

AEC-Q200

Automotive Grade

Capacitors



AEC-Q200 Automotive Grade Capacitors

At Knowles Capacitors we manufacture Single Layer, Multilayer, High Reliability and Precision Variable Capacitors; EMI Filters and Thin Film Devices.

One of our fields of expertise is the design and manufacture of components important to engineers in the automotive industry. Today's vehicles have many electronic control units that enable absolute precision and control.

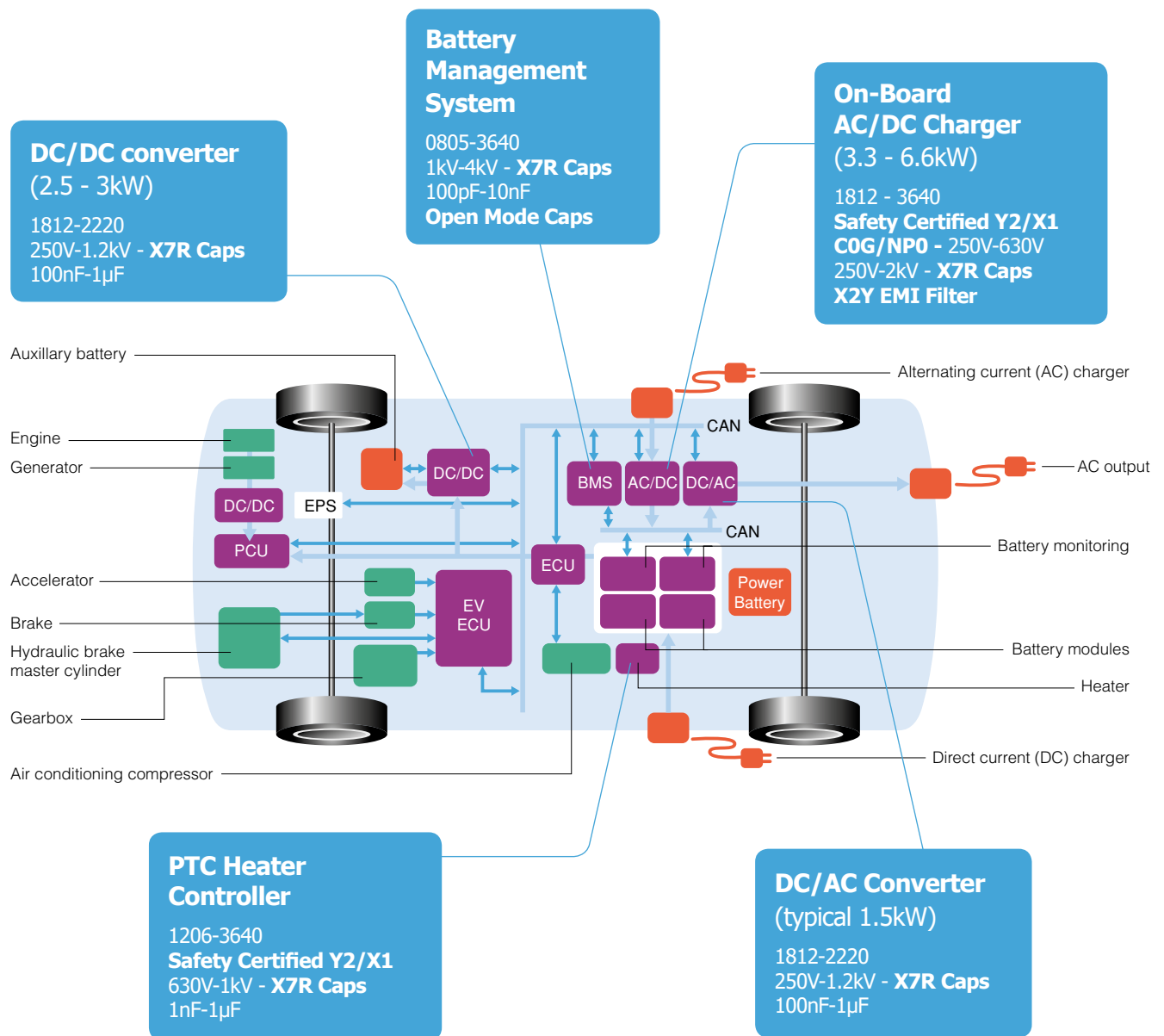
The Automotive Electronics Council (AEC) Component Technical Committee is the standardization body for establishing standards for reliable, high quality electronic components. Components meeting these specifications are suitable for use in the harsh automotive environment without additional component-level qualification testing.

The Component Technical Committee established AEC-Q200 "Stress Test Qualification for Passive Components" to define the

minimum stress test driven qualification requirements for passive electrical devices including ceramic capacitors.

Knowles has developed a range of MLC capacitors and surface mount EMI filters qualified to AEC-Q200 rev D to meet the needs of high reliability and automotive manufacturers.

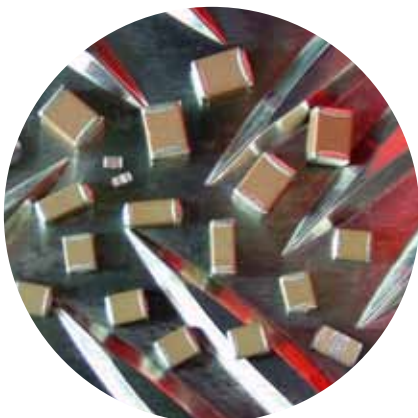
Please refer to the following pages for details of the product ranges offered by Knowles.



Electric Vehicle Charging - EV/HEV/PHEV

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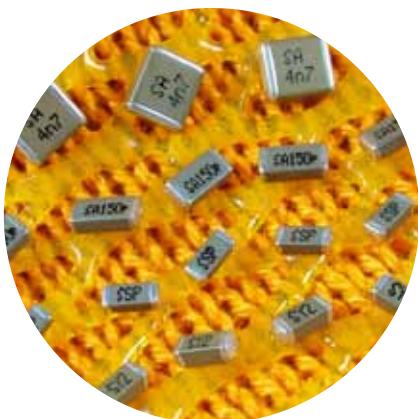
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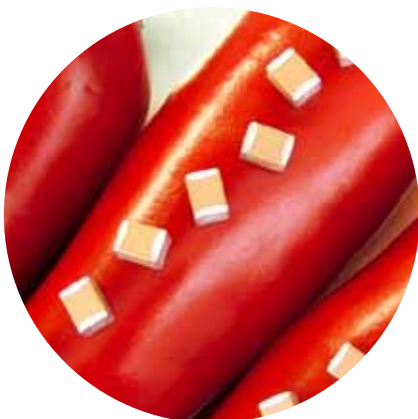
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Automotive Grade Capacitors - AEC-Q200 range

We offer a range of high quality automotive grade components. With AEC-Q200 approved ranges up to a voltage rating of 1kV we provide for the requirements of modern automotive applications including EV and HEV.

Ranges include :-

1. Standard MLCCs
2. StackiCap™ - large capacitance/small case size MLCCs
3. Open Mode and Tandem capacitors
4. 3 terminal EMI components
5. X2Y Integrated Passive Component
6. X8R high temperature MLCCs
7. Safety Certified MLCCs

All fully tested / approved and available with a range of suitable termination options, including tin/lead plating and Knowles FlexiCap™.



AEC-Q200 MLCC range - maximum capacitance values

| | | 0603 | 0805 | 1206 | 1210 | 1808 | 1812 | | 1825 | 2220 | | 2225 | 3640 | |
|--------------|---------|-------|-------|-------|-------|-------|-----------------------------------|-------|-------|-----------------------------------|-------|-------|-----------------------------------|-------|
| | | | | | | | StackiCap™ 3.2mm max thickness | | | StackiCap™ 4.5mm max thickness | | | StackiCap™ 4.5mm max thickness | |
| 50/ 63V | COG/NP0 | 470pF | 2.7nF | 10nF | 18nF | - | 39nF | - | 68nF | 68nF | - | 100nF | 220nF | - |
| | X7R | 33nF | 150nF | 470nF | 1µF | - | 1.5µF | - | 1.8µF | 3.3µF | - | 3.3µF | 4.7µF | - |
| | X8R | - | 33nF | 120nF | 220nF | 270nF | 470nF | - | - | 680nF | - | 1.0µF | - | - |
| 100V | COG/NP0 | 330pF | 1.8nF | 6.8nF | 12nF | - | 27nF | - | 47nF | 47nF | - | 68nF | 180nF | - |
| | X7R | 10nF | 47nF | 150nF | 470nF | - | 1µF | - | 1.2µF | 1.5µF | - | 1.5µF | 3.3µF | - |
| | X8R | - | 15nF | 56nF | 120nF | 150nF | 220nF | - | - | 470nF | - | 560nF | - | - |
| 200/ 250V | COG/NP0 | 100pF | 680pF | 2.2nF | 4.7nF | - | 12nF | - | 22nF | 22nF | - | 27nF | 82nF | - |
| | X7R | 5.6nF | 27nF | 100nF | 220nF | - | 470nF | 1.0µF | 1.0µF | 1.0µF | - | 1.0µF | 1.5µF | - |
| | X8R | - | 10nF | 33nF | 68nF | 82nF | 120nF | - | - | 220nF | - | 330nF | - | - |
| 500V | COG/NP0 | - | 330pF | 1.5nF | 3.9nF | - | 10nF | - | 15nF | 15nF | - | 22nF | 56nF | - |
| | X7R | - | 15nF | 68nF | 100nF | - | 270nF | 470nF | 560nF | 560nF | - | 680nF | 1.0µF | - |
| | X8R | - | 3.9nF | 18nF | 39nF | 47nF | 100nF | - | - | 180nF | - | 270nF | - | - |
| 630V | COG/NP0 | - | - | 1.0nF | 1.8nF | - | 5.6nF | - | 8.2nF | 10nF | - | 15nF | 39nF | - |
| | X7R | - | 10nF | 47nF | 68nF | - | 150nF | 330nF | 180nF | 330nF | 1.0µF | 390nF | 680nF | - |
| | X8R | - | 1.8nF | 3.9nF | 10nF | 12nF | 33nF | - | - | 150nF | - | 180nF | - | - |
| 1kV | COG/NP0 | - | - | 470pF | 1nF | - | 3.3nF | - | 4.7nF | 8.2nF | - | 10nF | 22nF | - |
| | X7R | - | 3.3nF | 10nF | 22nF | - | 68nF | 180nF | 120nF | 120nF | 470nF | 150nF | 180nF | 1.0µF |
| | X8R | - | 1nF | 2.2nF | 4.7nF | 5.6nF | 18nF | - | - | 39nF | - | 56nF | - | - |
| 1.2kV | COG/NP0 | - | - | 220pF | 680pF | - | 3.3nF | - | 3.9nF | 4.7nF | - | 6.8nF | 18nF | - |
| | X7R | - | - | 3.3nF | 10nF | - | 33nF | 100nF | 68nF | 82nF | - | 100nF | 150nF | - |
| | X8R | - | - | 1.8nF | 3.9nF | 4.7nF | 12nF | - | - | 33nF | - | 39nF | - | - |
| 1.5kV | COG/NP0 | - | - | 150pF | 470pF | - | 2.2nF | - | 2.7nF | 3.3nF | - | 4.7nF | 12nF | - |
| | X7R | - | - | 2.7nF | 6.8nF | - | 22nF | - | 47nF | 47nF | - | 68nF | 100nF | - |
| | X8R | - | - | 1.2nF | 2.2nF | 2.7nF | 8.2nF | - | - | 22nF | - | 27nF | - | - |
| 2kV | COG/NP0 | - | - | 100pF | 220pF | - | 1.5nF | - | 1.2nF | 1.8nF | - | 2.2nF | 5.6nF | - |
| | X7R | - | - | 2.2nF | 4.7nF | - | 10nF | - | 10nF | 27nF | - | 33nF | 47nF | - |
| | X8R | - | - | 470pF | 1.2nF | 1.8nF | 4.7nF | - | - | 12nF | - | 18nF | - | - |
| 2.5kV | X8R | - | - | - | - | 1.0nF | 2.7nF | - | - | 6.8nF | - | 10nF | - | - |
| 3kV | X8R | - | - | - | - | 680pF | 2.2nF | - | - | 4.7nF | - | 5.6nF | - | - |

Note: See page 6 for full details of the StackiCap™ range.

Safety Certified Capacitors

| Dielectric | Approval Body | X1 PY2 | | X2 SP | Y2/X1 SP | | Y2/X1 B16 | X2 B17 |
|------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|-------------------------------------|
| | | 1808 | 1812 | 1808 | 2211 | 2215 | 2220 | 2220 |
| COG/NP0 | TÜV, UL | 4.7pF - 390pF | 4.7pF - 390pF | 4.7pF - 1.5nF | 4.7pF - 1.5nF | 820pF - 1.0nF | - | - |
| X7R | TÜV, UL | 150pF - 1nF | 150pF - 2.2nF | 150pF - 4.7nF | 100pF - 3.9nF | 2.7nF - 3.9nF | 150pF - 5.6nF | 150pF - 22nF (TÜV approval only) |

Note: See pages 7, 8 and 9 for full details of 250Vac Safety Certified AC Capacitors and ordering information.

Automotive Grade Capacitors - AEC-Q200 range

AEC-Q200 range - Open Mode - max capacitance values

| | 0603 | 0805 | 1206 | 1210 | 1808 | 1812 | 2220 | 2225 |
|----------|-------|-------|-------|-------|-------|-------|-------|--------|
| | X7R | X7R | X7R | X7R | X7R | X7R | X7R | X7R |
| 16/25V | - | 56nF | 220nF | 470nF | - | - | - | - |
| 50/63V | 22nF | 100nF | 220nF | 470nF | 470nF | 1.0µF | 1.5µF | 2.7µF |
| 100V | 6.8nF | 27nF | 100nF | 220nF | 220nF | 680nF | 1.0µF | 1.5µF |
| 200/250V | 2.7nF | 15nF | 68nF | 100nF | 100nF | 330nF | 680nF | 1.0µF |
| 500V | - | 5.6nF | 39nF | 68nF | 68nF | 180nF | 330nF | 39 0nF |
| 630V | - | - | 22nF | 33nF | 27nF | 100nF | 180nF | 220nF |
| 1kV | - | - | 6.8nF | 15nF | 15nF | 47nF | 82nF | 100nF |

See page 10 for full details of the product range.

AEC-Q200 range - Tandem - max capacitance values

| | 0603 | 0805 | 1206 | 1210 | 1812 |
|----------|-------|-------|-------|-------|-------|
| | X7R | X7R | X7R | X7R | X7R |
| 50/63V | 6.8nF | 33nF | 100nF | 180nF | 390nF |
| 100V | 2.2nF | 10nF | 47nF | 82nF | 220nF |
| 200/250V | 1.0nF | 4.7nF | 22nF | 47nF | 100nF |

See page 10 for full details of the product range.

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

| | | E01 | | | E07 | | |
|------|---------|-------|-------|-------|-------|-------|-------|
| | | 0805 | 1206 | 1806 | 0805 | 1206 | 1806 |
| 50V | COG/NP0 | 820pF | 1.0nF | 2.2nF | 220pF | 1nF | 1.5nF |
| | X7R | 47nF | 100nF | 200nF | 47nF | 100nF | 200nF |
| 100V | COG/NP0 | 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. See page 12 and 13 for full details of the product range.

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

| | | 0805 | 1206 | 1410 | 1812 |
|------|---------|---------------|---------------|---------------|---------------|
| 50V | COG/NP0 | 390pF - 470pF | 1.2nF - 1.5nF | 4.7nF - 5.6nF | 8.2nF - 10nF |
| | X7R | 18nF - 33nF | 56nF - 150nF | 180nF - 330nF | 390nF - 560nF |
| 100V | COG/NP0 | 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. See page 14 and 15 for full details of the product range.

Ordering information - AEC-Q200 ranges

| 1210 | Y | 100 | 0103 | K | S | 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 | Y = FlexiCap™ termination base with Ni barrier (100% matte tin plating). RoHS compliant. H = FlexiCap™ termination base with Ni barrier (Tin/lead plating with min. 10% lead). Not RoHS compliant. J = Nickel barrier (100% matte tin plating). RoHS compliant. Lead free. A = Nickel barrier (Tin/lead plating with min. 10% lead). Not RoHS compliant. | 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 | 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 | F = ±1% G = ±2% J = ±5% K = ±10% M = ±20% | S = X7R (BME) AEC-Q200 E = X7R (2R1) AEC-Q200 A = COG/NP0 (1B/NP0) AEC-Q200 T = X8R with AEC-Q200 release <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> Note: AEC-Q200 X7R is only available in Y or H termination. </div> | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays | WS2 = StackiCap™ M01 = Open Mode T01 = Tandem E01/E07 & E03 = 3 terminal EMI component |

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. For example, a standard 150nF chip in a 8060 case size is now available in a much smaller 3640 case size.

Knowles's unique patented* 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.

* StackiCap™ technology is protected by international patents (pending) EP2847776, WO2013186172A1, US20150146343A1 and CN104471660A.



Maximum capacitance

Up to 5.6μF

Maximum voltage

Up to 2kV

Insulation resistance

Time Constant (RxCr) (whichever is the least - 500s or 500MΩ)

Maximum capacitance values - StackiCap™ Capacitors

| Chip Size | 1812 | 2220 | 3640 |
|-----------|-------|-------|-------|
| 200/250V | 1.0μF | 2.2μF | 5.6μF |
| 500V | 470nF | 1.0μF | 2.7μF |
| 630V | 330nF | 1.0μF | 2.2μF |
| 1kV | 180nF | 470nF | 1.0μF |
| 1.2kV | 100nF | 220nF | 470nF |
| 1.5kV | 56nF | 150nF | 330nF |
| 2kV | 33nF | 100nF | 150nF |

■ = AEC-Q200

Ordering information - StackiCap™ Capacitors

| 1812 | Y | 500 | 0474 | K | J | 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% | J = X7R (BME) E = X7R (2R1) AEC-Q200 S = X7R (BME) AEC-Q200 X = X7R | 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 | 500 | - |
| 330mm (13") Reel | 2,000 | 2,000 | 500 |

StackiCap™

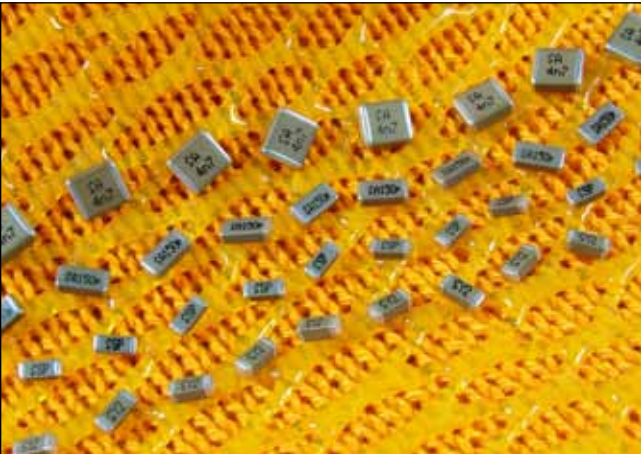
Note: Parts in this range may be defined as dual-use under export control legislation as such may be subject to export licence restrictions.

Please refer to page 12 for more information on the dual-use regulations and contact the Sales Office for further information on specific part numbers.

250Vac Safety Certified AC Capacitors

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.

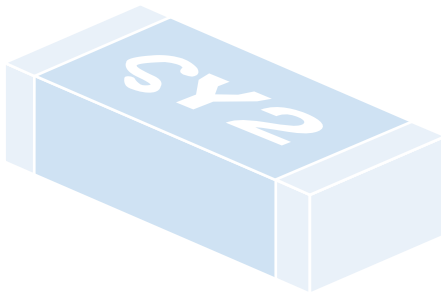
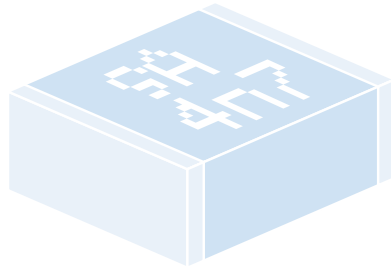
Knowles's high voltage capacitor expertise means the range offers among the highest range available of capacitance values in certain case sizes. Applications include: modems, AC-DC power supplies and where lightning strike or other voltage transients represent a threat to electronic equipment.



- 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

| 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.



250Vac Safety Certified AC Capacitors - Certification Chart

Classification and approval specification - Safety Certified capacitors

| CHIP SIZE | SUFFIX CODE | DIELECTRIC | CAP RANGE | CLASSIFICATION | APPROVAL SPECIFICATION | APPROVAL BODY | AEC-Q200 |
|-----------|--------------------|------------|----------------|------------------------------|--|---------------|---|
| 1808 | SP ⁽¹⁾ | COG/NP0 | 4.7pF to 1.5nF | <u>X2</u> NWGQ2, NWGQ8 | IEC60384-14 EN60384-14 UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | TÜV UL | TÜV & UL FULL RANGE |
| 1808 | SP ⁽¹⁾ | X7R | 150pF to 4.7nF | <u>X2</u> NWGQ2, NWGQ8 | IEC60384-14 EN60384-14 UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | TÜV UL | TÜV & UL FULL RANGE 'Y' TERM ONLY |
| 1808 | PY2 ⁽¹⁾ | COG/NP0 | 4.7pF to 390pF | <u>X1</u> NWGQ2, NWGQ8 | IEC60384-14 EN60384-14 UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | TÜV UL | TÜV & UL FULL RANGE |
| 1808 | PY2 ⁽¹⁾ | X7R | 150pF to 1nF | <u>X1</u> NWGQ2, NWGQ8 | IEC60384-14 EN60384-14 UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | TÜV UL | TÜV & UL 1nF max. 'Y' TERM ONLY |
| 1812 | PY2 ⁽¹⁾ | COG/NP0 | 4.7pF to 390pF | <u>X1</u> NWGQ2, NWGQ8 | IEC60384-14 EN60384-14 UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | TÜV UL | TÜV & UL FULL RANGE |
| 1812 | PY2 ⁽¹⁾ | X7R | 150pF to 2.2nF | <u>X1</u> NWGQ2, NWGQ8 | IEC60384-14 EN60384-14 UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | TÜV UL | TÜV & UL 2.2nF max. 'Y' TERM ONLY |
| 2211 | SP ⁽²⁾ | COG/NP0 | 4.7pF to 1nF | <u>Y2/X1</u> NWGQ2, NWGQ8 | IEC60384-14 EN60384-14 UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | TÜV UL | TÜV & UL FULL RANGE |
| 2211 | SP ⁽²⁾ | X7R | 100pF to 3.9nF | <u>Y2/X1</u> NWGQ2, NWGQ8 | IEC60384-14 EN60384-14 UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | TÜV UL | TÜV & UL FULL RANGE 'Y' & 'H' TERM ONLY |
| 2215 | SP ⁽²⁾ | COG/NP0 | 820pF to 1.0nF | <u>Y2/X1</u> NWGQ2, NWGQ8 | IEC60384-14 EN60384-14 UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | TÜV UL | TÜV & UL FULL RANGE |
| 2215 | SP ⁽²⁾ | X7R | 2.7nF to 3.9nF | <u>Y2/X1</u> NWGQ2, NWGQ8 | IEC60384-14 EN60384-14 UL-60950-1, 2nd Ed CSA 60950-1-07 2nd Ed | TÜV UL | TÜV & UL FULL RANGE 'Y' & 'H' TERM ONLY |
| 2220 | B16 | X7R | 150pF to 5.6nF | <u>Y2/X1</u> FOWX2, FOWX8 | IEC60384-14 EN60384-14 UL-60384-14:2010 CSA E60384-14:09 | TÜV UL | TÜV & UL FULL RANGE 'Y' & 'H' TERM ONLY |
| 2220 | B17 ⁽²⁾ | X7R | 150pF to 22nF | <u>X2</u> | 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.

PY2 Unmarked capacitors also available as released in accordance with approval specifications. Suffix Code SY2 applies.

SP Unmarked capacitors also available as released in accordance with approval specifications. Suffix Code SPU applies.



250Vac Safety Certified AC 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 | J = Nickel barrier (100% matte tin plating). RoHS compliant. Lead free. Y = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant. 2211/2215 only A = Nickel barrier (Tin/lead plating with min. 10% lead). Not RoHS compliant. H = FlexiCap™ termination base with nickel barrier (Tin/lead plating with minimum 10% lead). Not RoHS compliant. | A25 = 250Vac | First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following. Example: 0102 = 1.0nF | <10pF B = ±0.10pF C = ±0.25pF D = ±0.50pF ≥ 10pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20% | C = C0G/NP0 X = X7R A = C0G/NP0 (1B/NP0) AEC-Q200 E = X7R (2B1) AEC-Q200 | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays | SP = Surge Protection capacitors (marked and approved) SPU = Surge Protection capacitors (un-marked parts are in accordance with but not certified) |



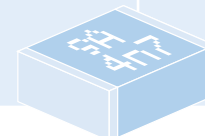
Ordering information - Safety Certified capacitors - Class PY2/SY2

| 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 | J = Nickel barrier (100% matte tin plating). RoHS compliant. Lead free. Y = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant. | A25 = 250Vac | First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following. Example: 0102 = 1.0nF | <10pF B = ±0.10pF C = ±0.25pF D = ±0.50pF ≥ 10pF F = ±1% G = ±2% J = ±5% K = ±10% M = ±20% | C = C0G/NP0 X = X7R A = C0G/NP0 (1B/NP0) AEC-Q200 E = X7R (2B1) AEC-Q200 | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays | PY2 = Safety tested Surge Protection capacitors (marked and approved) SY2 = Surge Protection capacitors (un-marked parts are in accordance with but not certified) |



Ordering information - Safety 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 | J = Nickel barrier (100% matte tin plating). RoHS compliant. Lead free. Y = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant. A = Nickel barrier (Tin/lead plating with min. 10% lead). Not RoHS compliant. H = FlexiCap™ termination base with nickel barrier (Tin/lead plating with minimum 10% lead). Not RoHS compliant. | A25 = 250Vac | First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following. Example: 0102 = 1.0nF | J = ±5% K = ±10% M = ±20% | X = X7R E = X7R (2B1) AEC-Q200 | T = 178mm (7") reel 1000 pieces R = 330mm (13") reel 4000 pieces B = Bulk pack - tubs or trays | B16 = Type A: X ¹ /Y ² B17 = Type B: X ² |

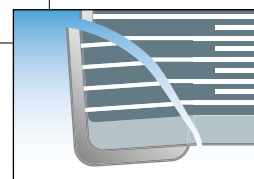
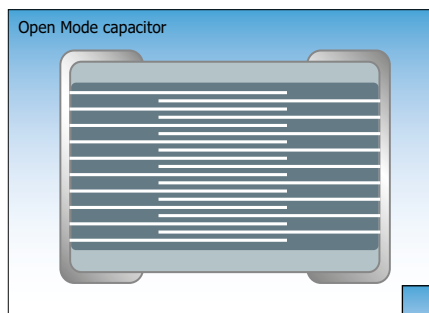


Open Mode and Tandem Capacitors - X7R

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 FlexiCap™ termination, 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.



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%.

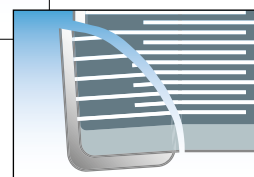
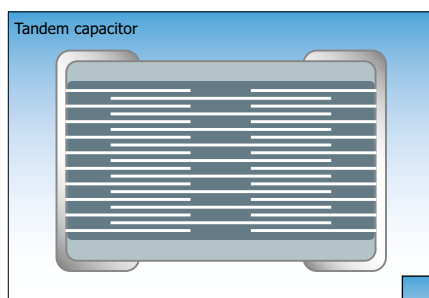
Open Mode max capacitance (X7R only) ■ = AEC-Q200 qualified

| | 0603 | 0805 | | 1206 | | 1210 | | 1808 | 1812 | 2220 | 2225 | |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 16V | 39nF | 56nF | 150nF | 100nF | 100nF | 470nF | 680nF | 680nF | 1.5μF | 3.3μF | 4.7μF | |
| 25V | 33nF | 56nF | 120nF | 220nF | 330nF | 470nF | 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 | 1.5μF | 1.8μF |
| 200/250V | 2.7nF | 15nF | | 68nF | | 100nF | | 100nF | 330nF | 680nF | 1.0μF | |
| 500V | - | 5.6nF | | 39nF | | 68nF | | 68nF | 180nF | 330nF | 390nF | |
| 630V | - | - | | 22nF | | 33nF | | 27nF | 100nF | 180nF | 220nF | |
| 1kV | - | - | | 6.8nF | | 15nF | | 15nF | 47nF | 82nF | 100nF | |

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 FlexiCap™ termination, 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.



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%.

Tandem max capacitance (X7R only) ■ = AEC-Q200 qualified

| | 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 |

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 0805 1206 1210 1808 1812 2220 2225 | Y = FlexiCap™ termination base with nickel barrier (100% matte tin plating). RoHS compliant. | 016 = 16V 025 = 25V 050 = 50V 063 = 63V 100 = 100V 200 = 200V 250 = 250V 500 = 500V 630 = 630V 1K0 = 1kV | First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following. Example: 0224 = 220000pF | J = ±5% K = ±10% M = ±20% | X = X7R S = X7R BME (AEC-Q200) E = X7R (AEC-Q200 product) | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays | M01 = Open Mode capacitor T01 = Tandem capacitor |

High Temperature Caps - up to 150°C X8R, Commercial, AEC-Q200

The X8R dielectric will operate from -55°C to +150°C, with a maximum capacitance change $\pm 15\%$ (without applied voltage). The devices are available in sizes 0805 to 2225, with voltage ranges from 25V to 3kV and capacitance values from 100pF to 1.8 μ F.

The capacitors have been developed by Knowles 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

100pF to 1.8 μ F (0805 to 2225)

Temperature Coefficient of Capacitance (TCC)

$\pm 15\%$ from -55°C to +150°C

Dissipation Factor (DF)

≤ 0.025

Termination

Nickel Barrier Tin Plated



Insulation Resistance (IR)

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

Dielectric Withstand Voltage (DWV)

2.5 x rated voltage for 5 \pm 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 | 4540* | 7565* |
|-----------------|-------|-------|-------|-------|-------|-------------|-------------|-------------|-------------|
| Min cap | 100pF | 100pF | 100pF | 100pF | 150pF | 220pF | 330pF | 1nF | 2.2nF |
| 25V | 56nF | 180nF | 330nF | 470nF | 680nF | 1.5 μ F | 1.8 μ F | 5.6 μ F | 15 μ F |
| 50V | 33nF | 120nF | 220nF | 270nF | 470nF | 680nF | 1 μ F | 4.7 μ F | 12 μ F |
| 100V | 15nF | 56nF | 120nF | 150nF | 220nF | 470nF | 560nF | 3.9 μ F | 10 μ F |
| 200/250V | 10nF | 33nF | 68nF | 82nF | 120nF | 220nF | 330nF | 2.7 μ F | 6.9 μ F |
| 500V | 3.9nF | 18nF | 39nF | 47nF | 100nF | 180nF | 270nF | 1.2 μ F | 3.2 μ F |
| 630V | 1.8nF | 3.9nF | 10nF | 12nF | 33nF | 150nF | 180nF | - | - |
| 1kV | 1nF | 2.2nF | 4.7nF | 5.6nF | 18nF | 39nF | 56nF | - | - |
| 1.2kV | - | 1.8nF | 3.9nF | 4.7nF | 12nF | 33nF | 39nF | - | - |
| 1.5kV | - | 1.2nF | 2.2nF | 2.7nF | 8.2nF | 22nF | 27nF | - | - |
| 2kV | - | 470pF | 1.2nF | 1.8nF | 4.7nF | 12nF | 18nF | - | - |
| 2.5kV | - | - | - | 1nF | 2.7nF | 6.8nF | 10nF | - | - |
| 3kV | - | - | - | 680pF | 2.2nF | 4.7nF | 5.6nF | - | - |

Notes: = X8R ranges in yellow available as qualified AEC-Q200. *Only available as Novacap parts.

Ordering information - Syfer 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). | 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 = $\pm 5\%$ K = $\pm 10\%$ M = $\pm 20\%$ | N = X8R T = X8R AEC-Q200 | T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays |

Ordering information - Novacap High Temperature Capacitors

| 4540 | S | 125 | K | 501 | N | T | M |
|--|----------------------------------|--|---|--|--|---|-------------------------------|
| Chip size | Dielectric codes | Capacitance in picofarads (pF) | Capacitance tolerance code | Voltage code | Termination codes | Packaging | Marking |
| 0805 1206 1210 1812 1825 2225 4540 7565 | S = X8R High Temp. (up to 150°C) | Value in Picofarads. Two significant figures, followed by number of zeros: 125 = 1.2nF | J = $\pm 5\%$ (X8R) K = $\pm 10\%$ (Class II) M = $\pm 20\%$ (Class II) | Two significant figures, followed by number of zeros: 250 = 25 Volts 500 = 50 Volts 101 = 100 Volts 251 = 250 Volts 501 = 500 Volts | P = Palladium Silver PR = Palladium Silver* K = Solderable Palladium Silver* N = Nickel Barrier* 100% tin Y = Nickel Barrier* 90% tin, 10% lead C = FlexiCap™/Nickel Barrier* 100% tin D = FlexiCap™/Nickel Barrier* 90% tin, 10% lead S = Solderable Silver* *Indicates RoHS terminations | None = Bulk T = Tape & Reel W = Waffle Pack | None = Unmarked M = Marked |

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.

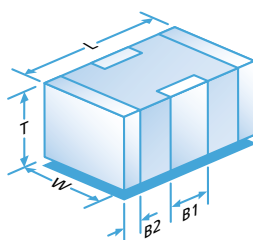
The filtered signal passes through the chip internal electrodes and the noise is filtered to the grounded side contacts, resulting in reduced length noise transmission paths.

Available in C0G/NP0 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.

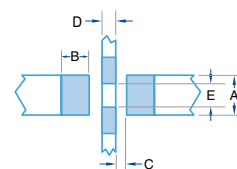
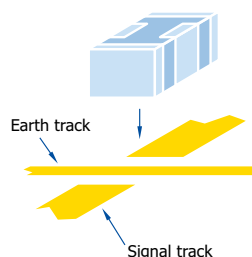


E01 300mA, E07 1A/2A/3A



E01/E07

Recommended solder lands



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 | C0G/NP0 | 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 |
| 50Vdc | C0G/NP0 | 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 |
| 100Vdc | C0G/NP0 | 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 |
| 200Vdc | C0G/NP0 | - | 560pF-1.2nF | 56pF-1nF | - | 15pF-180pF | 56pF-470pF |
| | X7R | - | 2.7nF-56nF | 3.9nF-100nF | - | 12nF-56nF | 22nF-100nF |

Note: E07 25Vdc C0G/NP0 1206 and 1806 ranges in green, have maximum current of 1A.

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

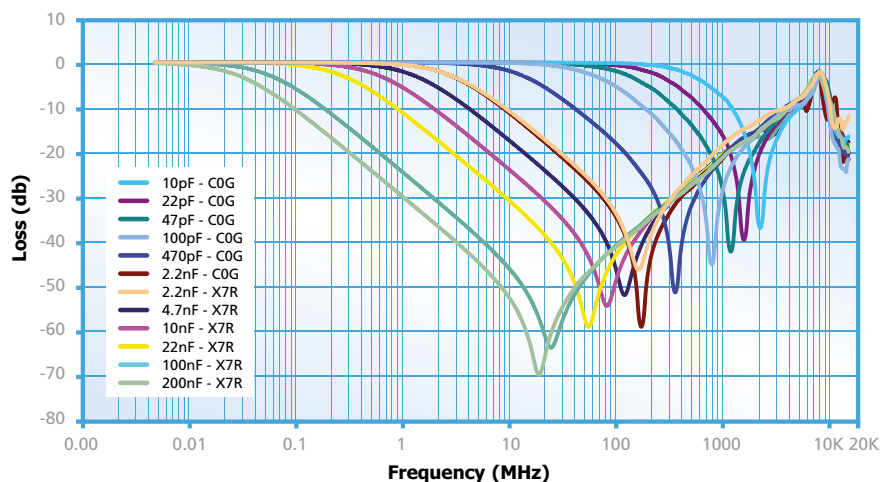
| Type | E01 | | | E07 | | |
|-----------|---------|-------|-------|-------|-------|-------|
| Chip Size | 0805 | 1206 | 1806 | 0805 | 1206 | 1806 |
| 50V | C0G/NP0 | 820pF | 1nF | 2.2nF | 220pF | 1nF |
| | X7R | 47nF | 100nF | 200nF | 47nF | 100nF |
| 100V | C0G/NP0 | 560pF | 1nF | 2.2nF | 120pF | 560pF |
| | X7R | 15nF | 15nF | 68nF | 15nF | 15nF |

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/NP0 AEC-Q200 C = COG/NP0 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 by Knowles Capacitors 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

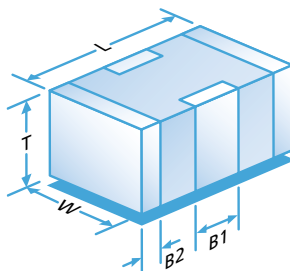
≤200V 2.5 times rated Volts for 5 secs
500V 1.5 times rated Volts for 5 secs
Charging current limited to 50mA Max.

| 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 |

Note: 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 |

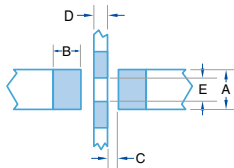


| | 0805 | 1206 | 1410 | 1812 |
|-----------|------------------------|------------------------|-------------------------|-------------------------|
| L | 2.0±0.3 (0.08±0.012) | 3.2±0.3 (0.126±0.012) | 3.6±0.3 (0.14±0.012) | 4.5±0.35 (0.18±0.014) |
| W | 1.25±0.2 (0.05±0.008) | 1.60±0.2 (0.063±0.008) | 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

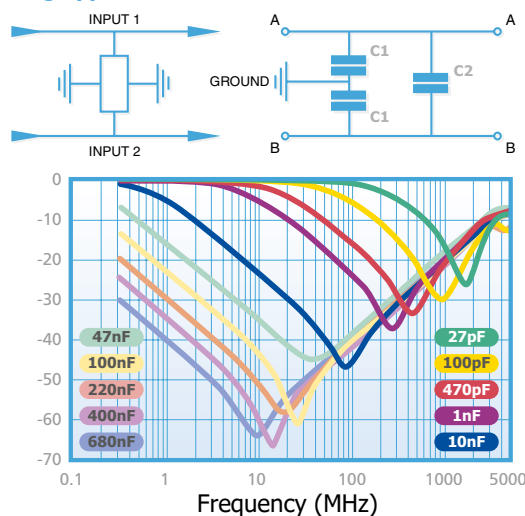
Recommended solder lands



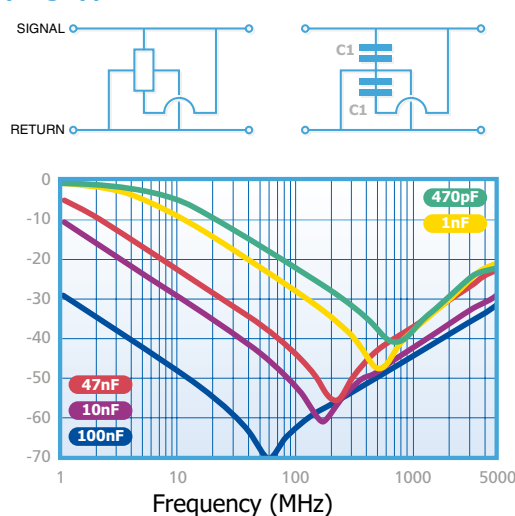
| | 0805 | 1206 | 1410 | 1812 |
|---|--------------|-------------|--------------|--------------|
| A | 0.95 (0.037) | 1.2 (0.047) | 2.05 (0.08) | 2.65 (0.104) |
| B | 0.9 (0.035) | 0.9 (0.035) | 1.0 (0.040) | 1.4 (0.055) |
| C | 0.3 (0.012) | 0.6 (0.024) | 0.7 (0.028) | 0.8 (0.031) |
| D | 0.4 (0.016)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

Filtering application



Decoupling application



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 | 330mm (13") reel | 0805 | 1206 | 1410 | 1812 |
|-----------------|------|------|------|------|------------------|-------|-------|------|------|
| | 3000 | 2500 | 2000 | 1000 | | 12000 | 10000 | 8000 | 4000 |



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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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| <u>1206Y5000153KTT</u> | <u>1812Y1K00153KTT</u> | <u>1206Y5000183KTT</u> | <u>1206Y1K00103KST</u> | <u>1206Y1K00472KST</u> |
| <u>1812Y1K00222KST</u> | <u>1812Y1K00682KST</u> | <u>2220Y2K00103KST</u> | <u>2220Y1K00223KST</u> | <u>1206Y1K00102KTT</u> |
| <u>2220Y1K00473KST</u> | <u>1812Y1K00472KST</u> | <u>1206Y2500103KTT</u> | <u>1210Y1000104KTT</u> | <u>2220Y1K00103KST</u> |
| <u>0805Y0500104KST</u> | | | | |