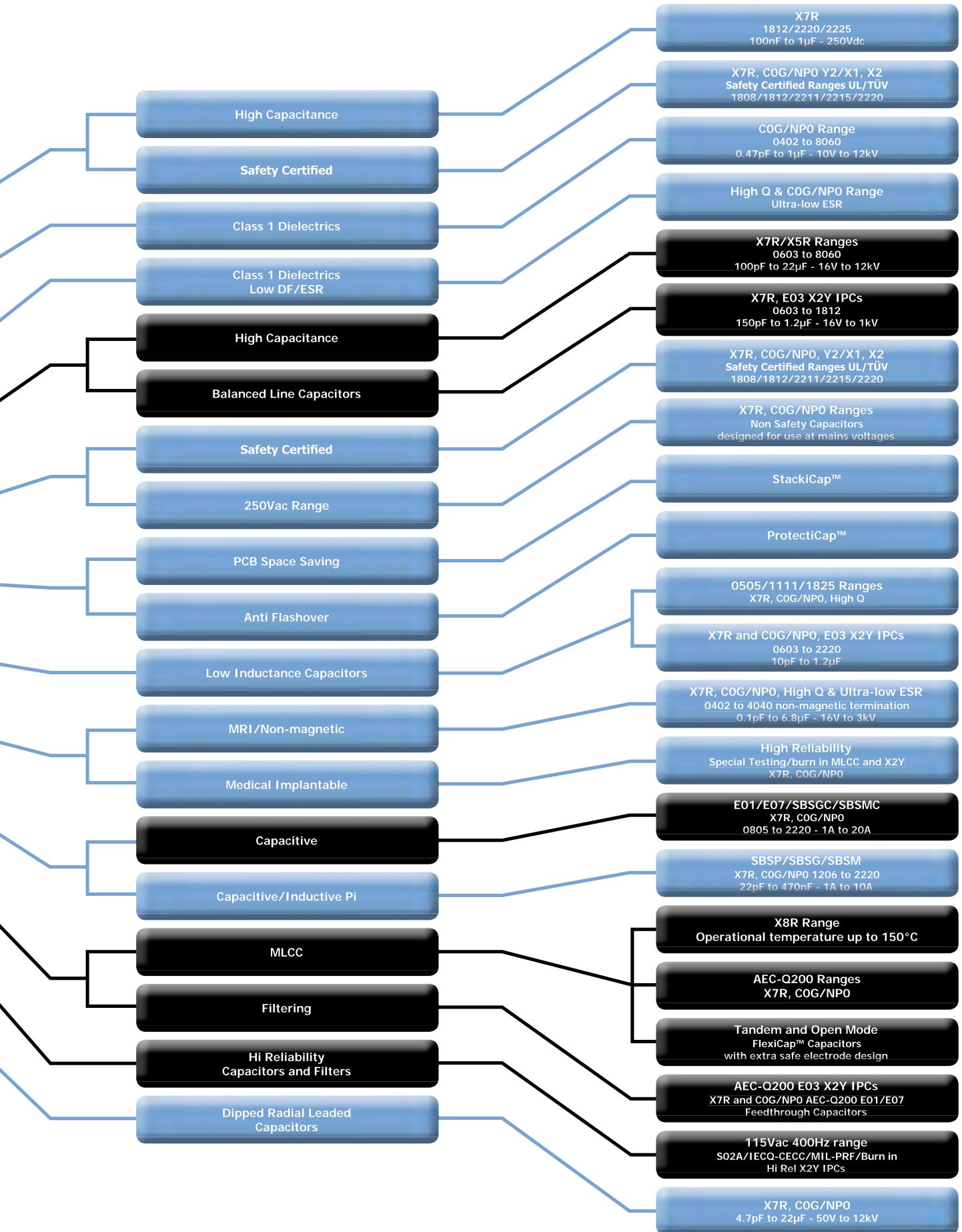
Custom chip sizes not included in the table, but larger than 2225, can be considered with minimum tooling charges. Please refer specific requests direct to the sales office.

Max thickness relates to standard components and actual thickness may be considerably less. Thicker parts, or components with reduced maximum thickness, can be considered by request – please refer requests to the sales office.



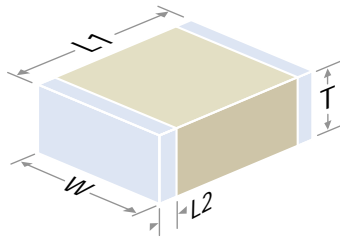
 FlexiCap™ is particularly recommended for these applications where possible.

Product Selector



Standard MLCC ranges - 10Vdc to 12Vdc

A range of dc rated multi-layer chip capacitors from 0.47pF to 22µF and case sizes 0603 to 8060 in COG/NPO and X7R dielectrics. Suitable for all general purpose and high reliability applications where package size and reliability are important. All are manufactured using Syfer's unique wet process and incorporate precious metal electrodes.



Range dimensions - Standard MLCC ranges

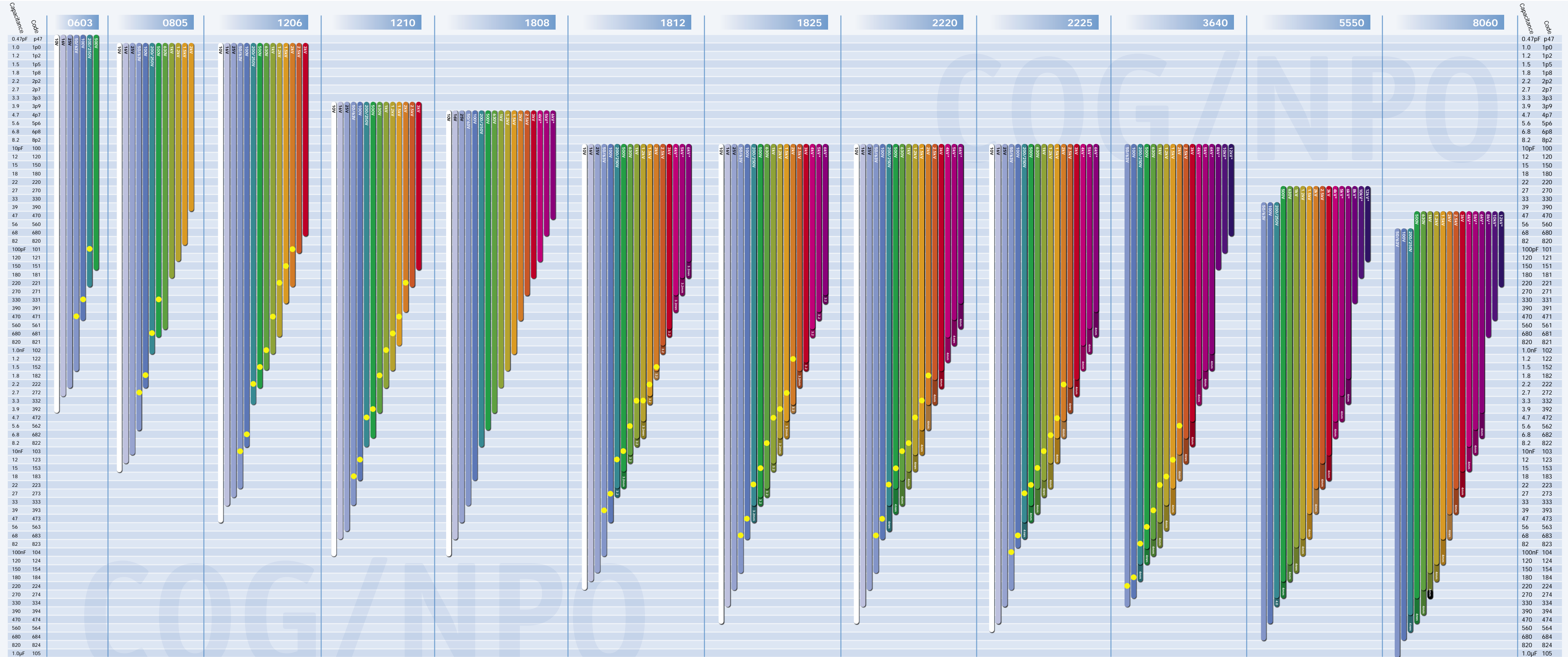
| Size | Length (L1) mm/inches | Width (W) mm/inches | Max. Thickness (T) mm/inches | Termination Band (L2) mm/inches | |
|-------------|----------------------------|----------------------------|---------------------------------|------------------------------------|---------------|
| | | | | min | max |
| 0603 | 1.6 ± 0.2 0.063 ± 0.008 | 0.8 ± 0.2 0.031 ± 0.008 | 0.8 0.031 | 0.10 0.004 | 0.40 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 |
| 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 |
| 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 |
| 2220 | 5.7 ± 0.4 0.225 ± 0.016 | 5.0 ± 0.4 0.197 ± 0.016 | 4.2 0.16 | 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 | 4.2 0.16 | 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 | 4.2 0.16 | 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 |

Custom chip sizes not included in the table, but larger than 2225, can be considered with minimum tooling charges. Please refer specific requests direct to the sales office.

Max thickness relates to standard components and actual thickness may be considerably less. Thicker parts, or components with reduced maximum thickness, can be considered by request – please refer requests to the Sales Office.

Ordering information - Standard MLCC ranges

| 1210 | Y | 100 | 0103 | J | X | T | --- |
|--|--|---|---|--|---|---|---|
| Chip size | Termination | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric | Packaging | Suffix code |
| 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). Not RoHS compliant. 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). Not RoHS compliant. | 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 8K0 = 8kV 10K = 10kV 12K = 12kV | <1.0pF Insert a P for the decimal point as the first character. eg. P300 = 0.3pF Values in 0.1pF steps ≥1.0pF & <10pF Insert a P for the decimal point as the second character. eg. 8P20 = 8.2pF Values are E24 series ≥10pF First digit is 0. Second and third digits are significant figures of capacitance code. Fourth digit is number of zeros eg. 0101 = 100pF Values are E24 series | <10pF H = ±0.05 pF B = ±0.10pF C = ±0.25pF D = ±0.50pF ≥ 10pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20% | C = COG/NPO (1B) X = X7R (2R1) P = X5R | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays | Used for specific customer requirements |



Note:
 1) *These parts may require conformal coating post soldering.
 2) Standard chip thickness = 2.5mm maximum unless specified as 3.2 or 4.0mm.

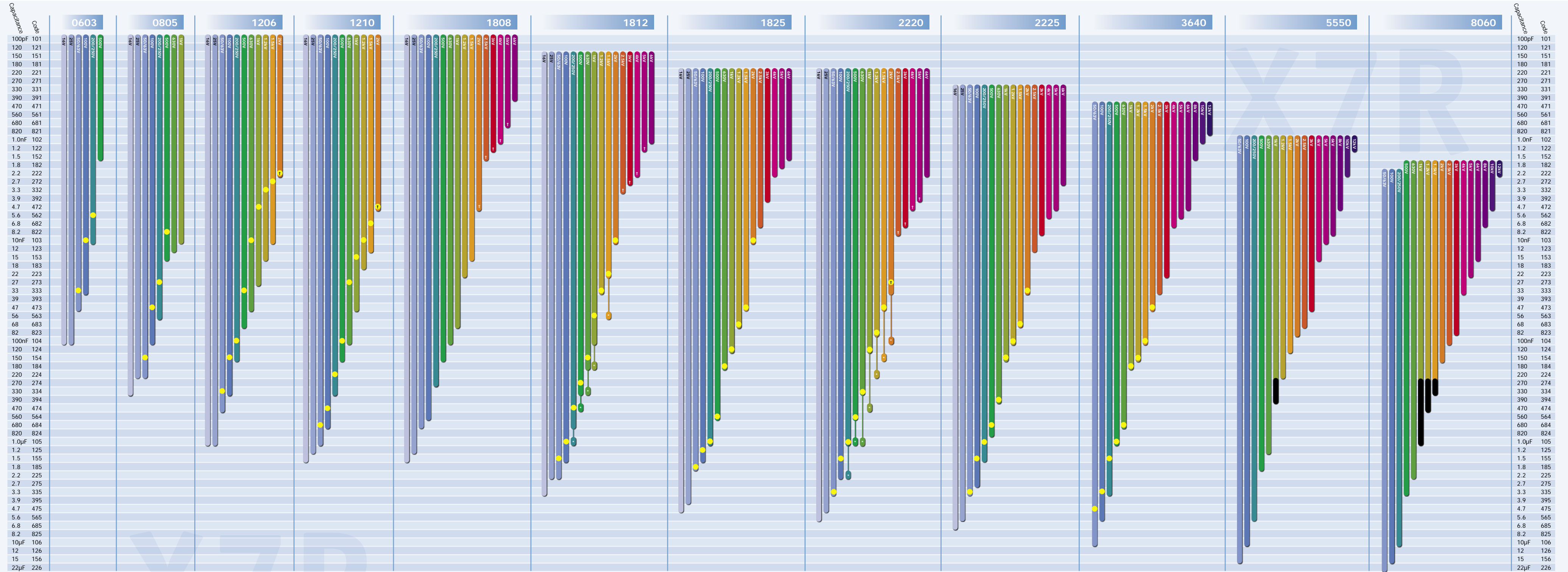
● = AEC-Q200 approved parts - maximum values.

Note: X7R ranges on reverse

Note: X7R ranges on reverse

Note: X7R ranges on reverse

● Note: The highlighted parts are defined as 'dual-use' under export control legislation and as such are subject to export licence restrictions. Please refer to page 9 for further details.



* StackiCap™ high capacitance versions available from the StackiCap™ range - see page 29 for details.
 † Higher capacitance values available from the ProtectiCap™ capacitors range - see page 19 for details.
 ● = AEC-Q200 approved parts - maximum values.

● Note: The highlighted parts are defined as 'dual-use' under export control legislation and as such are subject to export licence restrictions. Please refer to page 9 for further details.

Note: COG/NP0 ranges on reverse

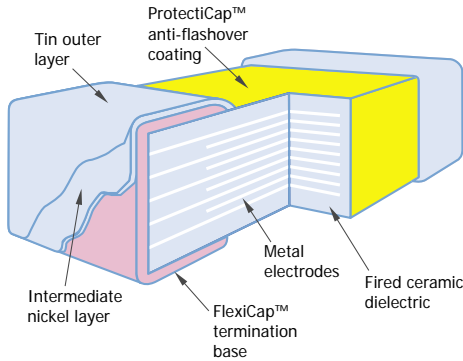
Note: COG/NP0 ranges on reverse

Note: COG/NP0 ranges on reverse

ProtectiCap™ capacitors - X7R

MLCCs are particularly suitable for high voltage applications where small size is required. For standard high voltage capacitors a coating may be required to be applied post-soldering, to minimise the risk of flashover from one termination on the chip to the other. By contrast, the new ProtectiCap™ high voltage range has been introduced to specifically address this issue. The integral coating minimises the risk of flashover without any requirement for the customer to apply conformal coating after soldering.

This range is fully compliant with the RoHS and WEEE directives. Parts are compatible with lead free solders and standard aqueous and solvent cleaning processes.



Operating Temperature

-55°C to +125°C

Temperature Coefficient of Capacitance (Typical)

±15%

Insulation resistance

Time constant (Ri xCr) (whichever is the least)

100GΩ or 1000s

Minimum/maximum capacitance values - ProtectiCap™ capacitors

| Chip Size | 1206 | 1210 | 1808 | 1812 | 2220 |
|-----------|--------|-------|-------|--------------|--------------|
| Min Cap | 220pF | 680pF | 330pF | 470pF | 1.0nF |
| 2000V | 3.3nF | 5.6nF | 5.6nF | 12nF | - |
| 2500V | 2.7nF | 4.7nF | 4.7nF | 8.2nF | 22nF |
| 3000V | 1.5nF | 3.3nF | 3.3nF | 4.7nF | 10nF |
| 4000V | - | - | 2.2nF | 3.3nF | 6.8nF |
| 5000V | - | - | - | - | 4.7nF |
| 7" Reel | 2,500 | 2,000 | 1,500 | 500/1,000* | 500/1,000* |
| 13" Reel | 10,000 | 8,000 | 6,000 | 2,000/4,000* | 2,000/4,000* |

NOTE: Other capacitance values may become available, please contact the sales office if you need values other than those shown in the above table. For dimensions and soldering information, please go to our website (www.syfer.com) or see our MLC Catalogue.

*Reel quantity depends on chip thickness. Please contact the Sales Office.

Ordering information - ProtectiCap™ capacitors

| 1206 | P | 2K0 | 0102 | K | X | T |
|--------------------------------------|--|---|--|---------------------------------|------------|--|
| Chip size | Termination | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric | Packaging |
| 1206 1210 1808 1812 2220 | P = ProtectiCap™ (FlexiCap™ termination base with Ni barrier, 100% matte tin plating). | 2K0 = 2kV 2K5 = 2.5kV 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 0's following Example 0102 = 1000pF | J = ±5% K = ±10% M = ±20% | X = X7R | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays |

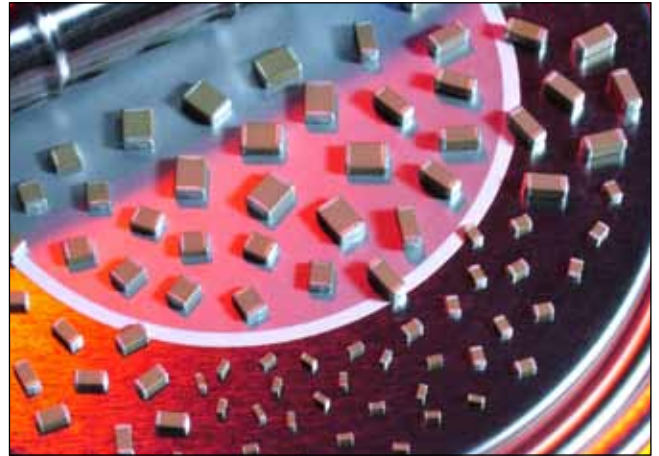
ProtectiCap™

TCC/VCC capacitors - X7R

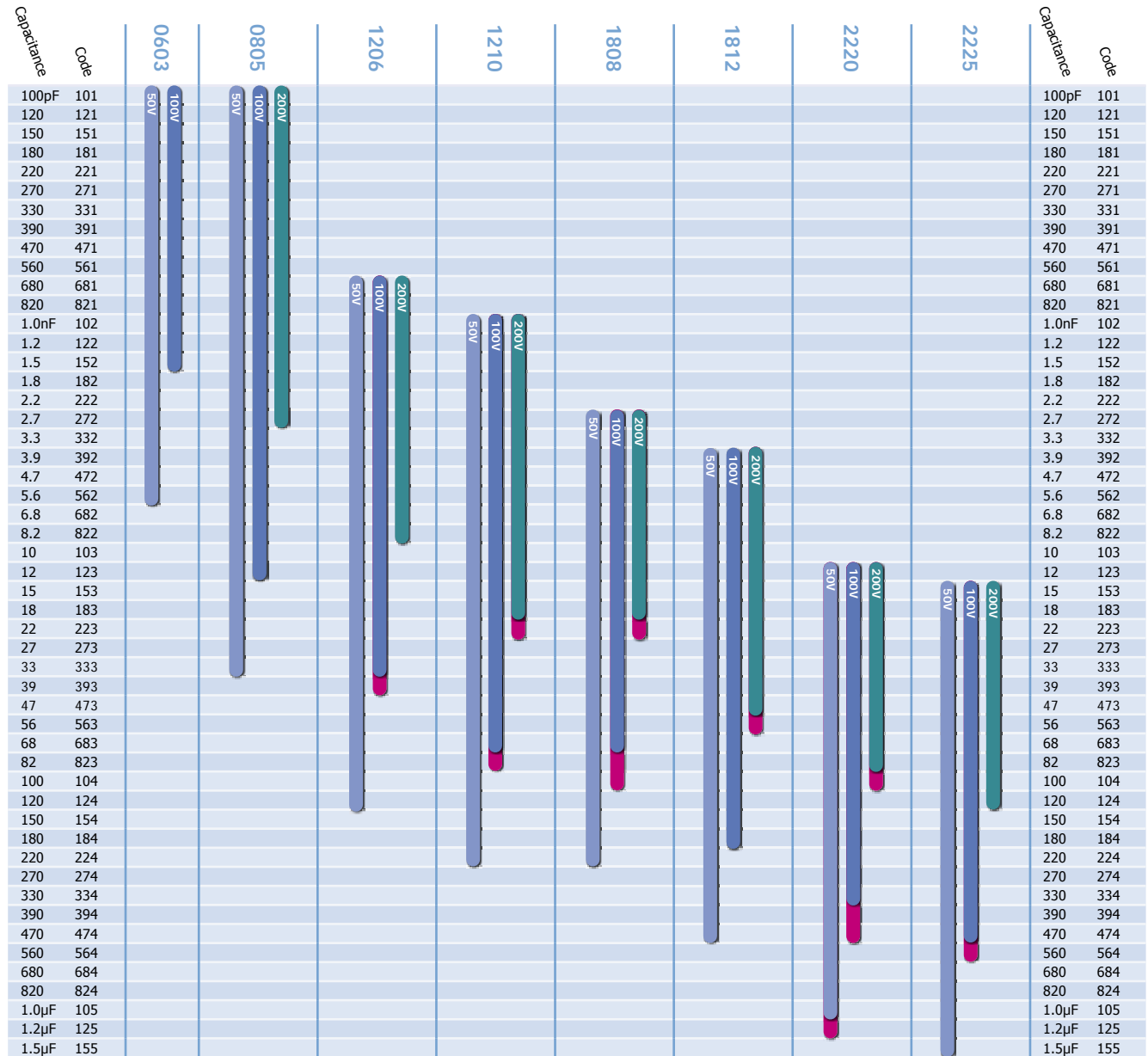
TCC/VCC range

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").



TCC/VCC capacitors - 2C1 (BZ)



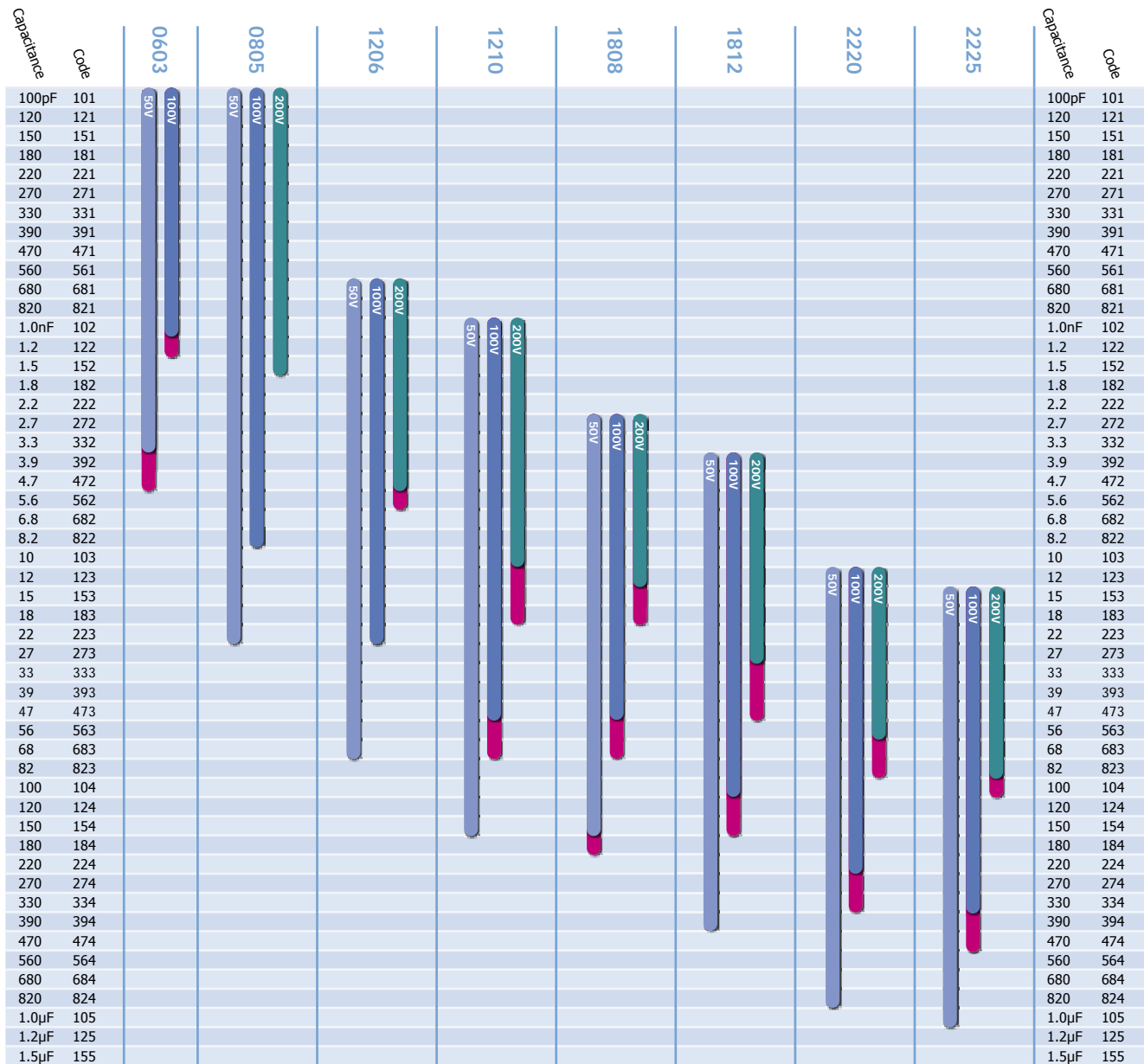
● = non RoHS compliant and FlexiCap™ termination only. Other values available in J, Y (FlexiCap™) and F terminations.

TCC/VCC capacitors - X7R

| | | X7R | | |
|--|-----------|-----------------|------|---------|
| Dielectric characteristics | | Stable | | |
| | IECQ-CECC | 2C1 | 2R1 | 2X1 |
| | EIA | - | X7R | - |
| | MIL | BZ | - | BX |
| Rated temperature range | | -55°C to +125°C | | |
| Maximum capacitance change 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.

TCC/VCC capacitors - 2X1 (BX)



● = non RoHS compliant and FlexiCap™ termination only. Other values available in J, Y (FlexiCap™) and F terminations.

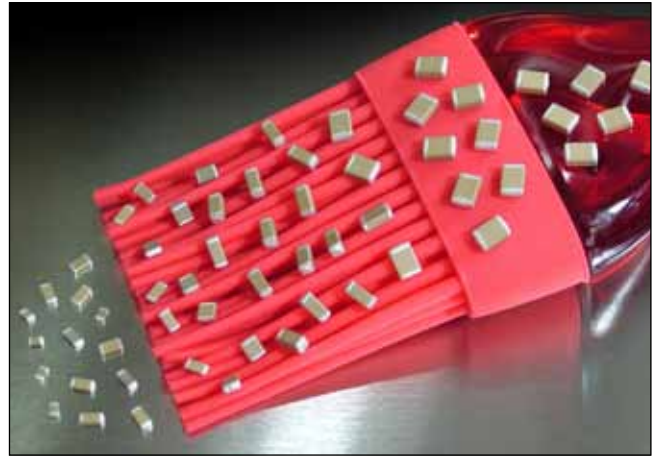
VC1 capacitors - X7R

VC1 residual range

The VC1 residual capacitance range MLCCs provide a more stable capacitance value with voltage - not to drop below 50% of the 1Vrms 1kHz value, up to full rated DC voltage, at room temperature.

They can be operated continuously at full rated voltage, but if de-rated will maintain a larger percentage of their original capacitance value, e.g. at 80% RV capacitance value equals 40% approx - see graph.

Defined capacitance value in case sizes from 0805 to 3640, with voltage rating up to 3kV. Ideal for Power supplies, capacitance critical circuits, smoothing circuits and EMI suppression.



Operating Temperature

-55°C to +125°C

Temperature Coefficient (Typical)

± 15%

Insulation Resistance at +25°C

Time constant ($R_i \times C_r$) (whichever is the least)
100GΩ or 1000s

Aging Rate

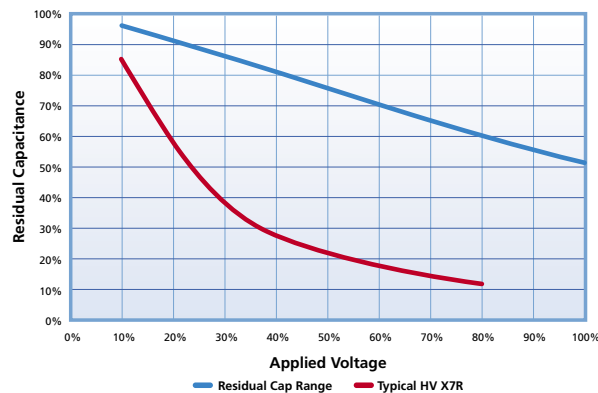
Typically up to 2% per time decade

Minimum/maximum capacitance values - VC1 capacitors

| Chip Size | 0805 | 1206 | 1210 | 1808 | 1812 | 2220 | 2225 | 3640 |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|
| Min Cap | 100pF | 150pF | 220pF | 220pF | 470pF | 1nF | 1nF | 2.2nF |
| 250V | 12nF | 39nF | 82nF | 82nF | 220nF | 680nF | 1μF | 1.8μF |
| 500V | 2.2nF | 6.8nF | 15nF | 15nF | 56nF | 150nF | 220nF | 560nF |
| 630V | 1.5nF | 4.7nF | 8.2nF | 8.2nF | 39nF | 100nF | 120nF | 470nF |
| 1000V | 390pF | 1.5nF | 2.7nF | 2.7nF | 15nF | 39nF | 56nF | 180nF |
| 1200V | - | 1nF | 2.2nF | 2.2nF | 10nF | 27nF | 39nF | 120nF |
| 1500V | - | 560pF | 1.2nF | 1.2nF | 5.6nF | 15nF | 22nF | 68nF |
| 2000V | - | 270pF | 560pF | 560pF | 3.3nF | 10nF | 12nF | 39nF |
| 2500V | - | - | - | - | 1.8nF | 5.6nF | 8.2nF | 22nF |
| 3000V | - | - | - | - | - | 3.9nF | 5.6nF | 12nF |

NOTE: Other capacitance values may become available, please contact our Sales Office if you need values other than those shown in the above table. For dimensions and soldering information, please go to our website (www.syfer.com).

Typical Performance Curves



VC1 capacitors - X7R

Ordering information - VC1 capacitors

| 1206 | Y | 1K0 | 0152 | K | X | T | VC1 |
|--|---|--|---|---------------------------------|------------|---|--------|
| Chip size | Termination | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric | Packaging | Suffix |
| 0805 1206 1210 1808 1812 2220 2225 3640 | Y = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant. | 250 = 250V 500 = 500V 630 = 630V 1K0 = 1.0kV 1K2 = 1.2kV 1K5 = 1.5kV 2K0 = 2.0kV 2K5 = 2.5kV 3K0 = 3.0kV | First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of 0's following Example: 0152 = 1500pF | J = ±5% K = ±10% M = ±20% | X = X7R | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs | |

Reeled quantities - VC1 capacitors

| Chip Size | 0805 | 1206 | 1210 | 1812 | 1812 | 1812 | 1812 | 3640 |
|-----------|--------|--------|-------|--------------|--------------|--------------|--------------|------|
| 7" Reel | 3,000 | 2,500 | 2,000 | 500/1,000* | 500/1,000* | 500/1,000* | 500/1,000* | n/a |
| 13" Reel | 12,000 | 10,000 | 8,000 | 2,000/4,000* | 2,000/4,000* | 2,000/4,000* | 2,000/4,000* | 500 |

*Reel quantity depends on chip thickness. Please contact Sales Office.

PSL capacitors - C0G/NP0 & X7R

PSL range

The PSL range of multilayer ceramic capacitors is suitable for a variety of applications including power supplies, DC-DC converters and LED lighting.

This range is manufactured to exacting standards using our unique screen printing process. This provides a high quality component suitable for demanding applications.



Now available with FlexiCap™ termination

Operating Temperature

-55°C to +125°C

Temperature Coefficient (Typical)

± 15%

Insulation Resistance at +25°C

Time constant ($R_i \times C_r$) (whichever is the least)
100GΩ or 1000s

Aging Rate

Typically less than 2% per time decade

Minimum/maximum capacitance values - PSL capacitors

| Rated Voltage | Chip Size | | | | | | | | | | |
|---------------|---------------|---------------|--------------|------------------------------|--------------|-------------|--------------|--------------|-------------|--------------|----------------------------|
| | 0805 | | 1206 | | 1210 | | 1808 | 1812 | | 2220 | |
| | C0G/NP0 | X7R | C0G/NP0 | X7R | C0G/NP0 | X7R | C0G/NP0 | C0G/NP0 | X7R | C0G/NP0 | X7R |
| 50V / 63V | N/A | 220pF - 100nF | N/A | 470pF - 470nF | N/A | 1nF - 1μF | N/A | N/A | N/A | N/A | N/A |
| 100V | 4.7pF - 1.5nF | 220pF - 47nF | 10pF - 3.3nF | 470pF - 150nF | 22pF - 5.6nF | 1nF - 330nF | 22pF - 5.6nF | 47pF - 12nF | 1nF - 680nF | 68pF - 27nF | 1nF - 1.5μF |
| 200V / 250V | 4.7pF - 1nF | 220pF - 27nF | 10pF - 2.2nF | 470pF - 100nF | 22pF - 4.7nF | 1nF - 180nF | 22pF - 4.7nF | 47pF - 10nF | 1nF - 470nF | 68pF - 22nF | 1nF - 1μF |
| 500V | 4.7pF - 470pF | 220pF - 10nF | 10pF - 1.5nF | 470pF - 56nF | 22pF - 3.3nF | 1nF - 100nF | 22pF - 3.3nF | 47pF - 6.8nF | 1nF - 220nF | 68pF - 15nF | 1nF - 560nF |
| 630V | 4.7pF - 220pF | 220pF - 5.6nF | 10pF - 1nF | 470pF - 47nF | 22pF - 2.2nF | 1nF - 68nF | 22pF - 2.2nF | 47pF - 5.6nF | 1nF - 150nF | 68pF - 12nF | 1nF - 330nF |
| 1kV | 4.7pF - 100pF | 220pF - 3.3nF | 10pF - 680pF | 470pF - 10nF | 22pF - 1.5nF | 1nF - 22nF | 22pF - 1.5nF | 47pF - 4.7nF | 1nF - 68nF | 68pF - 10nF | 1nF - 100nF 1nF - 120nF |
| 1.5kV | 4.7pF - 68pF | N/A | 10pF - 390pF | N/A | 22pF - 680pF | N/A | 22pF - 680pF | 47pF - 2.2nF | N/A | 68pF - 4.7nF | N/A |
| 2kV | 4.7pF - 33pF | N/A | 10pF - 220pF | 470pF - 1nF 470pF - 2.2nF | 22pF - 470pF | 1nF - 4.7nF | 22pF - 470pF | 47pF - 1nF | 1nF - 10nF | 68pF - 2.2nF | N/A |
| 2.5kV | N/A | N/A | 10pF - 100pF | N/A | 22pF - 150pF | N/A | 22pF - 270pF | 47pF - 680pF | N/A | 68pF - 1.5nF | N/A |
| 3kV | N/A | N/A | 10pF - 68pF | N/A | 22pF - 100pF | N/A | 22pF - 220pF | 47pF - 470pF | N/A | 68pF - 1nF | N/A |

Note: Other capacitance values may become available, please contact our Sales Office if you need values other than those shown in the above table. For dimensions and soldering information, please go to our website (www.syfer.com).

■ = AEC-Q200

PSL capacitors - COG/NP0 & X7R

Ordering information - PSL capacitors

| 1206 | J | 1K0 | 0103 | K | | J | T |
|--|--|---|---|--|---|---|--|
| Chip size | Termination | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | | Dielectric | Packaging |
| 0805 1206 1210 1808 1812 2220 | J = Nickel barrier with 100% matte tin plating. RoHS compliant. Y =FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant. Lead free. (X7R only). Note: AEC-Q200 qualified parts only available with FlexiCap™ termination. | 050 = 50V 063 = 63V 100 = 100V 200 = 200V 250 = 250V 500 = 500V 630 = 630V 1K0 = 1kV 1K5 = 1.5kV 2K0 = 2kV 2K5 = 2.5kV 3K0 = 3kV | First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of 0's following Example: 0103 = 10000pF | X7R K = ±10% M = ±20% | COG/NP0 F = ±1% G = ±2% J = ±5% K = ±10% | G = COG/NP0 J = X7R S = X7R AEC-Q200 | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs |

Reeled quantities - PSL capacitors

| Chip Size | 0805 | 1206 | 1210 | 1808 | 1812 | 2220 |
|-----------|--------|--------|-------|-------|--------------|--------------|
| 7" Reel | 3,000 | 2,500 | 2,000 | 1,500 | 500/1,000* | 500/1,000* |
| 13" Reel | 12,000 | 10,000 | 8,000 | 6,000 | 2,000/4,000* | 2,000/4,000* |

*Reel quantity depends on chip thickness. Please contact our Sales Office.

High Q capacitors - MS range

The Syfer High Q MS range offers a very stable, High Q material system that provides excellent, low loss performance in systems below 3GHz. Available in 0402 to 3640 case sizes with various termination options including FlexiCap™, this range of high frequency capacitors is suitable for many applications where economical, high performance is required.

CapCad™ capacitor modelling software is now available for the HiQ range. This software has been developed with an easy to use and readily accessible comparison tool for choosing the best MLCC to suit the customer's needs. Please consult the Syfer website to launch the software.



Operating Temperature

-55°C to +125°C

Temperature Coefficient (Typical)

0 ± 30 ppm/°C

Insulation resistance at +25°C

>100GΩ

Insulation resistance at +125°C

>10GΩ

Minimum/maximum capacitance values - High Q capacitors - MS range

| Chip Size | 0402* | 0603† | 0505 | 0805† | 1206 | 1111 | 1210 | 1812 | 2220 | 2225 | 3640 |
|--|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--|--|--|------------------|
| Min Cap | 0.1pF | 0.1pF | 0.2pF | 0.2pF | 0.5pF | 0.3pF | 0.3pF | 1.0pF | 2.0pF | 2.0pF | 4.0pF |
| 50V 63V | 33pF | 220pF | 330pF | 680pF | 2.2nF | | | | | | |
| 100V | 22pF | 150pF | 220pF | 470pF | 1.5nF | 3.3nF | 3.3nF | 6.8nF | 15nF | 18nF | |
| 150V | 18pF | 120pF | 180pF | 390pF | 1.2nF | 2.7nF | 2.7nF | 4.7nF | 12nF | 15nF | |
| 200V 250V | 15pF | 100pF | 150pF | 330pF | 1.0nF | 2.2nF | 2.2nF | 3.9nF | 10nF | 10nF | |
| 300V | | 56pF | 100pF | 220pF | 680pF | 1.5nF | 1.5nF | 3.3nF | 6.8nF | 8.2nF | |
| 500V | | | | 100pF | 330pF | 820pF | 820pF | 2.2nF | 4.7nF | 5.6nF | 15nF |
| 630V | | | | | 150pF | 390pF | 390pF | 1.0nF | 2.2nF | 3.3nF | 6.8nF |
| 1000V | | | | | 82pF | 220pF | 220pF | 680pF | 1.5nF | 2.2nF | 4.7nF |
| 2000V | | | | | 18pF | 68pF | 68pF | 150pF | 470pF | 560pF | 1.5nF |
| 3000V | | | | | | | | 68pF | 150pF | 220pF | 470pF |
| Tape quantities | 7" reel 5000 | 7" reel 4000 | 7" reel 2500 | 7" reel 3000 | 7" reel 2500 | 7" reel 1000 | 7" reel 2000 | 7" reel 500/1000 13" reel 2000/4000 | 7" reel 500/1000 13" reel 2000/4000 | 7" reel 500/1000 13" reel 2000/4000 | 13" reel only |
| 13" reel quantities available on request | | | | | | | | | | | |

Below 1pF capacitance values are available in 0.1pF steps. Above 1pF capacitance values are available in E24 series values.

Other values and taping quantities may be available on request, consult the Sales Office for details. For values < than 0.3pF please consult the Sales Office for availability.

*0402 size - please consult the Sales Office for availability.

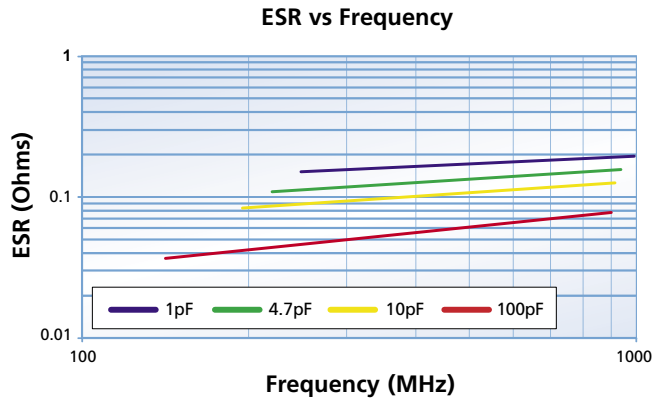
†0603 and 0805 sizes not recommended for new designs. Refer to Ultra-low ESR ranges on page 28.

Ordering information - High Q capacitors - MS range

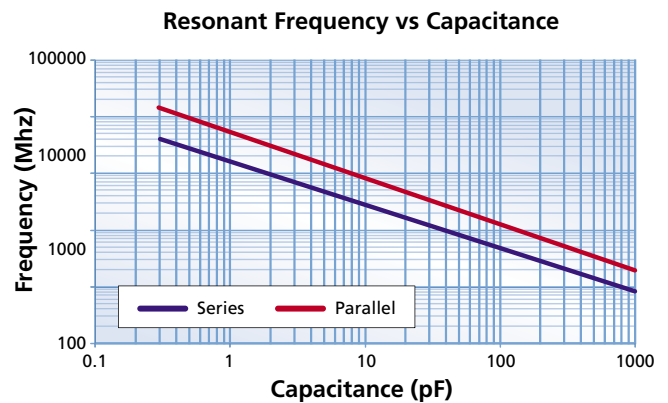
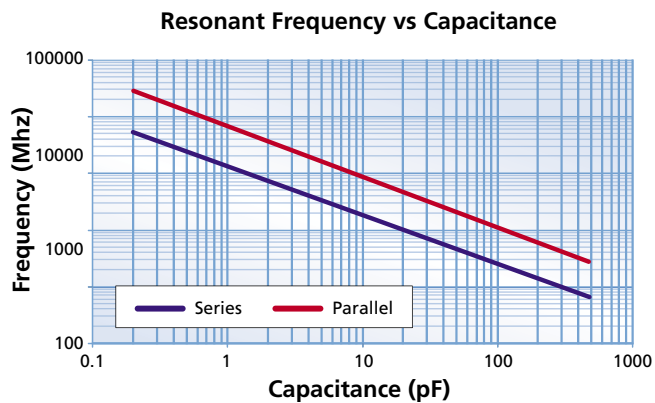
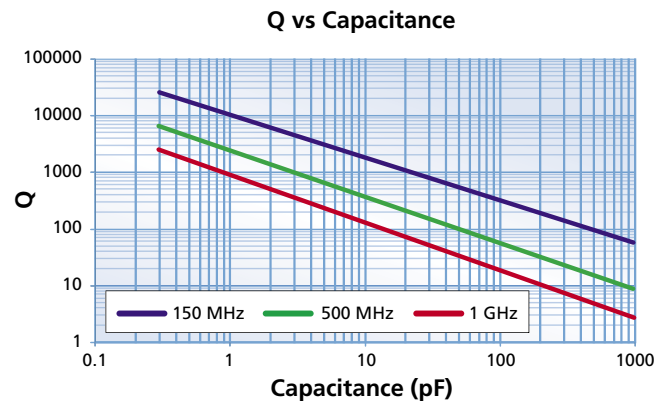
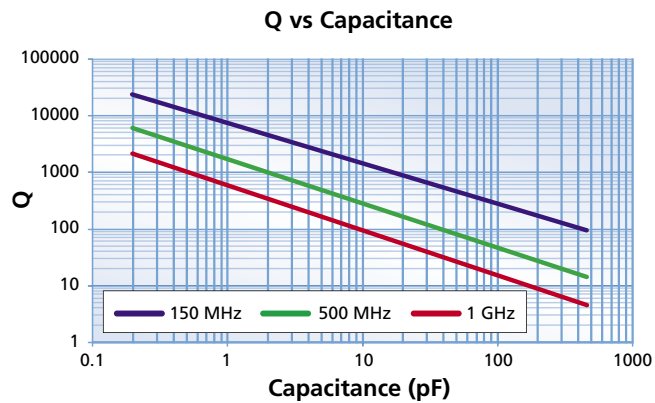
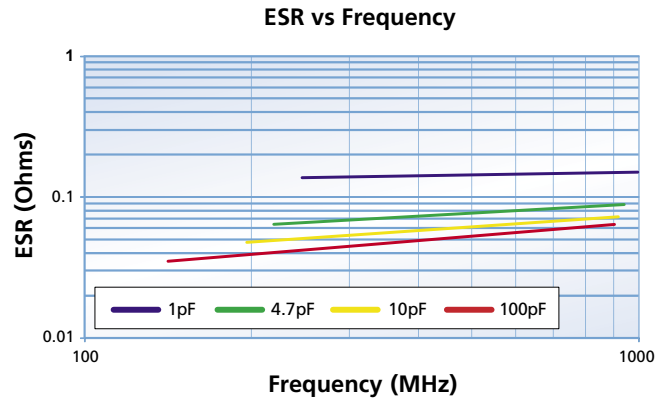
| 0505 | J | 250 | 4P70 | B | Q | T |
|---|---|---|---|--|--------------------|--|
| Chip size | Termination | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric | Packaging |
| 0402* 0603† 0505 0805† 1206 1111 1210 1812 2220 2225 3640 | J = Silver base with nickel barrier (100% matte tin plating). RoHS compliant. Lead free. A = Silver base with nickel barrier (Tin/lead plating with min. 10% lead). Not RoHS compliant. | 050 = 50V 063 = 63V 100 = 100V 150 = 150V 200 = 200V 250 = 250V 300 = 300V 500 = 500V 630 = 630V 1K0 = 1kV 2K0 = 2kV 3K0 = 3kV | <1.0pF Insert a P for the decimal point as the first character. eg. P300 = 0.3pF Values in 0.1pF steps ≥1.0pF & <10pF Insert a P for the decimal point as the second character. eg. 8P20 = 8.2pF Values are E24 series ≥10pF First digit is 0. Second and third digits are significant figures of capacitance code. Fourth digit is number of zeros eg. 0101 = 100pF Values are E24 series | <4.7pF H = ±0.05pF B = ±0.1pF C = ±0.25pF D = ±0.5pF <10pF B = ±0.1pF C = ±0.25pF D = ±0.5pF ≥10pF F = ±1% G = ±2% J = ±5% K = ±10% | Q = High Q Ceramic | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays |

High Q capacitors - MS range

Typical performance data - 0805 chip size*



Typical performance data - 1111 chip size*



* Please refer to the Sales Office for other chip size electrical data.

Ultra-low ESR capacitors - COG/NP0

The Ultra-low ESR range offers a very stable, High Q material system that provides excellent, low loss performance in systems below 3GHz. Available with various termination options including FlexiCap™, this range of high frequency capacitors is suitable for many applications where economical, high performance is required.

0603 S-parameter downloads are available from: <http://www.knowlescapacitors.com/syfer/en/products/mlc-capacitors/ultra-low-esr-capacitors> and the Syfer MVP page on the Modelithics website. Please visit the Syfer MVP page for more information at: <http://www.modelithics.com/mvp/syfer>

Operating Temperature

-55°C to +125°C

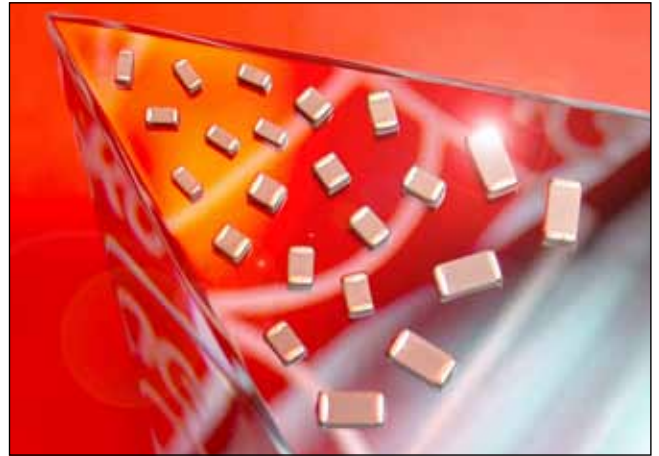
Temperature Coefficient (Typical)

0 ± 30 ppm/°C

Insulation resistance

Time constant (Ri xCr) (whichever is the least)

100GΩ or 1000s

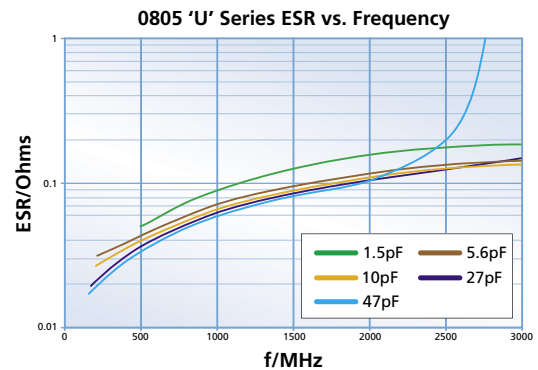
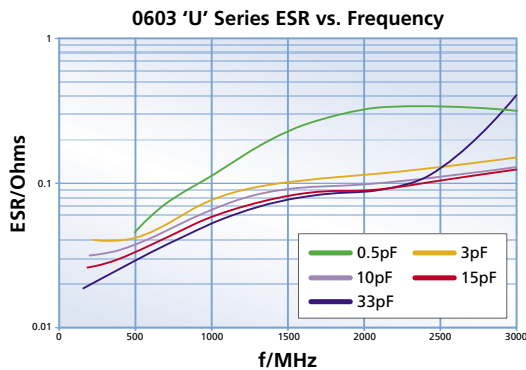


Minimum/maximum capacitance values - Ultra-low ESR capacitors

| Chip Size | 0603 | 0805 |
|----------------------|-------------------|-------------------|
| Min Cap | 0.1pF | 0.2pF |
| 200V _{250V} | 100pF | 240pF |
| Tape quantities | 7" reel - 4,000 | 7" reel - 3,000 |
| | 13" reel - 16,000 | 13" reel - 12,000 |

Note: Below 1pF capacitance values are available in 0.1pF steps. Above 1pF capacitance values are available in E24 series values. Other values and taping quantities may be available on request, consult the Sales Office for details.

Typical performance



Ordering information - Ultra-low ESR capacitors

| 0805 | J | 250 | 0101 | J | U | T |
|----------------------------|---|---|--|---|--------------------------|--|
| Chip size | Termination | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric | Packaging |
| 0603 0805 | <p>J = Silver base with nickel barrier (100% matte tin plating). RoHS compliant. Lead free.</p> <p>A = Silver base with nickel barrier (Tin/lead plating with min. 10% lead). Not RoHS compliant.</p> | <p>200 = 200V</p> <p>250 = 250V</p> | <p><1.0pF Insert a P for the decimal point as the first character. eg. P300 = 0.3pF Values in 0.1pF steps</p> <p>≥1.0pF & <10pF Insert a P for the decimal point as the second character. eg. 8P20 = 8.2pF Values are E24 series</p> <p>≥10pF First digit is 0. Second and third digits are significant figures of capacitance code. Fourth digit is number of zeros eg. 0101 = 100pF Values are E24 series</p> | <p><4.7pF H = ±0.05pF B = ±0.1pF C = ±0.25pF D = ±0.5pF <10pF B = ±0.1pF C = ±0.25pF D = ±0.5pF ≥10pF F = ±1% G = ±2% J = ±5% K = ±10%</p> | U = Ultra-low ESR | <p>T = 178mm (7") reel</p> <p>R = 330mm (13") reel</p> <p>B = Bulk pack - tubs or trays</p> |

StackiCap™ capacitors - X7R

The StackiCap™ range offers a significant reduction in 'PCB real estate' for an equivalent capacitance value when board space is at a premium.

Syfer's unique patent pending* construction and FlexiCap™ termination material make the StackiCap™ range suitable for applications including: power supplies, lighting, aerospace electronics and high voltage applications where a large amount of capacitance is required. Further developments are on-going, please contact the Sales Office for details of the full range.

* Patent application No. 1210261-2 applies.



Maximum capacitance

Up to 5.6µF

Maximum voltage

Up to 2kV

Comparison chart - StackiCap™ capacitors

| Chip Size | Voltage | StackiCap™ values (nF) * | Non- StackiCap™ range (nF) | Replaces Case Size |
|-----------|----------|--------------------------|----------------------------|--------------------|
| 1812 | 200/250V | 1000 | 680 | 2220 |
| | 500V | 470 | 330 | 2220 |
| | 630V | 330 | 180 | 2220 |
| | 1kV | 180 | 100 | 2225 / 3640 |
| | 1.2kV | 100 | 33 | 2225 |
| | 1.5kV | 56 | 22 | 2225 |
| 2220 | 200/250V | 2200 | 1000 | 3640 |
| | 500V | 1000 | 560 | 3640 |
| | 630V | 1000 | 330 | 5550 |
| | 1kV | 470 | 120 | 8060 |
| | 1.2kV | 220 | 82 | 5550 |
| | 1.5kV | 150 | 47 | 5550 |
| | 2kV | 100 | 27 | 8060 |
| 3640 | 200/250V | 5600 | 3300 | 5550 |
| | 500V | 2700 | 1000 | 8060 |
| | 630V | 2200 | 680 | 8060 |
| | 1kV | 1000 | 180 | 8060 |
| | 1.2kV | 470 | 150 | 8060 |
| | 1.5kV | 330 | 100 | 8060 |
| | 2kV | 150 | 47 | 8060 |

■ = AEC-Q200. *Other capacitance values available. Please consult the Sales Office.

Ordering information - StackiCap™ capacitors

| 1812 | Y | 500 | 0474 | J | X | T | WS2 |
|----------------------|---|--|--|---------------------------------|--------------------------------------|--|-------------|
| Chip size | Termination | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric | Packaging | Suffix code |
| 1812 2220 3640 | Y = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant. Lead free. H = FlexiCap™ Termination base with nickel barrier (Tin/lead plating with minimum 10% lead). Not RoHS compliant. | 200/250 = 200/250V 500 = 500V 630 = 630V 1K0 = 1kV 1K2 = 1.2kV 1K5 = 1.5kV 2K0 = 2kV | First digit is 0. Second and third digits are significant figures of capacitance code in picofarads (pF). Fourth digit is number of zeros eg. 0474 = 470nF Values are E12 series | J = ±5% K = ±10% M = ±20% | X = X7R E = X7R (2R1) AEC-Q200 | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays | WS2 |

Reeled quantities - StackiCap™ capacitors

| | 1812 | 2220 | 3640 |
|------------------|-------------|-------------|------|
| 178mm (7") Reel | 500/1,000 | 500/1,000 | - |
| 330mm (13") Reel | 2,000/4,000 | 2,000/4,000 | 500 |



Non-magnetic capacitors - COG/NP0, High Q, X7R

Multilayer ceramic capacitors with silver/palladium (Ag/Pd) terminations have often been used in medical applications where non-magnetic components are required, for example in MRI equipment. The use of conventional nickel barrier terminations is not suitable due to nickel exhibiting magnetic properties.

However, RoHS requirements have dictated the use of lead-free solders, and the composition of these solders has resulted in an increase in soldering temperatures. This has caused solder leaching problems for the Ag/Pd termination, and meant alternative terminations have had to be found.

As copper is non-magnetic, one solution is to use a copper barrier instead of a nickel barrier, with a tin finish on top and this is the solution Syfer has developed.

This Non-magnetic termination is offered with selected non-magnetic COG/NP0, High Q and X7R dielectrics, providing a fully non-magnetic component ($\mu_r = 1.0000$).

To meet high temperature 260°C soldering reflow profiles as detailed in J-STD-020, COG/NP0 dielectrics are supplied with FlexiCap™ or sintered termination and X7R dielectrics are supplied with Syfer's award winning FlexiCap™ termination.



COG/NP0 & High Q - minimum/maximum capacitance values

| Chip Size | 0402* | 0603 | 0505 | 0805 | 1206 | 1111 1210 | 1808 | 1812 | 2220 | 2225 |
|-------------------|--|-------|-------|-------|-------|--------------|-------|-------|-------|-------|
| Min Cap | 0.1pF | 0.1pF | 0.2pF | 0.2pF | 0.5pF | 0.3pF | 1.0pF | 1.0pF | 2.0pF | 2.0pF |
| Min Cap Tolerance | ±0.05pF (<4.7pF), 0.1pF (≥4.7pF & <10pF) and ±1% (≥10pF) | | | | | | | | | |
| 50V 63V | 22pF | 100pF | 220pF | 470pF | 1.5nF | - | - | - | - | - |
| 100V | 15pF | 68pF | 150pF | 330pF | 1.0nF | 2.2nF | 2.2nF | 4.7nF | 10nF | 15nF |
| 150V | 10pF | 47pF | 100pF | 220pF | 680pF | 1.5nF | 1.5nF | 3.3nF | 6.8nF | 10nF |
| 200V 250V | 6.8pF | 33pF | 56pF | 150pF | 470pF | 1.0nF | 1.0nF | 2.2nF | 4.7nF | 6.8nF |
| 300V | - | 27pF | 47pF | 120pF | 390pF | 820pF | 820pF | 1.8nF | 3.9nF | 5.6nF |
| 500V | - | - | - | 68pF | 270pF | 680pF | 680pF | 1.5nF | 3.3nF | 4.7nF |
| 630V | - | - | - | - | 150pF | 390pF | 390pF | 1.0nF | 2.2nF | 3.3nF |
| 1000V | - | - | - | - | 82pF | 220pF | 220pF | 680pF | 1.5nF | 2.2nF |
| 2000V | - | - | - | - | 18pF | 68pF | 68pF | 150pF | 470pF | 560pF |
| 3000V | - | - | - | - | - | - | - | 68pF | 150pF | 220pF |

For values < than 0.3pF please consult the Sales Office for availability.
*0402 - please consult the sales office for availability.

X7R - minimum/maximum capacitance values

| Chip Size | 0402* | 0603 | 0805 | 1206 | 1210 | 1808 | 1812 | 2220 | 2225 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Min Cap | 47pF | 100pF | 330pF | 680pF | 1.5nF | 2.2nF | 3.3nF | 6.8nF | 10nF |
| Min Cap Tolerance | ±5% | | | | | | | | |
| 16V | 10nF | 100nF | 330nF | 1.0µF | 1.5µF | 1.5µF | 3.3µF | 5.6µF | 6.8µF |
| 25V | 6.8nF | 68nF | 220nF | 820nF | 1.2µF | 1.2µF | 2.2µF | 4.7µF | 5.6µF |
| 50V 63V | 4.7nF | 47nF | 150nF | 470nF | 1.0µF | 680nF | 1.5µF | 3.3µF | 3.3µF |
| 100V | 1.5nF | 10nF | 47nF | 150nF | 470nF | 330nF | 1.0µF | 1.5µF | 1.5µF |
| 200V 250V | 680pF | 5.6nF | 27nF | 100nF | 220nF | 180nF | 470nF | 1.0µF | 1.0µF |
| 500V | - | 1.5nF | 8.2nF | 33nF | 100nF | 100nF | 270nF | 560nF | 680nF |
| 630V | - | - | 4.7nF | 10nF | 27nF | 33nF | 150nF | 330nF | 390nF |
| 1000V | - | - | 3.3nF | 4.7nF | 15nF | 18nF | 56nF | 120nF | 150nF |
| 1200V | - | - | - | 3.3nF | 10nF | 10nF | 33nF | 82nF | 100nF |
| 1500V | - | - | - | 2.7nF | 6.8nF | 6.8nF | 22nF | 47nF | 68nF |
| 2000V | - | - | - | 2.2nF | 4.7nF | 4.7nF | 10nF | 27nF | 33nF |

*0402 - please consult the factory for availability.

Non-magnetic capacitors - COG/NP0, High Q, X7R

Ordering information - Non-magnetic capacitors

| 1210 | 3 | 100 | 0103 | J | X | T | --- |
|---|--|---|--|---|---|--|---|
| Chip size | Termination | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric codes | Packaging | Suffix code |
| 0402* 0603 0505 0805 1206 1111 1210 1808 1812 2220 2225 | 2 = Sintered silver base with copper barrier (100% matte tin plating). RoHS compliant. (Available on COG/NP0 & High Q only). 3 = FlexiCap™ base with copper barrier (100% matte tin plating). RoHS compliant. 4 = Sintered silver base with copper barrier (tin/lead plating). Non RoHS compliant. (Available on COG/NP0 & High Q only). 5 = FlexiCap™ base with copper barrier (tin/lead plating). Non RoHS compliant. | 016 = 16V 025 = 25V 050 = 50V 063 = 63V 100 = 100V 150 = 150V 200 = 200V 250 = 250V 500 = 500V 630 = 630V 1K0 = 1kV 1K2 = 1.2kV 1K5 = 1.5kV 2K0 = 2kV 3K0 = 3kV | <10pF Insert a P for the decimal point, eg. P300 = 0.3pF, 8P20 = 8.2pF. ≥10pF 1st digit is 0. 2nd and 3rd digits are significant figures of capacitance code. The 4th digit is number of 0's following eg. 0103 = 10000pF Values <1pF in 0.1pF steps, above this values are E24 series | <4.7pF H = ±0.05pF B = ±0.1pF C = ±0.25pF D = ±0.5pF ≥4.7pF & <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) Q = High Q X = X7R (2R1) | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays | Used for specific customer requirements |

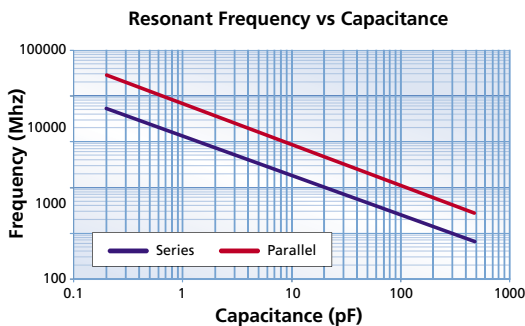
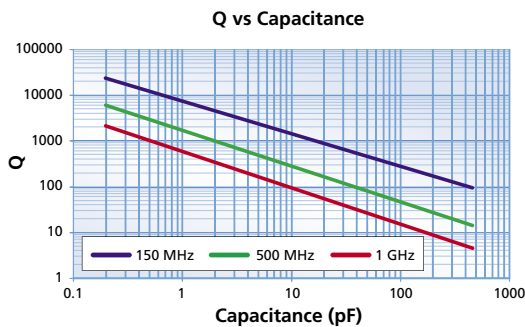
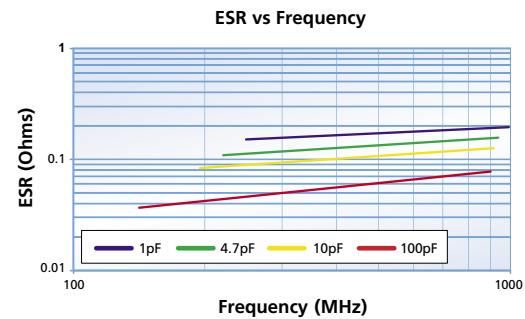
*0402 - please consult the sales office for availability.

Reeled Quantities

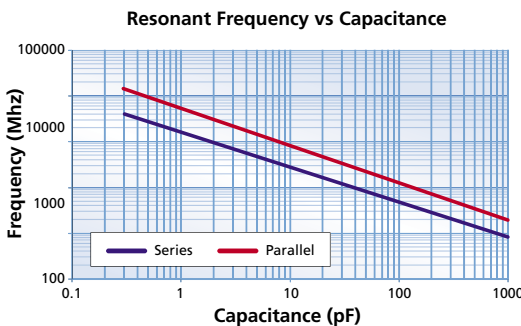
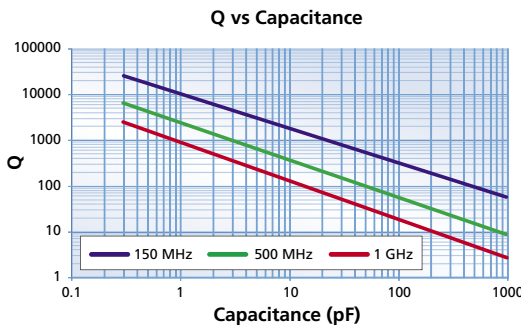
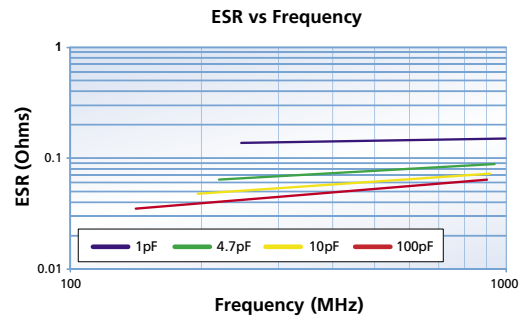
| Chip Size | 0402* | 0603 | 0505 | 0805 | 1206 | 1111 1210 | 1808 | 1812 | 2220 | 2225 |
|-----------|--|------|------|------|------|--------------|------|-----------|-----------|-----------|
| 7" Reel | 5000 | 4000 | 2500 | 3000 | 2500 | 1000/2000 | 2000 | 500/1000 | 500/1000 | 500/1000 |
| 13" Reel | 13" reel quantities available on request | | | | | | 8000 | 2000/4000 | 2000/4000 | 2000/4000 |

Note: Other capacitance values may become available, please contact our Sales Office if you need values other than those shown in the above tables. For dimensions and soldering information, please go to our website (www.syfer.com) or see our MLC catalogue.

Typical performance data - 0805 chip size



Typical performance data - 1111 chip size



Non-magnetic Ribbon Leaded capacitors - C0G/NP0, High Q, X7R

Capacitance values

1pF to 27nF (High Q)

Chip sizes

2225 and 4040

Operating temperature

-55°C to +125°C

High Q low ESR dielectrics

(other options available)

Insulation Resistance (IR)

100Gohm min @ 100 Vdc or 1000s (whichever is the less)

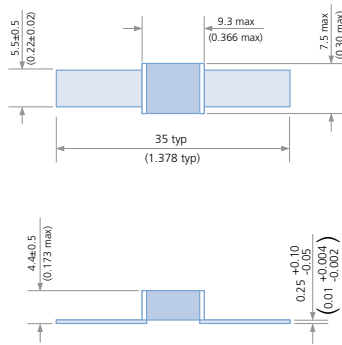
DWV up to 8400Vdc

Termination material

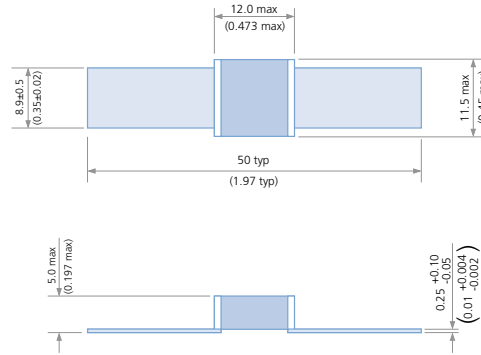
Silver plated copper ribbon attached with HMP solder (MP greater than 260°C)



2225



4040



Min/max capacitance values

| Chip Size | Case size 25 2225 | | Case size 40 4040 | |
|-----------|----------------------|---------------|----------------------|----------------|
| | Min. | Max. | Min. | Max. |
| 200V | 6.2nF | 10nF | 16nF | 27nF |
| 500V | 5.1nF | 5.6nF | 13nF | 15nF |
| 630V | 3.9nF | 4.7nF | 12nF | 12nF |
| 1kV | 1.2nF | 3.3nF | 5.6nF | 10nF |
| 2kV | 510pF | 1.0nF | 1.6nF | 5.1nF |
| 3kV | 1pF | 47pF* / 470pF | 910pF | 1.5nF |
| 4kV | - | - | 620pF | 820pF |
| 5kV | - | - | 390pF | 560pF |
| 6kV | - | - | 160pF | 330pF |
| 7.2kV | - | - | 1pF | 56pF** / 150pF |

*2225 - 47pF max. for dual rated @2.5kVac 30MHz **4040 - 56pF max. for dual rated @5kVac 30MHz.

Ordering information - Non-magnetic Ribbon Leaded capacitors

| 4040 | B | 7K0 | 0470 | G | Q | B | Lead options | Variant code |
|--------------|--------------|---|---|---|---|-----------------|-------------------|-------------------------|
| Chip size | Coating | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric | Packing | R | W001 |
| 2225 4040 | B = Uncoated | 200 = 200V 500 = 500V 1K0 = 1kV 2K0 = 2kV 3K0 = 3kV 5K0 = 5kV 7K0 = 7kV | <10pF Insert a P for the decimal point, eg 2P20 = 2.2pF. >10pF. 1st digit is 0. 2nd and 3rd digits are significant figures of capacitance code. The 4th digit is number of 0's following eg. 0470 = 47pF 0512 = 5100pF | <10pF B = ±0.10pF C = ±0.25pF D = ±0.50pF ≥10pF G = ±2% J = ±5% K = ±10% M = ±20% | C = C0G/NP0 (1B) Q = High Q X = X7R (2R1) | B = Bulk packed | R = Ribbon Leaded | W001 = Standard Variant |

Open Mode and Tandem 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 max capacitance (X7R only)

| | 0603 | 0805 | 1206 | 1210 | 1808 | 1812 | 2220 | 2225 |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|
| 16V | 39nF | 150nF | 470nF | 680nF | 680nF | 1.5µF | 3.3µF | 4.7µF |
| 25V | 33nF | 120nF | 330nF | 560nF | 560nF | 1.2µF | 2.2µF | 3.9µF |
| 50/63V | 22nF | 100nF | 220nF | 470nF | 470nF | 1.0µF | 1.5µF | 2.7µF |
| 100V | 6.8nF | 27nF | 100nF | 220nF | 220nF | 680nF | 1.0µF | 1.8µF |
| 200/250V | 2.7nF | 15nF | 68nF | 100nF | 100nF | 330nF | 680nF | 1.0µF |
| 500V | - | 5.6nF | 27nF | 68nF | 68nF | 180nF | 330nF | 330nF |
| 630V | - | - | 10nF | 27nF | 27nF | 82nF | 180nF | 180nF |
| 1kV | - | - | 4.7nF | 15nF | 15nF | 33nF | 82nF | 100nF |

■ = AEC-Q200

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's FlexiCap™ termination, Syfer Tandem capacitors provide an ultra robust and reliable component, for use in the most demanding applications.

Non-standard voltages are available. For more information please consult the sales office.

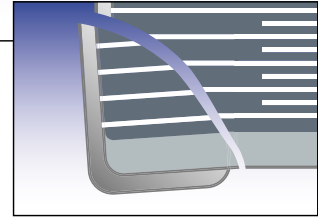
Tandem max capacitance (X7R only)

| | 0603 | 0805 | 1206 | 1210 | 1812 | 2220 | 2225 |
|----------|-------|-------|-------|-------|-------|-------|-------|
| 16V | 12nF | 47nF | 150nF | 270nF | 560nF | 1.2µF | 1.5µF |
| 25V | 10nF | 39nF | 120nF | 220nF | 470nF | 1.0µF | 1.2µF |
| 50/63V | 6.8nF | 33nF | 100nF | 180nF | 390nF | 680nF | 1.0µF |
| 100V | 2.2nF | 10nF | 47nF | 82nF | 220nF | 470nF | 680nF |
| 200/250V | 1.0nF | 4.7nF | 22nF | 47nF | 100nF | 220nF | 330nF |

■ = AEC-Q200



Open Mode capacitor -

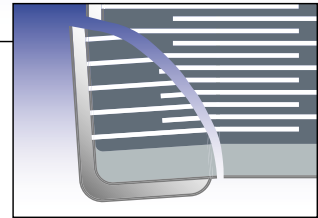


Qualification included cracking the components by severe bend tests. Following the bend tests cracked components were subjected to endurance / humidity tests, with no failures evident due to short circuits.

Note: Depending on the severity of the crack, capacitance loss was between 0% and 70%.



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%.

Ordering information - Open Mode and Tandem capacitors

| 1206 | Y | 050 | 0224 | K | X | T | --- |
|-----------|---|------------|--|---------------------------------|--|---------------------|---|
| Chip size | Termination | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric codes | Packaging | Suffix code |
| 0603 | Y = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant. | 016 = 16V | 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 | J = ±5% K = ±10% M = ±20% | X = X7R E = X7R (AEC-Q200 product) | T = 178mm (7") reel | M01 = Syfer Open Mode capacitor T01 = Syfer Tandem capacitor |
| 0805 | | 025 = 25V | | | | | |
| 1206 | | 050 = 50V | | | | | |
| 1210 | | 063 = 63V | | B = Bulk pack - tubs or trays | | | |
| 1808 | | 100 = 100V | | | | | |
| 1812 | | 200 = 200V | | | | | |
| 2220 | | 250 = 250V | | | | | |
| 2225 | 500 = 500V | | | | | | |
| | 630 = 630V | | | | | | |
| | 1K0 = 1kV | | | | | | |

IECQ-CECC range - Specialty High Rel. and approved parts

IECQ-CECC, AEC-Q200 and Space grade range

A range of specialist, high reliability, multilayer ceramic capacitors for use in critical or high reliability environments. All fully tested / approved and available with a range of suitable termination options, including tin/lead plating and Syfer FlexiCap™.

Ranges include :-

1. Range tested and approved in accordance with IECQ-CECC QC32100.
2. Range qualified to the requirements of AEC-Q200.
3. Range qualified to the requirements of Syfer detail specification S02A-0100 (based on ESCC 3009).



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 |
| 200/ 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 and AEC-Q200 range

| 1210 | Y | 100 | 0103 | J | D | T | --- |
|--|---|--|---|--|---|--|---|
| Chip size | Termination | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric Release codes | Packaging | Suffix code |
| 0603 0805 1206 1210 1808 1812 1825 2220 2225 3640 | <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). Not RoHS compliant.</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). Not RoHS compliant.</p> | <p>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</p> | <p>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</p> | <p><10pF B = ±0.1pF C = ±0.25pF D = ±0.5pF ≥ 10pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%</p> | <p>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 For B and R codes please refer to TCC/VCC range for full capacitance values E = X7R (2R1) AEC-Q200 A = COG/NP0 (1B/NP0) AEC-Q200 T = X8R with AEC-Q200 release</p> | <p>T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays</p> | Used for specific customer requirements |

AEC-Q200 range - Specialty High Rel. and approved parts

AEC-Q200 range - maximum capacitance values

| | | 0603 | 0805 | 1206 | 1210 | 1808 | 1812 | 1825 | 2220 | 2225 | 3640 |
|--------------|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 50/63V | COG/NPO | 470pF | 2.7nF | 10nF | 18nF | n/a | 39nF | 68nF | 68nF | 100nF | 220nF |
| | X7R | 33nF | 150nF | 330nF | 680nF | n/a | 1.5µF | 1.8µF | 3.3µF | 3.3µF | 4.7µF |
| | X8R | n/a | 33nF | 120nF | 220nF | 270nF | 470nF | n/a | 680nF | 1.0µF | n/a |
| 100V | COG/NPO | 330pF | 1.8nF | 6.8nF | 12nF | n/a | 27nF | 47nF | 47nF | 68nF | 180nF |
| | X7R | 10nF | 47nF | 150nF | 470nF | n/a | 1µF | 1.2µF | 1.5µF | 1.5µF | 3.3µF |
| | X8R | n/a | 15nF | 56nF | 120nF | 150nF | 220nF | n/a | 470nF | 560nF | n/a |
| 200/ 250V | COG/NPO | 100pF | 680pF | 2.2nF | 4.7nF | n/a | 12nF | 22nF | 22nF | 27nF | 82nF |
| | X7R | 5.6nF | 27nF | 100nF | 220nF | n/a | 470nF | 1.0µF | 1.0µF | 1.0µF | 1.5µF |
| | X8R | n/a | 10nF | 33nF | 68nF | 82nF | 120nF | n/a | 220nF | 330nF | n/a |
| 500V | COG/NPO | n/a | 330pF | 1.5nF | 3.9nF | n/a | 10nF | 15nF | 15nF | 22nF | 56nF |
| | X7R | n/a | 8.2nF | 33nF | 100nF | n/a | 270nF | 560nF | 560nF | 680nF | 1.0µF |
| | X8R | n/a | 3.9nF | 18nF | 39nF | 47nF | 100nF | n/a | 180nF | 270nF | n/a |
| 630V | COG/NPO | n/a | n/a | 1.0nF | 1.8nF | n/a | 5.6nF | 8.2nF | 10nF | 15nF | 39nF |
| | X7R | n/a | n/a | 10nF | 27nF | n/a | 150nF | 180nF | 330nF | 390nF | 680nF |
| | X8R | n/a | 1.8nF | 3.9nF | 10nF | 12nF | 33nF | n/a | 150nF | 180nF | n/a |
| 1kV | COG/NPO | n/a | n/a | 470pF | 1nF | n/a | 3.3nF | 4.7nF | 8.2nF | 10nF | 22nF |
| | X7R | n/a | n/a | 4.7nF | 15nF | n/a | 56nF | 120nF | 120nF | 150nF | 180nF |
| | X8R | n/a | 1nF | 2.2nF | 4.7nF | 5.6nF | 18nF | n/a | 39nF | 56nF | n/a |
| 1.2kV | COG/NPO | n/a | n/a | 220pF | 680pF | n/a | 3.3nF | 3.9nF | 4.7nF | 6.8nF | 18nF |
| | X7R | n/a | n/a | 3.3nF | 10nF | n/a | 33nF | 68nF | 82nF | 100nF | 150nF |
| | X8R | n/a | n/a | 1.8nF | 3.9nF | 4.7nF | 12nF | n/a | 33nF | 39nF | n/a |
| 1.5kV | COG/NPO | n/a | n/a | 150pF | 470pF | n/a | 2.2nF | 2.7nF | 3.3nF | 4.7nF | 12nF |
| | X7R | n/a | n/a | 2.7nF | 6.8nF | n/a | 22nF | 47nF | 47nF | 68nF | 100nF |
| | X8R | n/a | n/a | 1.2nF | 2.2nF | 2.7nF | 8.2nF | n/a | 22nF | 27nF | n/a |
| 2kV | COG/NPO | n/a | n/a | 100pF | 220pF | n/a | 1.5nF | 1.2nF | 1.8nF | 2.2nF | 5.6nF |
| | X7R | n/a | n/a | 2.2nF | 4.7nF | n/a | 10nF | 10nF | 27nF | 33nF | 47nF |
| | X8R | n/a | n/a | 470pF | 1.2nF | 1.8nF | 4.7nF | n/a | 12nF | 18nF | n/a |
| 2.5kV | X8R | n/a | n/a | n/a | n/a | 1.0nF | 2.7nF | n/a | 6.8nF | 10nF | n/a |
| 3kV | X8R | n/a | n/a | n/a | n/a | 680pF | 2.2nF | n/a | 4.7nF | 5.6nF | n/a |

3 Terminal EMI Components (E01) & (E07) - AEC-Q200 range - maximum capacitance values

| | | E01 | | | E07 | | |
|------|---------|-------|-------|-------|-------|-------|-------|
| | | 0805 | 1206 | 1806 | 0805 | 1206 | 1806 |
| 50V | COG/NPO | 820pF | 1.0nF | 2.2nF | 220pF | 1nF | 1.5nF |
| | X7R | 47nF | 100nF | 200nF | 47nF | 100nF | 200nF |
| 100V | COG/NPO | 560pF | 1.0nF | 2.2nF | 120pF | 560pF | 680pF |
| | X7R | 15nF | 15nF | 68nF | 15nF | 15nF | 68nF |

Note: For some lower capacitance parts, higher voltage rated parts may be supplied. Please refer to page 44.

X2Y Integrated Passive Components (E03) - AEC-Q200 range - capacitance values

| | | 0805 | 1206 | 1410 | 1812 |
|------|---------|---------------|---------------|---------------|---------------|
| 50V | COG/NPO | 390pF - 470pF | 1.2nF - 1.5nF | 4.7nF - 5.6nF | 8.2nF - 10nF |
| | X7R | 18nF - 33nF | 56nF - 150nF | 180nF - 330nF | 390nF - 560nF |
| 100V | 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: For some lower capacitance parts, higher voltage rated parts may be supplied. Please refer to page 46.

S02A Space grade range - Specialty High Rel. and approved parts

S02A Space grade range - minimum/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 |
| 500V | COG/NP0 | - | 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 range - 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 | <p>Y = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant.</p> <p>H = FlexiCap™ termination base with nickel barrier (Tin/lead plating with min. 10% lead). Not RoHS compliant.</p> <p>F = Silver Palladium. RoHS compliant.</p> <p>A = Silver base with nickel barrier (Tin/lead plating with min. 10% lead). Not RoHS compliant. Available in COG/NP0 only.</p> | <p>016 = 16V 025 = 25V 050 = 50V 063 = 63V 100 = 100V 200 = 200V 500 = 500V</p> | <p>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</p> | <p><10pF B = ±0.1pF C = ±0.25pF D = ±0.5pF</p> <p>≥ 10pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%</p> | <p>C = COG/NP0 (1B) X = X7R (2R1)</p> | <p>T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays Q = Waffle pack</p> | <p>Used for specific customer requirements S02A = S (Space Grade) High Rel</p> |

Notes:

- Termination **A**, **H** & **F** available for Space applications. If another termination type is required then contact the sales office.
- 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.
- S02A Space Grade Options**
S02A: with LAT1 (also incorporates LAT2 & LAT3).
S02A: with LAT2 (also incorporates LAT3).
S02A: with LAT3.
S02A: No LAT conducted.
S02A5: S02A design with 100% visual inspection and 100% electrical test verification.
No screening tests (including no burn in).
No LAT tests etc. These are typically ordered for Engineering Models.

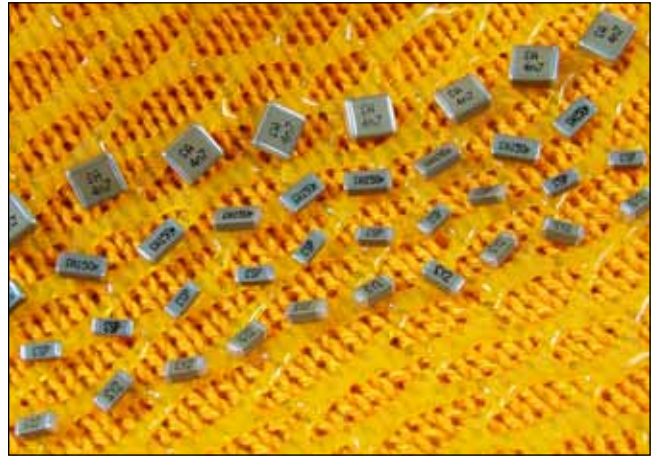
Safety Certified capacitors

Safety Certified capacitors

Syfer Technology's Safety Certified 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.

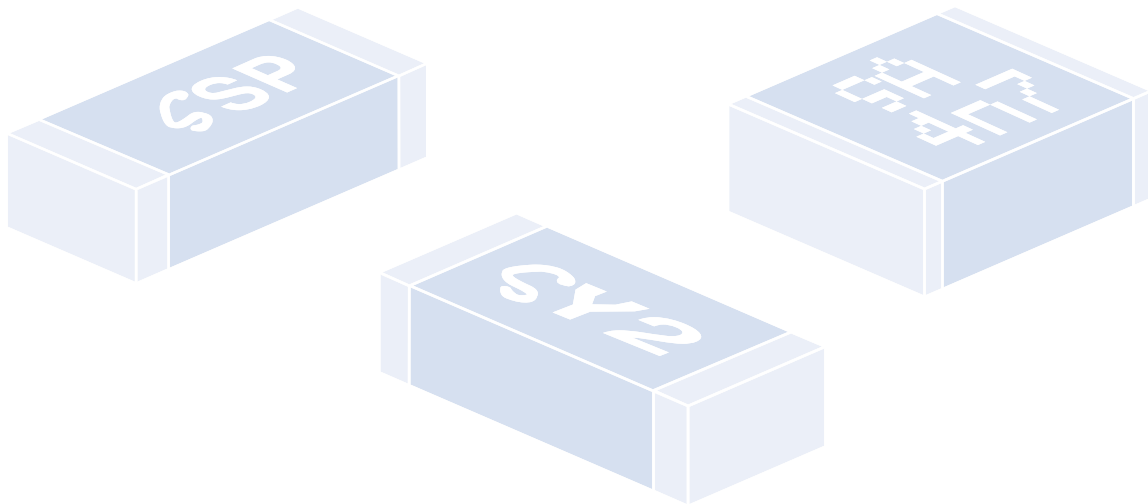
- Surface mount multilayer ceramic capacitors
- Meet Class Y2/X1, X1 and X2 requirements
- Approved for mains ac voltages, up to 250Vac
- Approved by UL and TÜV
- Sizes 1808, 1812, 2211, 2215 and 2220
- Smaller sizes suitable for use in equipment certified to EN60950
- Certification specifications for larger sizes include IEC/EN60384-14, UL/CSA60950 and UL60384-14
- Surface mount package



- Reduces board area and height restrictions
- Reduced assembly costs over conventional through hole components
- FlexiCap™ option available on all sizes
- Specific parts qualified to AEC-Q200

| Class | Rated voltage | Impulse voltage | Insulation bridging | May be used in primary circuit |
|-------|---------------|-----------------|-------------------------|--------------------------------|
| Y1 | 250Vac | 8000V | Double or reinforced | Line to protective earth |
| Y2 | 250Vac | 5000V | Basic or supplementary* | Line to protective earth |
| Y4 | 150Vac | 2500V | Basic or supplementary* | Line to protective earth |
| X1 | 250Vac | 4000V | - | Line to line |
| X2 | 250Vac | 2500V | - | Line to line |
| X3 | 250Vac | None | - | Line to line |

* 2 x Y2 or Y4 rated may bridge double or reinforced insulation when used in series.



Safety Certified capacitors - Certification Chart

Classification and approval specification - Safety Certified capacitors

| CHIP SIZE | DIELECTRIC | CAP RANGE | SYFER FAMILY CODE | CLASSIFICATION | APPROVAL SPECIFICATION | APPROVAL BODY | AEC-Q200 |
|-----------|------------|--|----------------------|---------------------------------------|---|---------------|---|
| 1808 | COG/NPO | 4.7pF to 1.5nF | SP ⁽¹⁾ | X2 | IEC60384-14 EN60384-14 | TÜV | TÜV & UL FULL RANGE |
| | | | | NWGQ2, NWGQ8 | UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | UL | |
| 1808 | X7R | 150pF to 4.7nF | SP ⁽¹⁾ | X2 | IEC60384-14 EN60384-14 | TÜV | TÜV & UL FULL RANGE 'Y' TERM ONLY |
| | | | | NWGQ2, NWGQ8 | UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | UL | |
| 1808 | COG/NPO | 4.7pF to 390pF | PY2 ⁽¹⁾ | X1 | IEC60384-14 EN60384-14 | TÜV | TÜV & UL FULL RANGE |
| | | | | NWGQ2, NWGQ8 | UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | UL | |
| 1808 | X7R | 150pF to 1nF std. term.* >1nF to 1.5nF P term. only | PY2 ^(1,3) | X1 | IEC60384-14 EN60384-14 | TÜV | TÜV & UL 1nF max. 'Y' TERM ONLY |
| | | | | NWGQ2, NWGQ8 | UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | UL | |
| 1812 | COG/NPO | 4.7pF to 390pF | PY2 ⁽¹⁾ | X1 | IEC60384-14 EN60384-14 | TÜV | TÜV & UL FULL RANGE |
| | | 4.7pF to 470pF | | | | | |
| 1812 | X7R | 150pF to 2.2nF std. term.* >2.2nF to 4.7nF P term. only | PY2 ^(1,4) | X1 | IEC60384-14 EN60384-14 | TÜV | TÜV & UL 2.2nF max. 'Y' TERM ONLY |
| | | | | | | | |
| 2211 | COG/NPO | 4.7pF to 1nF | SP ⁽²⁾ | Y2/X1 | IEC60384-14 EN60384-14 | TÜV | TÜV & UL FULL RANGE |
| | | | | NWGQ2, NWGQ8 | UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | UL | |
| 2211 | X7R | 100pF to 3.9nF | SP ⁽²⁾ | Y2/X1 | IEC60384-14 EN60384-14 | TÜV | TÜV & UL FULL RANGE 'Y' & 'H' TERM ONLY |
| | | | | NWGQ2, NWGQ8 | UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | UL | |
| 2215 | COG/NPO | 820pF to 1.0nF | SP ⁽²⁾ | Y2/X1 | IEC60384-14 EN60384-14 | TÜV | TÜV & UL FULL RANGE |
| | | | | NWGQ2, NWGQ8 | UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | UL | |
| 2215 | X7R | 2.7nF to 3.9nF | SP ⁽²⁾ | Y2/X1 | IEC60384-14 EN60384-14 | TÜV | TÜV & UL FULL RANGE 'Y' & 'H' TERM ONLY |
| | | | | NWGQ2, NWGQ8 | UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | UL | |
| 2220 | X7R | 150pF to 5.6nF | B16 | Y2/X1 ⁽²⁾ | IEC60384-14 EN60384-14 | TÜV | TÜV & UL FULL RANGE 'Y' & 'H' TERM ONLY |
| | | | | Y2/X1, ⁽¹⁾ FOWX2, FOWX8 | UL-60384-14:2010 CSA E60384-14:09 | UL | |
| 2220 | X7R | 150pF to 22nF std. term.* >22nF to 33nF P term. only | B17 ^(2,5) | X2 | IEC60384-14 EN60384-14 | TÜV | TÜV ONLY 22nF max. 'Y' & 'H' TERM ONLY |

Notes

Termination availability

- (1) J & Y terminations only.
- (2) J, Y, A & H terminations available.
- (3) For cap values >1000pF available in "P" ProtectiCap™ termination only.
- (4) For cap values >2200pF available in "P" ProtectiCap™ termination only.
- (5) B17 values above 22nF available in "P" ProtectiCap™ termination only.

PY2 Unmarked capacitors also available as released in accordance with approval specifications. Family code SY2 applies.

SP Unmarked capacitors also available as released in accordance with approval specifications. Family code SPU applies.

Capacitance values in red qualified to AEC-Q200.


*std. term. = Standard Termination.



Safety Certified capacitors - Ordering information


Ordering information - Safety Certified 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 code |
| 1808 2211 2215 | <p>J = Ni barrier</p> <p>Y = FlexiCap™ termination base with Ni barrier (100% matte tin plating). RoHS compliant.</p> <p>2211/2215 only</p> <p>A = Silver base with Ni barrier (Tin/lead plating with min. 10% lead). Not RoHS compliant.</p> <p>H = FlexiCap™ termination base with Ni barrier (Tin/lead plating with min. 10% lead). Not RoHS compliant.</p> | A25 = 250Vac | <p>First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following.</p> <p>Example: 0102 = 1.0nF</p> | <p><10pF</p> <p>B = ±0.10pF</p> <p>C = ±0.25pF</p> <p>D = ±0.50pF</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>C = COG/NP0</p> <p>X = X7R</p> <p>A = COG/NP0 (1B/NP0) AEC-Q200</p> <p>E = X7R (2B1) AEC-Q200</p> | <p>T = 178mm (7") reel</p> <p>R = 330mm (13") reel</p> <p>B = Bulk pack - tubs or trays</p> | <p>SP = Surge Protection capacitors (marked and approved)</p> <p>SPU = Surge Protection capacitors (un-marked parts are in accordance with, but not certified)</p> |




Ordering information - Safety Certified 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 code |
| 1808 1812 | <p>J = Ni barrier</p> <p>Y = FlexiCap™ termination base with Ni barrier (100% matte tin plating). RoHS compliant.</p> <p>P = ProtectiCap™ FlexiCap™ termination base with Ni barrier, (100% matte tin plating).</p> | A25 = 250Vac | <p>First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following.</p> <p>Example: 0102 = 1.0nF</p> | <p><10pF</p> <p>B = ±0.10pF</p> <p>C = ±0.25pF</p> <p>D = ±0.50pF</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>C = COG/NP0</p> <p>X = X7R</p> <p>A = COG/NP0 (1B/NP0) AEC-Q200</p> <p>E = X7R (2B1) AEC-Q200</p> | <p>T = 178mm (7") reel</p> <p>R = 330mm (13") reel</p> <p>B = Bulk pack - tubs or trays</p> | <p>PY2 = Safety tested Surge Protection capacitors (marked and approved)</p> <p>SY2 = Surge Protection capacitors (un-marked parts are in accordance with, but not certified)</p> |



Ordering information - Safety Certified 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 code |
| 2220 | <p>J = Ni barrier</p> <p>Y = FlexiCap™ termination base with Ni barrier (100% matte tin plating). RoHS compliant.</p> <p>A = Silver base with Ni barrier (Tin/lead plating with min. 10% lead). Not RoHS compliant.</p> <p>H = FlexiCap™ termination base with Ni barrier (Tin/lead plating with min. 10% lead). Not RoHS compliant.</p> <p>P = ProtectiCap™ FlexiCap™ termination base with Ni barrier, (100% matte tin plating).</p> | A25 = 250Vac | <p>First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following.</p> <p>Example: 0102 = 1.0nF</p> | <p>J = ±5%</p> <p>K = ±10%</p> <p>M = ±20%</p> | <p>X = X7R</p> <p>E = X7R (2B1) AEC-Q200</p> | <p>T = 178mm (7") reel</p> <p>1000 pieces</p> <p>R = 330mm (13") reel</p> <p>4000 pieces</p> <p>B = Bulk pack - tubs or trays</p> | <p>B16 = Type A: X1/Y2</p> <p>B17 = Type B: X2</p> |



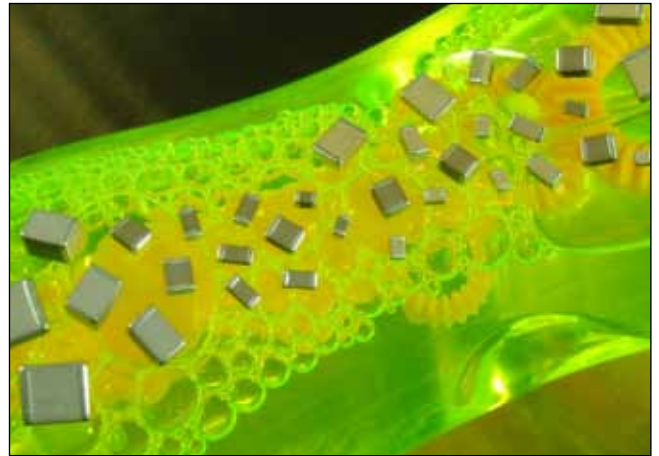
250Vac Non Safety Rated AC Capacitors - COG/NPO & X7R

Industry wide standard multilayer ceramic capacitors are supplied with a DC rating only. For AC use Surge and Safety capacitors with an AC rating of 250Vac have been available but the capacitance range is limited as a result of the strict impulse and VP requirements in the international standards.

Knowles offers a solution in both our original and PSL range for operation up to 250Vac 60Hz continuous use provided for non-safety critical applications where extended capacitance ranges are required.

Capacitance range

Case sizes 0805 to 2220 are available in both X7R and COG/NPO dielectrics with capacitances of up to 120nF. The capacitance ranges are divided into four groups which are based on the voltage coefficient of capacitance, COG/NPO which has negligible capacitance shift with applied voltage and three subgroups of X7R. Type A with typical current flow of 0.093mA per nF @ 240V 50Hz, Type B with typical current flow of 0.082mA per nF @ 240V 50Hz and Type C with typical current flow of 0.06mA per nF @ 240V 50Hz.



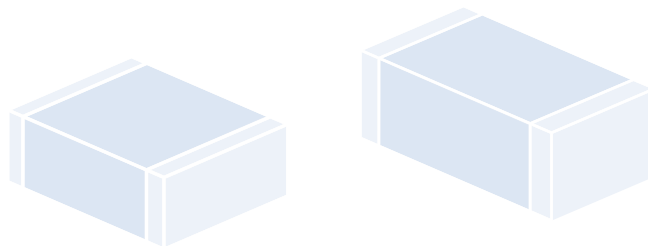
250Vac Non Safety Rated AC capacitors - minimum/maximum capacitance values

| Chip size | 0805 | 1206 | 1210 | 1808 | 1812 | 2220 |
|-------------|---------------|---------------|---------------|---------------|---------------|--------------|
| COG/NPO | 1.0pF - 470pF | 1.0pF - 1.2nF | 4.7pF - 2.2nF | 4.7pF - 2.2nF | 10pF - 5.6nF | 10pF - 10nF |
| X7R - A | 560pF - 1.5nF | 1.5nF - 10nF | 2.7nF - 22nF | 2.7nF - 22nF | 6.8nF - 56nF | 12nF - 120nF |
| X7R - B | 1.8nF - 3.3nF | 12nF | 27nF | 27nF | 68nF - 82nF | - |
| X7R - C | 3.9nF - 10nF | 15nF - 47nF | 33nF - 100nF | 33nF - 100nF | 100nF - 120nF | - |
| PSL X7R - A | - | 3.3nF - 10nF | 10nF - 22nF | - | 10nF - 68nF | 47nF - 120nF |
| PSL X7R - C | - | 12nF - 22nF | 27nF - 68nF | - | 82nF - 100nF | - |

Note: Please see website for further details.

Ordering information - 250Vac Non Safety Rated AC capacitors

| 1812 | Y | A25 | 0103 | K | X | T |
|--|---|----------------------|--|--|---------------------------------------|--|
| Chip size | Termination | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric codes | Packaging |
| 0805 1206 1210 1808 1812 2220 | 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. | A25 = 250Vac 60Hz | <10pF Insert a P for the decimal point, eg P300 = 0.3pF, 8P20 = 8.2pF. ≥10pF 1st digit is 0, 2nd and 3rd digits are significant figures of capacitance code. The 4th digit is number of 0's following eg. 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 X = X7R J = PSL X7R | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays |

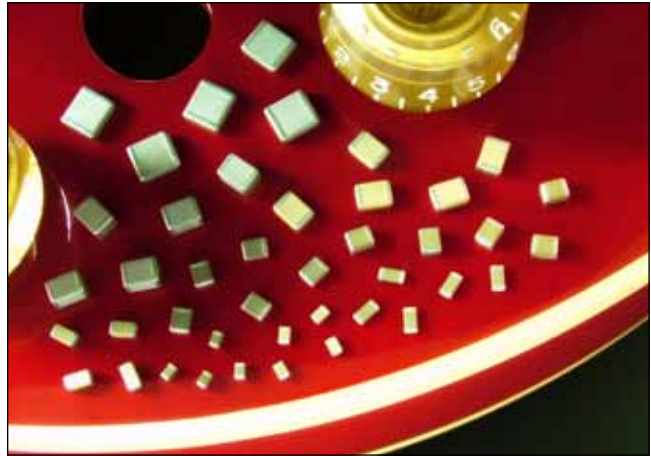


115Vac 400Hz capacitors - COG/NP0, X7R

115Vac 400Hz capacitors for aerospace applications

Syfer Technology has conducted reliability testing on standard surface mount ceramic capacitors in order to ensure their performance at 115Vac 400Hz and the associated voltage and frequency transients required by MIL-STD-704. Self heating will occur due to losses in the capacitor but has been measured at less than 25°C rise with neutral mounting conditions at room temperature.

Please note that the 115V 400Hz ranges are not RoHS 2011/65/EU compliant.



115Vac 400Hz capacitors - minimum/maximum capacitance values

| | 0805 | 1206 | 1210 | 1808 | 1812 | 2220 |
|------------|----------------------------|--------------|---------------|---------------|--------------|---------------|
| Dielectric | Maximum capacitance values | | | | | |
| COG/NP0 | 1pF - 330pF | 1pF - 1.5nF | 3.9pF - 3.9nF | 4.7pF - 3.9nF | 10pF - 10nF | 10pF - 15nF |
| X7R | 100pF - 4.7nF | 100pF - 18nF | 100pF - 39nF | 100pF - 39nF | 150pF - 82nF | 220pF - 100nF |

Ordering information - 115Vac 400Hz capacitors

| 1206 | Y | A12 | 0103 | J | X | T |
|--|---|---------------------|---|--|--|--|
| Chip size | Termination | Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric codes | Packaging |
| 0805 1206 1210 1808 1812 2220 | <p>Y = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant.</p> <p>H = FlexiCap™ termination base with nickel barrier (Tin/lead plating with min. 10% lead). Not 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). Not RoHS compliant.</p> | A12 = 115Vac | <p>First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following.</p> <p>Example: 0103 = 10nF</p> | <p><4.7pF H = ±0.05pF B = ±0.10pF C = ±0.25pF D = ±0.50pF</p> <p>≥4.7pF & <10pF B = ±0.10pF C = ±0.25pF D = ±0.50pF</p> <p>≥10pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20%</p> | <p>C = COG/NP0 X = X7R</p> | <p>T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays</p> |



DWV chip range - COG/NPO, X7R

High Dielectric Withstand Voltage capacitors (DWV range)

The 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 minimum 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, 1210, 1808, 1812, 2220 and 2225
- COG/NPO and X7R dielectrics
- Capacitance values from 4.7pF to 120nF
- For full range information please see Syfer web site, or contact the Sales Office.



DWV capacitors - minimum/maximum capacitance range

| | | 1206 | 1210 | 1808 | 1812 | 2220 | 2225 |
|-------|---------|---------------|---------------|---------------|--------------|---------------|---------------|
| 1.5kV | COG/NPO | 4.7pF - 330pF | 4.7pF - 1nF | 4.7pF - 1.2nF | 10pF - 2.2nF | 100pF - 4.7nF | 100pF - 5.6nF |
| | X7R | 4.7pF - 3.9nF | 4.7pF - 10nF | 4.7pF - 12nF | 10pF - 33nF | 100pF - 100nF | 100pF - 120nF |
| 2.5kV | COG/NPO | 4.7pF - 220pF | 4.7pF - 560nF | 4.7pF - 1nF | 10pF - 1.5nF | 100pF - 3.3nF | 100pF - 3.9nF |
| | X7R | 4.7pF - 1nF | 4.7pF - 2.2nF | 4.7pF - 2.7nF | 10pF - 5.6nF | 10pF - 15nF | 100pF - 18nF |

Ordering information - DWV capacitors

| 1812 | J | 1K5 | 0820 | K | C | T | DWV |
|--|---|--|---|---|--------------------------------------|---|------------------------------|
| Chip size | Termination | Dielectric Withstand Voltage | Capacitance in picofarads (pF) | Capacitance tolerance | Dielectric codes | Packaging | Suffix code |
| 1206 1210 1808 1812 2220 2225 | 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. | 1K5 = 1.5kV 2K5 = 2.5kV | 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 | <10pF B = ±0.10pF C = ±0.25pF D = ±0.50pF ≥10pF F = ±1% G = ±2% ≥10pF J = ±5% K = ±10% M = ±20% | C = COG/NPO X = X7R | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays | Dielectric Withstand Voltage |



High Temperature capacitors - X8R

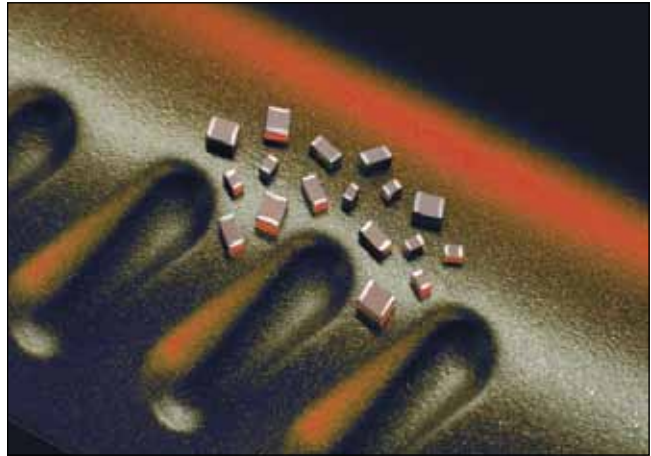
The X8R dielectric will operate from -55°C to +150°C, with a maximum capacitance change ±15% (without applied voltage).

The devices are available in sizes 0805 to 2225, with voltage ranges from 25V to 3kV and capacitance values from 270pF 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.

For information, X8R dielectric contains lead within the ceramic and parts rated less than 250Vdc are not compliant with the EU 2011/65/ EU RoHS directive.



Capacitance Range

270pF 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, 50mA charging current maximum.

Ageing Rate

1% per decade (typical)

X8R High Temperature capacitors - minimum/maximum cap. values according to the rated d.c. voltage

| | 0805 | 1206 | 1210 | 1808 | 1812 | 2220 | 2225 |
|---|----------|-------|-------|-------|-------|-------|-------|
| Minimum capacitance value | 680pF | 270pF | 680pF | 390pF | 1nF | 2.7nF | 3.9nF |
| Maximum capacitance value according to the rated dc voltage | 25V | 56nF | 180nF | 330nF | 470nF | 680nF | 1.5µF |
| | 50V | 33nF | 120nF | 220nF | 270nF | 470nF | 680nF |
| | 100V | 15nF | 56nF | 120nF | 150nF | 220nF | 470nF |
| | 200/250V | 10nF | 33nF | 68nF | 82nF | 120nF | 220nF |
| | 500V | 3.9nF | 18nF | 39nF | 47nF | 100nF | 180nF |
| | 630V | 1.8nF | 3.9nF | 10nF | 12nF | 33nF | 150nF |
| | 1kV | 1nF | 2.2nF | 4.7nF | 5.6nF | 18nF | 39nF |
| | 1.2kV | - | 1.8nF | 3.9nF | 4.7nF | 12nF | 33nF |
| | 1.5kV | - | 1.2nF | 2.2nF | 2.7nF | 8.2nF | 22nF |
| | 2kV | - | 470pF | 1.2nF | 1.8nF | 4.7nF | 12nF |
| | 2.5kV | - | - | - | 1nF | 2.7nF | 6.8nF |
| 3kV | - | - | - | 680pF | 2.2nF | 4.7nF | |

■ = X8R ranges in yellow available as qualified AEC-Q200.

Ordering information - X8R 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 1808 1812 2220 2225 | Y = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant. | 025 = 25V 050 = 50V 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 | 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 = X8R AEC-Q200 | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays |

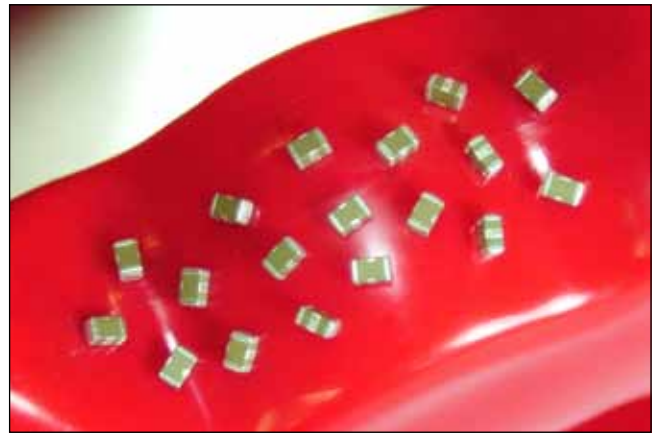
Surface mount EMI Filters - E01 & E07 feedthrough capacitors

The Syfer E01 and E07 ranges of feedthrough MLCC chip 'C' filters are 3 terminal chip devices designed to offer reduced inductance compared to conventional MLCCs when used in signal line filtering.

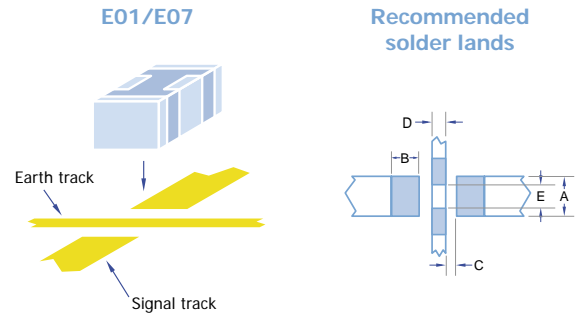
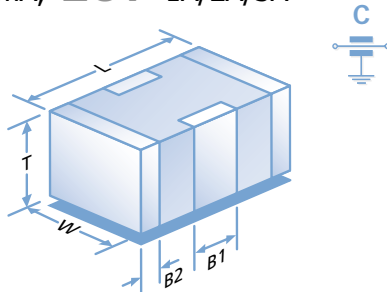
The filtered signal passes through the chip internal electrodes and the noise is filtered to the grounded side contacts, resulting in reduced length noise transmission paths.

Available in COG/NPO and X7R dielectrics, with current ratings of 300mA, 1A, 2A, 3A and voltage ratings of 25Vdc to 200Vdc. Also available with FlexiCap™ termination which is strongly recommended for new designs.

Commonly used in automotive applications, a range qualified to AECQ-200 is also available.



E01 300mA, E07 1A/2A/3A



Dimensions

| | 0805 | 1206 | 1806 | 1812 |
|----|-------------------------------|-------------------------------|-------------------------------|--------------------------------|
| L | 2.0 ± 0.3 (0.079 ± 0.012) | 3.2 ± 0.3 (0.126 ± 0.012) | 4.5 ± 0.35 (0.177 ± 0.014) | 4.5 ± 0.35 (0.177 ± 0.014) |
| W | 1.25 ± 0.2 (0.049 ± 0.008) | 1.6 ± 0.2 (0.063 ± 0.008) | 1.6 ± 0.2 (0.063 ± 0.008) | 3.2 ± 0.3 (0.126 ± 0.012) |
| T | 1.0 ± 0.15 (0.039 ± 0.006) | 1.1 ± 0.2 (0.043 ± 0.008) | 1.1 ± 0.2 (0.043 ± 0.008) | 2.0 ± 0.3 (0.079 ± 0.012) |
| B1 | 0.60 ± 0.2 (0.024 ± 0.008) | 0.95 ± 0.3 (0.037 ± 0.012) | 1.4 ± 0.3 (0.055 ± 0.012) | 1.45 ± 0.35 (0.055 ± 0.012) |
| B2 | 0.3 ± 0.15 (0.012 ± 0.006) | 0.5 ± 0.25 (0.02 ± 0.01) | 0.5 ± 0.25 (0.02 ± 0.01) | 0.75 ± 0.25 (0.02 ± 0.01) |

| | 0805 | 1206 | 1806 | 1812 |
|---|--------------|--------------|--------------|--------------|
| A | 0.95 (0.037) | 1.20 (0.047) | 1.2 (0.047) | 2.65 (0.104) |
| B | 0.90 (0.035) | 0.90 (0.035) | 1.40 (0.055) | 1.40 (0.055) |
| C | 0.30 (0.012) | 0.60 (0.024) | 0.80 (0.031) | 0.80 (0.031) |
| D | 0.40 (0.016) | 0.80 (0.031) | 1.40 (0.055) | 1.40 (0.055) |
| E | 0.75 (0.030) | 1.0 (0.039) | 1.0 (0.039) | 2.05 (0.080) |

Notes: 1) All dimensions mm (inches).

2) Pad widths less than chip width gives improved mechanical performance.

3) The solder stencil should place 4 discrete solder pads. The unprinted distance between ground pads is shown as dim E.

4) Insulating the earth track underneath the filters is acceptable and can help avoid displacement of filter during soldering but can result in residue entrapment under the chip.

Standard Range - E01 & E07 Feedthrough Capacitors

| Type | | E01 | | | E07 | | | |
|---------------|------------|--|-------------|-------------|-------------|-------------|-------------|-------------|
| Chip Size | | 0805 | 1206 | 1806 | 0805 | 1206 | 1806 | 1812 |
| Max Current | | 300mA | 300mA | 300mA | 1A | 2A | 2A | 3A |
| Rated Voltage | Dielectric | Minimum and maximum capacitance values | | | | | | |
| 25Vdc | COG/NPO | 180pF-1.5nF | 560pF-3.9nF | 820pF-4.7nF | 180pF-1.5nF | 560pF-3.9nF | 820pF-4.7nF | - |
| | X7R | 470pF-100nF | 5.6nF-330nF | 3.9nF-560nF | 820pF-100nF | 10nF-330nF | 22nF-560nF | 560nF-1.8µF |
| 50Vdc | COG/NPO | 22pF-820pF | 22pF-3.3nF | 22pF-3.9nF | 10pF-220pF | 22pF-1nF | 100pF-1.5nF | - |
| | X7R | 560pF-68nF | 4.7nF-220nF | 3.3nF-330nF | 1nF-68nF | 10nF-220nF | 22nF-330nF | 330nF-1.5µF |
| 100Vdc | COG/NPO | 22pF-560pF | 22pF-2.2nF | 22pF-3.3nF | 10pF-120pF | 22pF-560pF | 100pF-680pF | - |
| | X7R | 560pF-27nF | 1.8nF-100nF | 3.3nF-180nF | 1nF-27nF | 10nF-100nF | 22nF-180nF | 180nF-820nF |
| 200Vdc | COG/NPO | - | 560pF-1.2nF | 56pF-1nF | - | 15pF-180pF | 56pF-470pF | - |
| | X7R | - | 2.7nF-56nF | 3.9nF-100nF | - | 12nF-56nF | 22nF-100nF | 100nF-270nF |

Note: E07 25Vdc COG/NPO 1206 and 1806 ranges in green, have maximum current of 1A.

AEC-Q200 Qualified Range - E01 & E07 Feedthrough Capacitors - maximum capacitance values

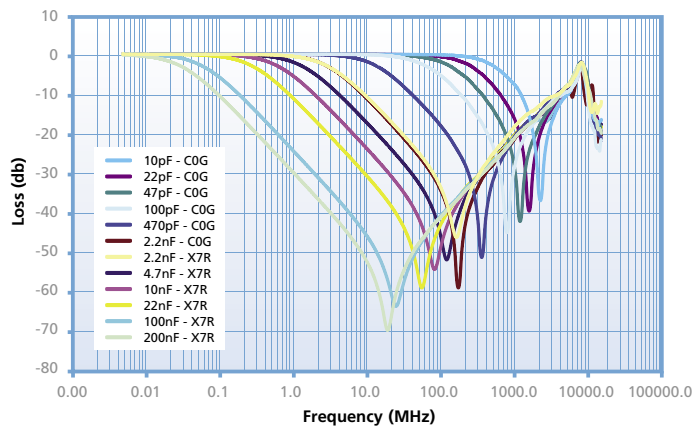
| Type | | E01 | | | E07 | | |
|-----------|---------|-------|-------|-------|-------|-------|-------|
| Chip Size | | 0805 | 1206 | 1806 | 0805 | 1206 | 1806 |
| 50V | COG/NPO | 820pF | 1nF | 2.2nF | 220pF | 1nF | 1.5nF |
| | X7R | 47nF | 100nF | 200nF | 47nF | 100nF | 200nF |
| 100V | COG/NPO | 560pF | 1nF | 2.2nF | 120pF | 560pF | 680pF |
| | X7R | 15nF | 15nF | 68nF | 15nF | 15nF | 68nF |

Note: For some lower capacitance parts, higher voltage rated parts may be supplied. Please refer to the table below.

Surface mount EMI Filters - E01 & E07 feedthrough capacitors

Open board insertion loss performance in 50Ω system

| Open Board Performance | | | | | | |
|------------------------|--------|------|-------|--------|------|------------------------------|
| Capacitance | 0.1MHz | 1MHz | 10MHz | 100MHz | 1GHz | Resonance Freq (MHz) approx. |
| 10pF | 0 | 0 | 0 | 0 | 7.5 | 2200 |
| 22pF | 0 | 0 | 0 | 0 | 16 | 1600 |
| 33pF | 0 | 0 | 0 | 1 | 22 | 1350 |
| 47pF | 0 | 0 | 0 | 2 | 28 | 1150 |
| 68pF | 0 | 0 | 0 | 3 | 41 | 900 |
| 100pF | 0 | 0 | 0 | 5 | 28 | 800 |
| 150pF | 0 | 0 | 0 | 8 | 24 | 700 |
| 220pF | 0 | 0 | 0 | 12 | 20 | 600 |
| 330pF | 0 | 0 | 1 | 15 | 20 | 500 |
| 470pF | 0 | 0 | 2 | 18 | 20 | 425 |
| 560pF | 0 | 0 | 3 | 20 | 20 | 350 |
| 680pF | 0 | 0 | 4 | 22 | 20 | 300 |
| 820pF | 0 | 0 | 5 | 24 | 20 | 260 |
| 1nF | 0 | 0 | 7 | 27 | 20 | 220 |
| 1.5nF | 0 | 0 | 9 | 31 | 20 | 200 |
| 2.2nF | 0 | 0 | 12 | 34 | 20 | 170 |
| 3.3nF | 0 | 1 | 14 | 39 | 20 | 135 |
| 4.7nF | 0 | 2 | 18 | 46 | 20 | 110 |
| 6.8nF | 0 | 3 | 21 | 50 | 20 | 90 |
| 10nF | 0 | 5 | 24 | 48 | 20 | 80 |
| 15nF | 0 | 8 | 27 | 45 | 20 | 65 |
| 22nF | 0 | 12 | 31 | 43 | 20 | 56 |
| 33nF | 1 | 14 | 34 | 40 | 20 | 40 |
| 47nF | 2 | 17 | 38 | 40 | 20 | 34 |
| 68nF | 4 | 20 | 41 | 40 | 20 | 30 |
| 100nF | 6 | 24 | 45 | 40 | 20 | 28 |
| 150nF | 8 | 26 | 48 | 40 | 20 | 24 |
| 220nF | 10 | 30 | 52 | 40 | 20 | 17 |
| 330nF | 13 | 33 | 55 | 40 | 20 | 15.5 |
| 470nF | 16 | 36 | 60 | 40 | 20 | 14 |
| 560nF | 18 | 39 | 65 | 40 | 20 | 12 |



Ordering Information - E01 & E07 feedthrough capacitors

| 1206 | Y | 100 | 0103 | M | X | T | E07 |
|----------------------|--|--|--|-----------|--|---|------------|
| Chip Size | Termination | Voltage | Capacitance in picofarads (pF) | Tolerance | Dielectric | Packaging | Type |
| 0805 1206 1806 | J = Nickel Barrier (Tin) *Y = FlexiCap™ (Tin - X7R only) A = (Tin/Lead) Not RoHS compliant. *H = FlexiCap™ (Tin/Lead) Not RoHS compliant. | 025 = 25V 050 = 50V 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 = 10000pF. | M = ±20% | A = COG/NPO AEC-Q200 C = COG/NPO E = X7R AEC-Q200 X = X7R | T = 178mm (7") reel R = 330mm (13") reel B = Bulk | E01 E07 |

Note: *FlexiCap™ termination only available in X7R material. Please contact our Sales Office for any special requirements.

Reeled quantities

| 178mm (7") reel | 0805 | 1206 | 1806 | 330mm (13") reel | 0805 | 1206 | 1806 |
|-----------------|------|------|------|------------------|-------|-------|-------|
| | 3000 | 2500 | 2500 | | 12000 | 10000 | 10000 |

Surface mount EMI Filters - E03 X2Y Integrated Passive Components

The Syfer X2Y Integrated Passive Component is a 3 terminal EMI chip device.

When used in balanced line applications, the revolutionary design provides simultaneous line-to-line and line-to-ground filtering, using a single ceramic chip. In this way, differential and common mode filtering are provided in one device.

For unbalanced applications, it provides ultra low ESL (equivalent series inductance). Capable of replacing 2 or more conventional devices, it is ideal for balanced and unbalanced lines, twisted pairs and dc motors, in automotive, audio, sensor and other applications.

Available in sizes from 0805 to 1812, these filters can prove invaluable in meeting stringent EMC demands.

Manufactured in the UK by Syfer Technology Limited under licence from X2Y Attenuators LLC.



Dielectric
X7R or COG/NPO

Electrical configuration
Multiple capacitance

Capacitance measurement
At 1000hr point

Typical capacitance matching
Better than 5%
(down to 1% available on request)

Temperature rating
-55°C to 125°C

Insulation resistance
100Gohms or 1000s (whichever is the less)

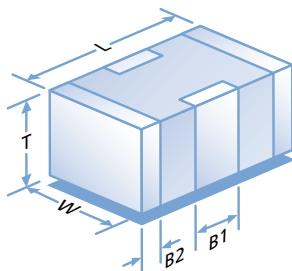
Dielectric withstand voltage
≤200V 2.5 times rated Volts for 5 secs
500V 1.5 times rated Volts for 5 secs
Charging current limited to 50mA Max.

| Type | | E03 | | | |
|---------------|------------|---------------|---------------|---------------|---------------|
| Chip size | | 0805 | 1206 | 1410 | 1812 |
| Rated voltage | Dielectric | | | | |
| 16Vdc | COG/NPO | - | - | - | - |
| | X7R | - | - | - | - |
| 25Vdc | COG/NPO | 560pF - 820pF | 1.8nF - 3.3nF | 6.8nF - 8.2nF | 12nF - 15nF |
| | X7R | 56nF - 68nF | - | 470nF | 820nF |
| 50Vdc | COG/NPO | 390pF - 470pF | 1.2nF - 1.5nF | 4.7nF - 5.6nF | 8.2nF - 10nF |
| | X7R | 18nF - 47nF | 56nF - 220nF | 180nF - 400nF | 390nF - 680nF |
| 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 |
| 200Vdc | COG/NPO | - | 22pF - 1.0nF | 100pF - 3.3nF | 820pF - 5.6nF |
| | X7R | - | 820pF - 33nF | 1.2nF - 120nF | 2.7nF - 180nF |
| 500Vdc | COG/NPO | - | - | - | 820pF - 3.9nF |
| | X7R | - | - | - | 2.7nF - 100nF |

Notes: 1) For some lower capacitance parts, higher voltage rated parts may be supplied.

AEC-Q200 range (E03) - capacitance values

| Chip size | | 0805 | 1206 | 1410 | 1812 |
|-----------|---------|---------------|---------------|---------------|---------------|
| 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 |



| | 0805 | 1206 | 1410 | 1812 |
|----|------------------------|------------------------|-------------------------|-------------------------|
| L | 2.0±0.3 (0.08±0.012) | 3.2±0.3 (0.126±0.012) | 3.6±0.3 (0.14±0.012) | 4.5±0.35 (0.18±0.014) |
| W | 1.25±0.2 (0.05±0.008) | 1.60±0.2 (0.063±0.008) | 2.5±0.3 (0.1±0.012) | 3.2±0.3 (0.126±0.012) |
| T | 1.0±0.15 (0.04±0.006) | 1.1±0.2 (0.043±0.008) | 2.0 max. (0.08 max.) | 2.1 max. (0.08 max.) |
| B1 | 0.5±0.25 (0.02±0.01) | 0.95±0.3 (0.037±0.012) | 1.20±0.3 (0.047±0.012) | 1.4±0.35 (0.06±0.014) |
| B2 | 0.3±0.15 (0.012±0.006) | 0.5±0.25 (0.02±0.01) | 0.5±0.25 (0.02±0.01) | 0.75±0.25 (0.03±0.01) |

Notes: 1) All dimensions mm (inches).

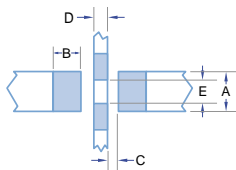
2) Pad widths less than chip width gives improved mechanical performance.

3) The solder stencil should place 4 discrete solder pads. The un-printed distance between ground pads is shown as dim E.

4) Insulating the earth track underneath the filters is acceptable and can help avoid displacement of filter during soldering but can result in residue entrapment under the chip.

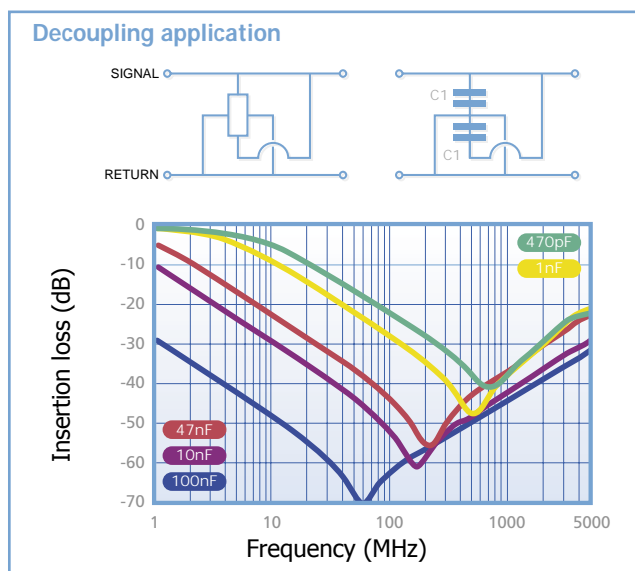
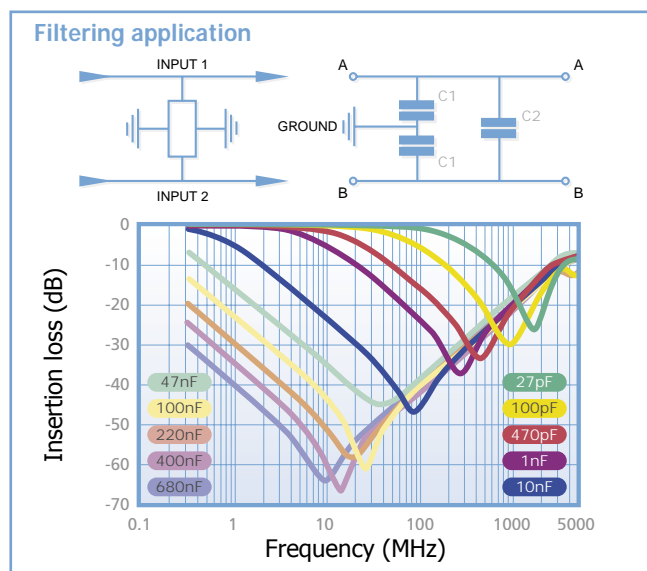
Surface mount EMI Filters - E03 X2Y Integrated Passive Components

Recommended solder lands



| | 0805 | 1206 | 1410 | 1812 |
|---|--------------|-------------|--------------|--------------|
| A | 0.95 (0.037) | 1.2 (0.047) | 2.05 (0.08) | 2.65 (0.104) |
| B | 0.9 (0.035) | 0.9 (0.035) | 1.0 (0.040) | 1.4 (0.055) |
| C | 0.3 (0.012) | 0.6 (0.024) | 0.7 (0.028) | 0.8 (0.031) |
| D | 0.4 (0.016) | 0.8 (0.031) | 0.9 (0.035) | 1.4 (0.055) |
| E | 0.75 (0.030) | 1.0 (0.039) | 1.85 (0.071) | 2.05 (0.080) |

| Component | Advantages | Disadvantages | Applications |
|---|--|---|---|
| Chip capacitor | Industry standard | Requires 1 per line High inductance Capacitance matching problems | By-pass Low frequency |
| 3 terminal feedthrough | Feedthrough Lower inductance | Current limited | Feedthrough Unbalanced lines High frequency |
| Syfer X2Y Integrated Passive Component | Very low inductance Replaces 2 (or 3) components Negates the effects of temperature, voltage and ageing Provides both common mode and differential mode attenuation Can be used on balanced & unbalanced lines | Care must be taken to optimise circuit design | By-pass Balanced lines High frequency dc electric motors Unbalanced lines Audio amplifiers CANBUS |



Ordering Information - X2Y IPC range

| 1812 | Y | 100 | 0334 | M | X | T | E03 |
|------------------------------|--|---|---|--|--|---|--|
| Chip Size | Termination | Voltage | Capacitance in picofarads (pF) C ₁ | Tolerance | Dielectric | Packaging | Type |
| 0805 1206 1410 1812 | J = Nickel Barrier (Tin) *Y = FlexiCap™ (Tin - X7R only) A = (Tin/Lead) Not RoHS compliant. *H = FlexiCap™ (Tin/Lead) Not RoHS compliant. | 016 = 16V 025 = 25V 050 = 50V 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: 0334=330nF. Note: C ₁ = 2C ₂ | M = ±20% (Tighter tolerances may be available on request). | A = COG/NP0 AEC-Q200 C = COG/NP0 E = X7R AEC-Q200 X = X7R | T = 178mm (7") reel R = 330mm (13") reel B = Bulk | Syfer X2Y Integrated Passive Component |

Note: *FlexiCap™ termination only available in X7R material. Please contact the sales office for any special requirements.

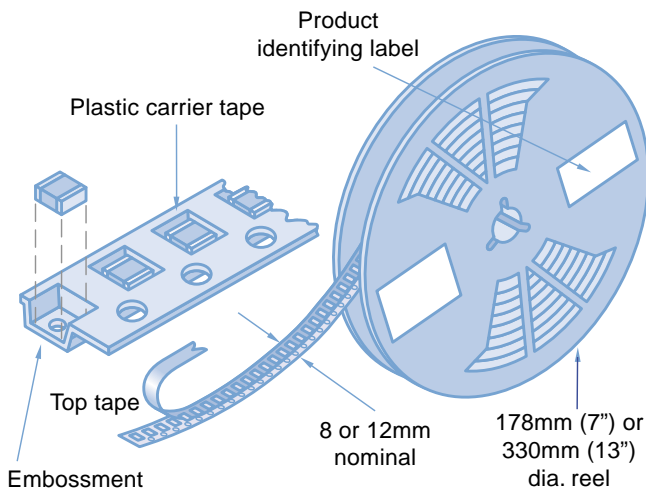
Reeled quantities

| 178mm (7") reel | 0805 | 1206 | 1410 | 1812 |
|-----------------|------|------|------|------|
| | 3000 | 2500 | 2000 | 1000 |

| 330mm (13") reel | 0805 | 1206 | 1410 | 1812 |
|------------------|-------|-------|------|------|
| | 12000 | 10000 | 8000 | 4000 |

Ceramic chip capacitors - Packaging information

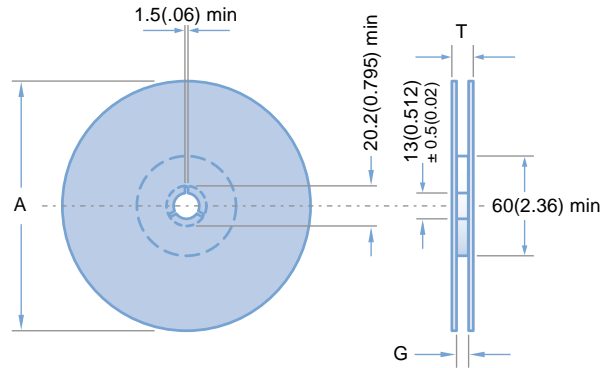
Tape and reel packing of surface mounting chip capacitors for automatic placement are in accordance with IEC60286-3.



Peel force

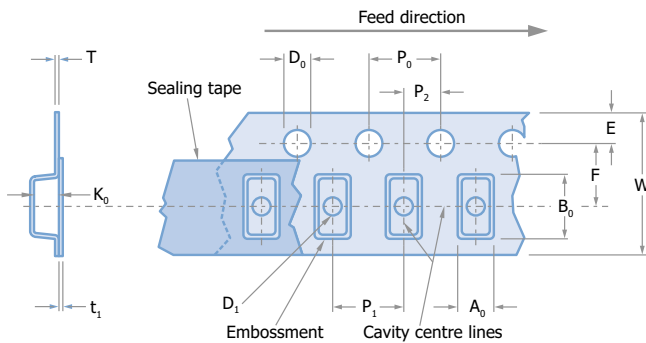
The peel force of the top sealing tape is between 0.2 and 1.0 Newton at 180°. The breaking force of the carrier and sealing tape in the direction of unreeling is greater than 10 Newtons.

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



| Symbol | Description | Dimensions mm (inches) | |
|----------------|--|---|---------------------------|
| | | 8mm tape | 12mm tape |
| A ₀ | Width of cavity | Dependent on chip size to minimize rotation | |
| B ₀ | Length of cavity | Dependent on chip size to minimize rotation | |
| K ₀ | 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) |
| T | Carrier tape thickness | 0.3 (0.012) ± 0.1 (0.004) | 0.4 (0.016) ± 0.1 (0.004) |
| t ₁ | Top tape thickness | 0.1 (0.004) max | |

Ceramic Chip Capacitors - Packaging Information

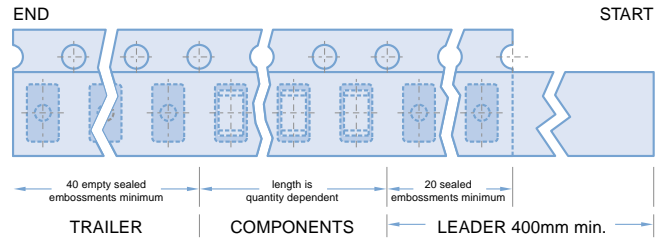
Missing components

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.

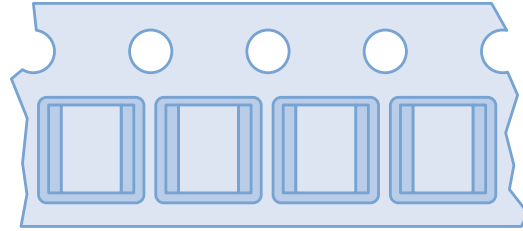
Leader and Trailer



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) IEC60286-3 states $A_o \leq B_o$ (see tape dimensions on page 48).
 2) Regarding the orientation of 1825 and 2225 components, the termination bands are right to left, NOT front to back. Please see diagram.

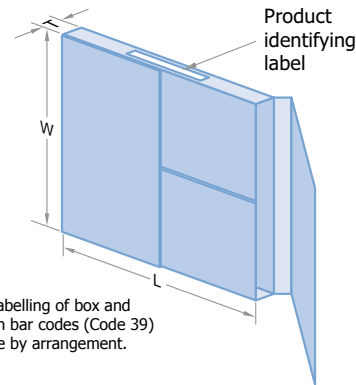


Orientation of 1825 & 2225 components

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) |



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 | 1.8mm | 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" | 0.07" | 0.06" | 0.08" | 0.08" | 0.08" | 0.1" | 0.1" | 0.1" | 0.1" | 0.1" | 0.1" |
| Reel quantities | 178mm (7") | 10000 | 2500 | 4000 | 3000 | 1000 | 2500 | 2000 | 2000 | 1500 | 500/1000 | 500 | 750 | 500 | 500/1000 |
| | 330mm (13") | - | - | 16000 | 12000 | - | 10000 | 8000 | 8000 | 6000 | 2000/4000 | 2000 | - | 4000 | 2000/4000 |

Notes:

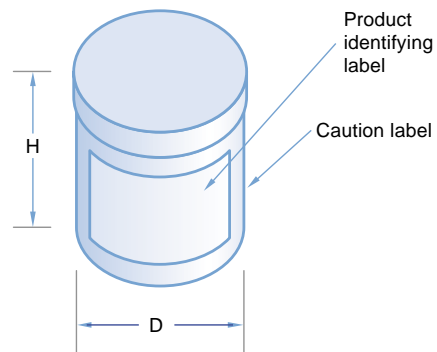
- 1) The above quantities per reel are for the maximum manufactured chip thickness. Thinner chips can be taped in larger quantities per reel.
 2) Where two different quantities are shown for the same case size, please contact the Sales Office to determine the exact quantity for any specific part number.

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 - COG/NP0, X7R

Syfer Technology produces a wide range of dipped radial leaded capacitors. These are available in rated voltages of 50V up to 6kV. Although our catalogue range extends to 6kV, we are able to offer a capability for specials up to 12kV. 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.

- High working voltage - up to 12kVdc
- Large case sizes
- RoHS compliant versions
- Tin-lead plated wire option to reduce tin whiskers (quote suffix A97 for 8111 to 8141 & A31 for 8151, 8161, 8171).



| | | 8111M | 8111N | 8121M | 8121N | 8121T | 8131M | 8131M T = 6.3mm | 8131T | 8141M | 8151M | 8151M T = 6.3mm | 8161M | 8161M T = 7.0mm | 8171M | 8171M T = 7.0mm |
|-----------------|---------|-------|-------|-------|-------|-------|-------|-----------------------|-------|-------|-------|-----------------------|-------|-----------------------|-------|-----------------------|
| Min. cap values | COG/NP0 | 4.7pF | 4.7pF | 4.7pF | 4.7pF | 4.7pF | 4.7pF | - | 10pF | 4.7pF | 10pF | - | 27pF | - | 47pF | - |
| | X7R | 100pF | 100pF | 100pF | 100pF | 330pF | 100pF | - | 150pF | 100pF | 470pF | - | 1.0nF | - | 1.8nF | - |
| 50/63V | COG/NP0 | 5.6nF | 5.6nF | 33nF | 33nF | 33nF | 220nF | - | 100nF | 220nF | 330nF | - | 680nF | - | 1.0µF | - |
| | X7R | 220nF | 220nF | 1.0µF | 1.0µF | 1.0µF | 3.3µF | - | 2.2µF | 4.7µF | 10µF | - | 15µF | - | 22µF | - |
| 100V | COG/NP0 | 2.2nF | 2.2nF | 18nF | 18nF | 18nF | 82nF | - | 47nF | 82nF | 270nF | - | 470nF | - | 680nF | - |
| | X7R | 100nF | 100nF | 680nF | 680nF | 680nF | 2.7µF | - | 1.5µF | 2.7µF | 5.6µF | - | 10µF | - | 15µF | - |
| 200/ 250V | COG/NP0 | 1.0nF | 1.0nF | 8.2nF | 8.2nF | 8.2nF | 47nF | 68nF | 22nF | 47nF | 120nF | 180nF | 270nF | 330nF | 390nF | 560nF |
| | X7R | 56nF | 56nF | 330nF | 330nF | 330nF | 1.5µF | - | 680nF | 1.5µF | 3.3µF | - | 5.6µF | - | 10µF | - |
| 500V | COG/NP0 | 680pF | 680pF | 6.8nF | 6.8nF | 6.8nF | 33nF | 47nF | 15nF | 33nF | 82nF | 120nF | 180nF | 270nF | 270nF | 470nF |
| | X7R | 15nF | 15nF | 150nF | 150nF | 150nF | 820nF | - | 330nF | 820nF | 1.0µF | - | 1.8µF | - | 3.3µF | - |
| 630V | COG/NP0 | 560pF | 560pF | 3.9nF | 3.9nF | 3.9nF | 22nF | 39nF | 10nF | 22nF | 68nF | 100nF | 120nF | 180nF | 220nF | 390nF |
| | X7R | 12nF | 12nF | 100nF | 100nF | 100nF | 390nF | - | 180nF | 470nF | 680nF | - | 1.2µF | - | 2.2µF | - |
| 1kV | COG/NP0 | 180pF | 180pF | 2.2nF | 2.2nF | 2.2nF | 18nF | 27nF | 6.8nF | 18nF | 47nF | 82nF | 82nF | 150nF | 150nF | 270nF |
| | X7R | 10nF | 10nF | 47nF | 47nF | 47nF | 150nF | - | 100nF | 150nF | 180nF | - | 390nF | - | 1.0µF | - |
| 1.2kV | COG/NP0 | 120pF | 120pF | 1.5nF | 1.5nF | 1.5nF | 12nF | 22nF | 4.7nF | 12nF | 33nF | 56nF | 68nF | 100nF | 100nF | 180nF |
| | X7R | - | - | 10nF | 10nF | 10nF | 100nF | - | 33nF | 100nF | 150nF | - | 220nF | - | 470nF | - |
| 1.5kV | COG/NP0 | 82pF | 82pF | 820pF | 820pF | 820pF | 6.8nF | 12nF | 2.7nF | 6.8nF | 22nF | 39nF | 39nF | 68nF | 68nF | 120nF |
| | X7R | - | - | 6.8nF | 6.8nF | 6.8nF | 68nF | - | 22nF | 68nF | 100nF | - | 150nF | - | 330nF | - |
| 2kV | COG/NP0 | 39pF | 39pF | 390pF | 390pF | 390pF | 4.7nF | 6.8nF | 1.5nF | 4.7nF | 10nF | 18nF | 22nF | 39nF | 39nF | 68nF |
| | X7R | - | - | 4.7nF | 4.7nF | 4.7nF | 33nF | - | 10nF | 47nF | 47nF | - | 82nF | - | 150nF | - |
| 2.5kV | COG/NP0 | - | - | 220pF | 220pF | 220pF | 2.2nF | 3.9nF | 820pF | 2.2nF | 6.8nF | 12nF | 12nF | 22nF | 22nF | 39nF |
| | X7R | - | - | - | - | - | 12nF | - | 3.3nF | 12nF | 33nF | - | 68nF | - | 100nF | - |
| 3kV | COG/NP0 | - | - | 150pF | 150pF | 150pF | 1.8nF | 2.7nF | 560pF | 1.8nF | 4.7nF | 8.2nF | 10nF | 18nF | 15nF | 27nF |
| | X7R | - | - | - | - | - | 8.2nF | - | 2.7nF | 10nF | 22nF | - | 47nF | - | 82nF | - |
| 4kV | COG/NP0 | - | - | - | - | - | 820pF | 1.5nF | 270pF | 820pF | 1.8nF | 3.3nF | 4.7nF | 6.8nF | 8.2nF | 15nF |
| | X7R | - | - | - | - | - | 5.6nF | - | 2.2nF | 5.6nF | 6.8nF | - | 15nF | - | 33nF | - |
| 5kV | COG/NP0 | - | - | - | - | - | 560pF | 1.0nF | 180pF | 560pF | 1.5nF | 2.2nF | 2.7nF | 4.7nF | 5.6nF | 10nF |
| | X7R | - | - | - | - | - | 4.7nF | - | 1.2nF | 4.7nF | 5.6nF | - | 10nF | - | 22nF | - |
| 6kV | COG/NP0 | - | - | - | - | - | 390pF | 680pF | 120pF | 390pF | 1.0nF | 1.5nF | 1.8nF | 3.3nF | 3.9nF | 6.8nF |
| | X7R | - | - | - | - | - | 2.7nF | - | 1.0nF | 2.7nF | 4.7nF | - | 8.2nF | - | 15nF | - |
| 8kV | COG/NP0 | - | - | - | - | - | - | - | - | - | 150pF | - | 330pF | - | 680pF | - |
| | X7R | - | - | - | - | - | - | - | - | - | 1.5nF | - | 4.7nF | - | 6.8nF | - |
| 10kV | COG/NP0 | - | - | - | - | - | - | - | - | - | 100pF | - | 180pF | - | 470pF | - |
| | X7R | - | - | - | - | - | - | - | - | - | 1.0nF | - | 2.2nF | - | 4.7nF | - |
| 12kV | COG/NP0 | - | - | - | - | - | - | - | - | - | 68pF | - | 120pF | - | 220pF | - |
| | X7R | - | - | - | - | - | - | - | - | - | 820pF | - | 1.2nF | - | 2.2nF | - |

Note: T = Maximum thickness.

Radial Leaded Capacitors - Packaging information

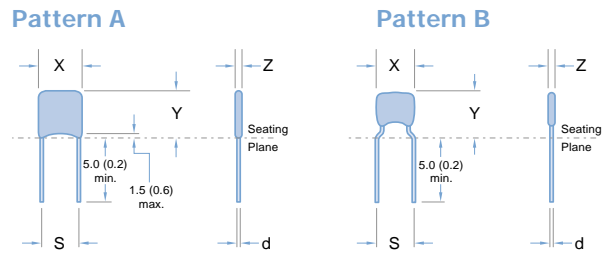
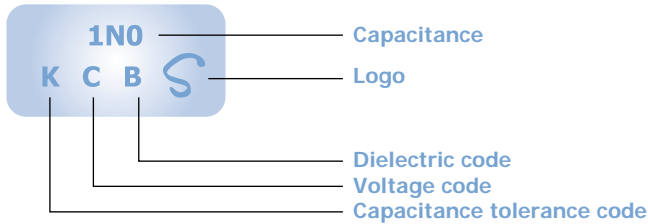
Dimensions - Radial Leaded capacitors

| | | Width | Height | Thickness | Lead Space | Lead Diameter |
|-------|---------|----------------------|----------------------|-----------------------|-------------------------|--------------------------|
| | Pattern | (X) max. mm (inches) | (Y) max. mm (inches) | (Z) max. mm (inches) | (S) mm (inches) | (d) mm (inches) |
| 8111M | 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 | 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 | 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 | 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 | 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) | 21.0 ±0.6 (0.83 ±0.024) | 0.6 ±0.05 (0.025 ±0.002) |

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



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

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 code | Suffix code |
| 8111M | 050 = 50V (C) | <10pF | <10pF | C = C0G/NP0 (1B/CG; CG/BP) | 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. |
| 8111N | 063 = 63V (D) | Insert a P for the decimal point as the second character. eg. 8P20 = 8.2pF | D: ± 0.5pF F: ± 1.0pF ≥10pF | X = X7R (2R1) | | |
| 8121M | 100 = 100V (E) | ≥10pF | J: ± 5% | To Special Order | | |
| 8121N | 200 = 200V (F) | First digit is 0. Second and third digits are significant figures of capacitance code. Fourth digit is number of zeros eg. 0101 = 100pF | K: ± 10% M: ± 20% ≥27pF G: ± 2% (C0G/NP0 only). | B = 2X1 (BX) R = 2C1 (BZ) | | |
| 8121T | 250 = 250V (Q) | | | | | |
| 8131M | 500 = 500V | | | | | |
| 8131T | 630 = 630V | | | | | |
| 8141M | 1K0 = 1kV | | | | | |
| 8151M | 1K2 = 1.2kV | | | | | |
| 8161M | 1K5 = 1.5kV | | | | | |
| 8165M | 2K0 = 2kV | | | | | |
| 8171M | 2K5 = 2.5kV | | | | | |
| | 3K0 = 3kV | | | | | |
| | 4K0 = 4kV | | | | | |
| | 5K0 = 5kV | | | | | |
| | 6K0 = 6kV | | | | | |
| | 8K0 = 8kV | | | | | |
| | 10K = 10kV | | | | | |
| | 12K = 12kV | | | | | |

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.

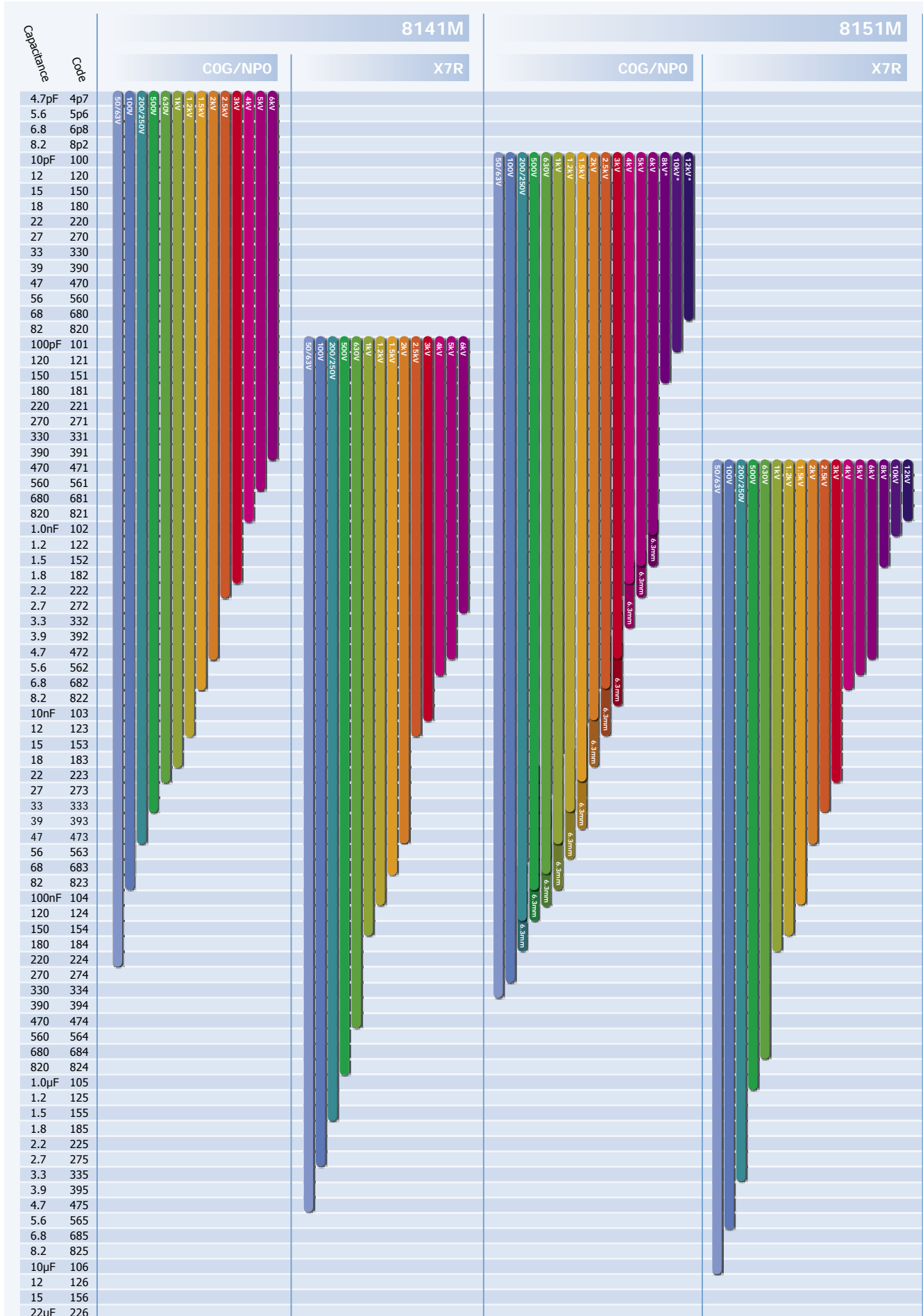
Radial Leaded Capacitors - C0G/NP0 & X7R ranges

| Capacitance | Code | 8111M / 8111N | | 8121M / 8121N | | 8121T | |
|-------------|------|---------------|-----|---------------|-----|---------|-----|
| | | C0G/NP0 | X7R | C0G/NP0 | X7R | C0G/NP0 | X7R |
| | | | | | | | |
| 4.7pF | 4p7 | | | | | | |
| 5.6 | 5p6 | | | | | | |
| 6.8 | 6p8 | | | | | | |
| 8.2 | 8p2 | | | | | | |
| 10pF | 100 | | | | | | |
| 12 | 120 | | | | | | |
| 15 | 150 | | | | | | |
| 18 | 180 | | | | | | |
| 22 | 220 | | | | | | |
| 27 | 270 | | | | | | |
| 33 | 330 | | | | | | |
| 39 | 390 | | | | | | |
| 47 | 470 | | | | | | |
| 56 | 560 | | | | | | |
| 68 | 680 | | | | | | |
| 82 | 820 | | | | | | |
| 100pF | 101 | | | | | | |
| 120 | 121 | | | | | | |
| 150 | 151 | | | | | | |
| 180 | 181 | | | | | | |
| 220 | 221 | | | | | | |
| 270 | 271 | | | | | | |
| 330 | 331 | | | | | | |
| 390 | 391 | | | | | | |
| 470 | 471 | | | | | | |
| 560 | 561 | | | | | | |
| 680 | 681 | | | | | | |
| 820 | 821 | | | | | | |
| 1.0nF | 102 | | | | | | |
| 1.2 | 122 | | | | | | |
| 1.5 | 152 | | | | | | |
| 1.8 | 182 | | | | | | |
| 2.2 | 222 | | | | | | |
| 2.7 | 272 | | | | | | |
| 3.3 | 332 | | | | | | |
| 3.9 | 392 | | | | | | |
| 4.7 | 472 | | | | | | |
| 5.6 | 562 | | | | | | |
| 6.8 | 682 | | | | | | |
| 8.2 | 822 | | | | | | |
| 10nF | 103 | | | | | | |
| 12 | 123 | | | | | | |
| 15 | 153 | | | | | | |
| 18 | 183 | | | | | | |
| 22 | 223 | | | | | | |
| 27 | 273 | | | | | | |
| 33 | 333 | | | | | | |
| 39 | 393 | | | | | | |
| 47 | 473 | | | | | | |
| 56 | 563 | | | | | | |
| 68 | 683 | | | | | | |
| 82 | 823 | | | | | | |
| 100nF | 104 | | | | | | |
| 120 | 124 | | | | | | |
| 150 | 154 | | | | | | |
| 180 | 184 | | | | | | |
| 220 | 224 | | | | | | |
| 270 | 274 | | | | | | |
| 330 | 334 | | | | | | |
| 390 | 394 | | | | | | |
| 470 | 474 | | | | | | |
| 560 | 564 | | | | | | |
| 680 | 684 | | | | | | |
| 820 | 824 | | | | | | |
| 1.0μF | 105 | | | | | | |
| 1.2 | 125 | | | | | | |
| 1.5 | 155 | | | | | | |
| 1.8 | 185 | | | | | | |
| 2.2 | 225 | | | | | | |
| 2.7 | 275 | | | | | | |
| 3.3 | 335 | | | | | | |
| 3.9 | 395 | | | | | | |
| 4.7 | 475 | | | | | | |
| 5.6 | 565 | | | | | | |
| 6.8 | 685 | | | | | | |
| 8.2 | 825 | | | | | | |
| 10μF | 106 | | | | | | |
| 12 | 126 | | | | | | |
| 15μF | 156 | | | | | | |

Radial Leaded Capacitors - C0G/NP0 & X7R ranges

| 8131M | | 8131T | | Capacitance | Code |
|----------|----------|----------|----------|-------------|------|
| C0G/NP0 | X7R | C0G/NP0 | X7R | | |
| 6kV | 6kV | 6kV | 6kV | 4.7pF | 4p7 |
| 5kV | 5kV | 5kV | 5kV | 5.6 | 5p6 |
| 4kV | 4kV | 4kV | 4kV | 6.8 | 6p8 |
| 3kV | 3kV | 3kV | 3kV | 8.2 | 8p2 |
| 2.5kV | 2.5kV | 2.5kV | 2.5kV | 10pF | 100 |
| 2kV | 2kV | 2kV | 2kV | 12 | 120 |
| 1.5kV | 1.5kV | 1.5kV | 1.5kV | 15 | 150 |
| 1kV | 1kV | 1kV | 1kV | 18 | 180 |
| 750V | 750V | 750V | 750V | 22 | 220 |
| 500V | 500V | 500V | 500V | 27 | 270 |
| 200/250V | 200/250V | 200/250V | 200/250V | 33 | 330 |
| 100V | 100V | 100V | 100V | 39 | 390 |
| 50/63V | 50/63V | 50/63V | 50/63V | 47 | 470 |
| | | | | 56 | 560 |
| | | | | 68 | 680 |
| | | | | 82 | 820 |
| | | | | 100pF | 101 |
| | | | | 120 | 121 |
| | | | | 150 | 151 |
| | | | | 180 | 181 |
| | | | | 220 | 221 |
| | | | | 270 | 271 |
| | | | | 330 | 331 |
| | | | | 390 | 391 |
| | | | | 470 | 471 |
| | | | | 560 | 561 |
| | | | | 680 | 681 |
| | | | | 820 | 821 |
| | | | | 1.0nF | 102 |
| | | | | 1.2 | 122 |
| | | | | 1.5 | 152 |
| | | | | 1.8 | 182 |
| | | | | 2.2 | 222 |
| | | | | 2.7 | 272 |
| | | | | 3.3 | 332 |
| | | | | 3.9 | 392 |
| | | | | 4.7 | 472 |
| | | | | 5.6 | 562 |
| | | | | 6.8 | 682 |
| | | | | 8.2 | 822 |
| | | | | 10nF | 103 |
| | | | | 12 | 123 |
| | | | | 15 | 153 |
| | | | | 18 | 183 |
| | | | | 22 | 223 |
| | | | | 27 | 273 |
| | | | | 33 | 333 |
| | | | | 39 | 393 |
| | | | | 47 | 473 |
| | | | | 56 | 563 |
| | | | | 68 | 683 |
| | | | | 82 | 823 |
| | | | | 100nF | 104 |
| | | | | 120 | 124 |
| | | | | 150 | 154 |
| | | | | 180 | 184 |
| | | | | 220 | 224 |
| | | | | 270 | 274 |
| | | | | 330 | 334 |
| | | | | 390 | 394 |
| | | | | 470 | 474 |
| | | | | 560 | 564 |
| | | | | 680 | 684 |
| | | | | 820 | 824 |
| | | | | 1.0μF | 105 |
| | | | | 1.2 | 125 |
| | | | | 1.5 | 155 |
| | | | | 1.8 | 185 |
| | | | | 2.2 | 225 |
| | | | | 2.7 | 275 |
| | | | | 3.3 | 335 |
| | | | | 3.9 | 395 |
| | | | | 4.7 | 475 |
| | | | | 5.6 | 565 |
| | | | | 6.8 | 685 |
| | | | | 8.2 | 825 |
| | | | | 10μF | 106 |
| | | | | 12 | 126 |
| | | | | 15μF | 156 |

Radial Leaded Capacitors - COG/NPO & X7R ranges



Radial Leaded Capacitors - COG/NP0 & X7R ranges

| 8161M | | 8171M | | Capacitance | Code |
|-----------|-----------|-----------|-----------|-------------|------|
| COG/NP0 | X7R | COG/NP0 | X7R | | |
| 12kV | 12kV | 12kV | 12kV | 4.7pF | 4p7 |
| 10kV | 10kV | 10kV | 10kV | 5.6 | 5p6 |
| 8kV | 8kV | 8kV | 8kV | 6.8 | 6p8 |
| 6kV | 6kV | 6kV | 6kV | 8.2 | 8p2 |
| 5kV | 5kV | 5kV | 5kV | 10pF | 100 |
| 4kV | 4kV | 4kV | 4kV | 12 | 120 |
| 3kV | 3kV | 3kV | 3kV | 15 | 150 |
| 2.5kV | 2.5kV | 2.5kV | 2.5kV | 18 | 180 |
| 2kV | 2kV | 2kV | 2kV | 22 | 220 |
| 1.5kV | 1.5kV | 1.5kV | 1.5kV | 27 | 270 |
| 1.2kV | 1.2kV | 1.2kV | 1.2kV | 33 | 330 |
| 1kV | 1kV | 1kV | 1kV | 39 | 390 |
| 750V | 750V | 750V | 750V | 47 | 470 |
| 500V | 500V | 500V | 500V | 56 | 560 |
| 250V/250V | 250V/250V | 250V/250V | 250V/250V | 68 | 680 |
| 100V | 100V | 100V | 100V | 82 | 820 |
| 50V/63V | 50V/63V | 50V/63V | 50V/63V | 100pF | 101 |
| 12kV | 12kV | 12kV | 12kV | 120 | 121 |
| 10kV | 10kV | 10kV | 10kV | 150 | 151 |
| 8kV | 8kV | 8kV | 8kV | 180 | 181 |
| 6kV | 6kV | 6kV | 6kV | 220 | 221 |
| 5kV | 5kV | 5kV | 5kV | 270 | 271 |
| 4kV | 4kV | 4kV | 4kV | 330 | 331 |
| 3kV | 3kV | 3kV | 3kV | 390 | 391 |
| 2.5kV | 2.5kV | 2.5kV | 2.5kV | 470 | 471 |
| 2kV | 2kV | 2kV | 2kV | 560 | 561 |
| 1.5kV | 1.5kV | 1.5kV | 1.5kV | 680 | 681 |
| 1.2kV | 1.2kV | 1.2kV | 1.2kV | 820 | 821 |
| 1kV | 1kV | 1kV | 1kV | 1.0nF | 102 |
| 750V | 750V | 750V | 750V | 1.2 | 122 |
| 500V | 500V | 500V | 500V | 1.5 | 152 |
| 250V/250V | 250V/250V | 250V/250V | 250V/250V | 1.8 | 182 |
| 100V | 100V | 100V | 100V | 2.2 | 222 |
| 50V/63V | 50V/63V | 50V/63V | 50V/63V | 2.7 | 272 |
| 12kV | 12kV | 12kV | 12kV | 3.3 | 332 |
| 10kV | 10kV | 10kV | 10kV | 3.9 | 392 |
| 8kV | 8kV | 8kV | 8kV | 4.7 | 472 |
| 6kV | 6kV | 6kV | 6kV | 5.6 | 562 |
| 5kV | 5kV | 5kV | 5kV | 6.8 | 682 |
| 4kV | 4kV | 4kV | 4kV | 8.2 | 822 |
| 3kV | 3kV | 3kV | 3kV | 10nF | 103 |
| 2.5kV | 2.5kV | 2.5kV | 2.5kV | 12 | 123 |
| 2kV | 2kV | 2kV | 2kV | 15 | 153 |
| 1.5kV | 1.5kV | 1.5kV | 1.5kV | 18 | 183 |
| 1.2kV | 1.2kV | 1.2kV | 1.2kV | 22 | 223 |
| 1kV | 1kV | 1kV | 1kV | 27 | 273 |
| 750V | 750V | 750V | 750V | 33 | 333 |
| 500V | 500V | 500V | 500V | 39 | 393 |
| 250V/250V | 250V/250V | 250V/250V | 250V/250V | 47 | 473 |
| 100V | 100V | 100V | 100V | 56 | 563 |
| 50V/63V | 50V/63V | 50V/63V | 50V/63V | 68 | 683 |
| 12kV | 12kV | 12kV | 12kV | 82 | 823 |
| 10kV | 10kV | 10kV | 10kV | 100nF | 104 |
| 8kV | 8kV | 8kV | 8kV | 120 | 124 |
| 6kV | 6kV | 6kV | 6kV | 150 | 154 |
| 5kV | 5kV | 5kV | 5kV | 180 | 184 |
| 4kV | 4kV | 4kV | 4kV | 220 | 224 |
| 3kV | 3kV | 3kV | 3kV | 270 | 274 |
| 2.5kV | 2.5kV | 2.5kV | 2.5kV | 330 | 334 |
| 2kV | 2kV | 2kV | 2kV | 390 | 394 |
| 1.5kV | 1.5kV | 1.5kV | 1.5kV | 470 | 474 |
| 1.2kV | 1.2kV | 1.2kV | 1.2kV | 560 | 564 |
| 1kV | 1kV | 1kV | 1kV | 680 | 684 |
| 750V | 750V | 750V | 750V | 820 | 824 |
| 500V | 500V | 500V | 500V | 1.0μF | 105 |
| 250V/250V | 250V/250V | 250V/250V | 250V/250V | 1.2 | 125 |
| 100V | 100V | 100V | 100V | 1.5 | 155 |
| 50V/63V | 50V/63V | 50V/63V | 50V/63V | 1.8 | 185 |
| 12kV | 12kV | 12kV | 12kV | 2.2 | 225 |
| 10kV | 10kV | 10kV | 10kV | 2.7 | 275 |
| 8kV | 8kV | 8kV | 8kV | 3.3 | 335 |
| 6kV | 6kV | 6kV | 6kV | 3.9 | 395 |
| 5kV | 5kV | 5kV | 5kV | 4.7 | 475 |
| 4kV | 4kV | 4kV | 4kV | 5.6 | 565 |
| 3kV | 3kV | 3kV | 3kV | 6.8 | 685 |
| 2.5kV | 2.5kV | 2.5kV | 2.5kV | 8.2 | 825 |
| 2kV | 2kV | 2kV | 2kV | 10μF | 106 |
| 1.5kV | 1.5kV | 1.5kV | 1.5kV | 12 | 126 |
| 1.2kV | 1.2kV | 1.2kV | 1.2kV | 15 | 156 |
| 1kV | 1kV | 1kV | 1kV | 22μF | 226 |

● Note: The highlighted parts may be defined as 'dual-use' under export control legislation and as such may be subject to export licence restrictions. Please refer to page 9 for further details.

Radial Leded Capacitors - Packaging information

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.

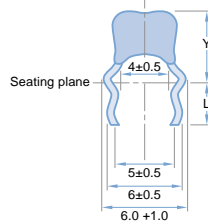
Dimensions as for standard product except as specified.

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)

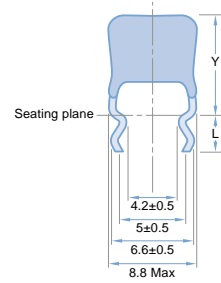


Suffix code - AD2

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)

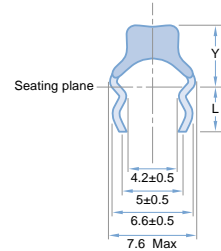


Suffix code - AD3

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)

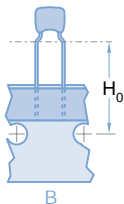
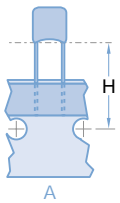


Bandoliered suffix codes

Dipped radial leded 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.

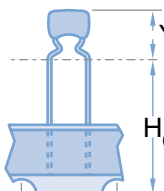
Dipped – straight and formed leads



| Product code | Lead style | Diagram | H | H ₀ | Suffix code | | |
|--------------|-------------------|---------|--------|----------------|-----------------|------------------------------|-----|
| | | | | | Reel 2500pcs | AMMO pack 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 |

Radial Leaded Capacitors - Packaging information

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.

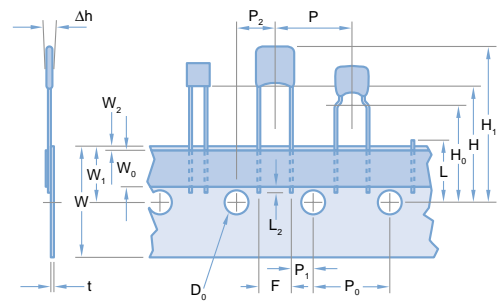
At the beginning and end of a reel the bandolier will exhibit at least 10 blank positions.

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.

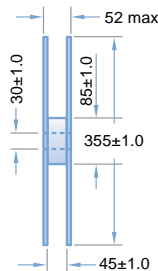
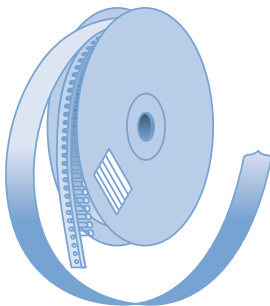


In accordance with IEC 60286 part 2.

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 protrusion from hold down | L ₂ | 2.0 (0.08) | 2.0 (0.08) | Max |

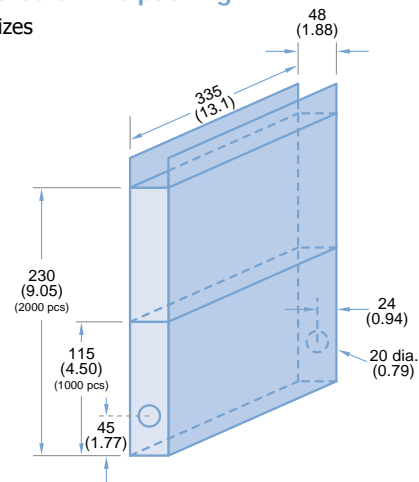
Bandoliered reels



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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Knowles Capacitors designs, manufactures and sells special electronic components. Our products are used in military, space, telecom infrastructure, medical and industrial applications where function and reliability are crucial.



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