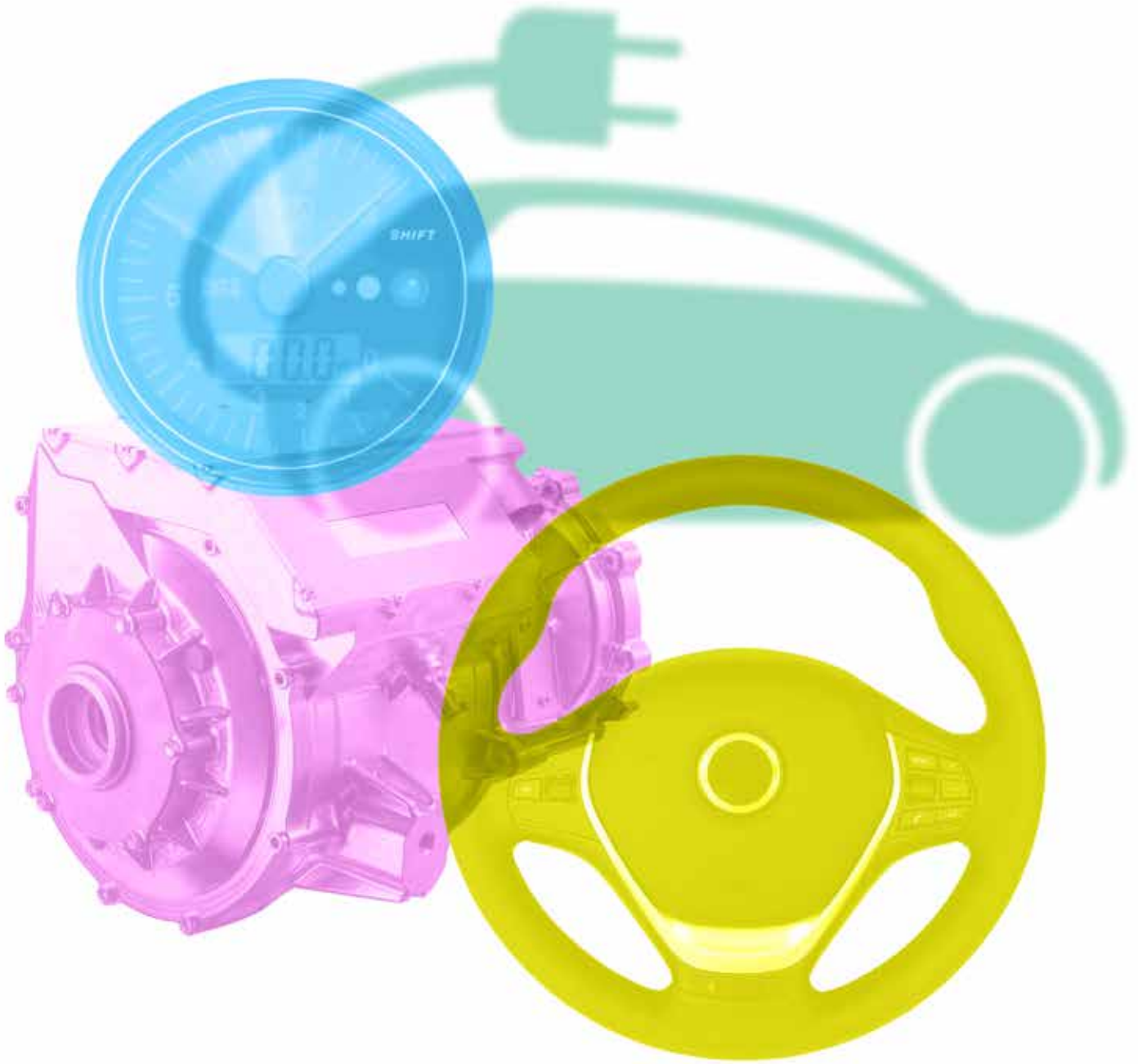


AEC-Q200 **Automotive Grade Capacitors**



DLI•JohansonMFG•Novacap•Syfer•Voltronics

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.

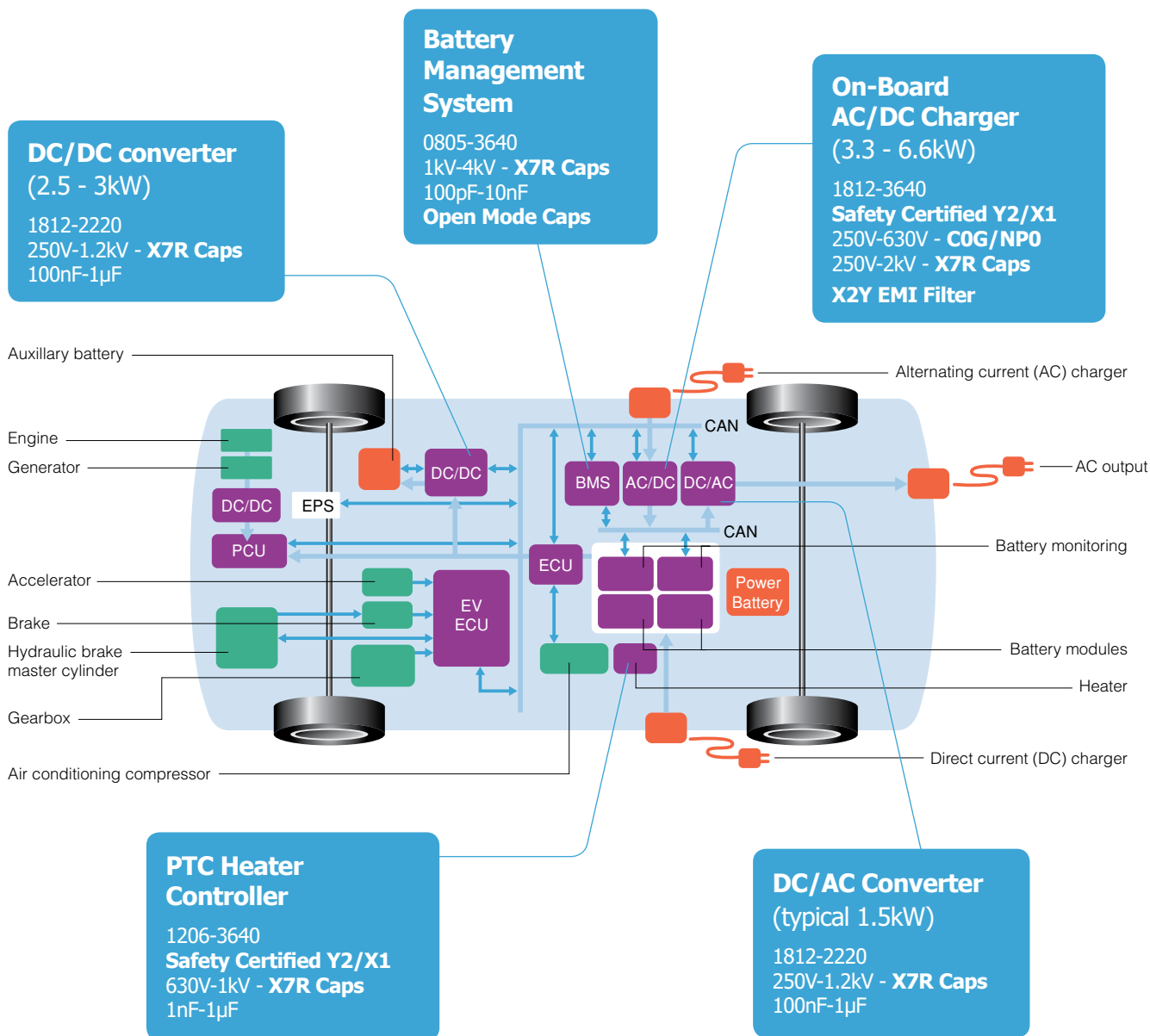
The Automotive Electronics Council (AEC) Component Technical Committee is the standardization body for establishing standards for reliable, high quality electronic components. Components meeting these specifications are suitable for use in the harsh automotive environment without additional component-level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

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™ 4.2mm max thickness | | StackiCap™ 4.2mm max thickness | | | |
| 50/ 63V | COG/NPO | 1nF | 4.7nF | 15nF | 27nF | 27nF | 47nF | - | 82nF | 100nF | - | 150nF | 220nF | - |
| | X7R | 100nF * | 220nF | 470nF | 1µF | - | 2.2µF | - | 2.2µF | 3.3µF | - | 3.3µF | 4.7µF | - |
| 100V | COG/NPO | 470pF | 2.2nF | 8.2nF | 15nF | 15nF | 39nF | - | 47nF | 56nF | - | 68nF | 180nF | - |
| | X7R | 47nF | 100nF | 220nF | 680nF | - | 1µF | - | 1.5µF | 1.5µF | - | 2.2µF | 3.3µF | - |
| 200/ 250V | X8R | - | 33nF | 100nF | 220nF | 220nF | 470nF | - | - | 1.0µF | - | 1.5µF | - | - |
| | COG/NPO | 220pF | 1nF | 3.3nF | 8.2nF | 8.2nF | 18nF | - | 27nF | 33nF | - | 33nF | 82nF | - |
| 500V | X7R | 10nF | 47nF | 150nF | 330nF | - | 680nF | 1.0µF | 1.0µF | 1.0µF | 2.2µF | 1.5µF | 1.5µF | 5.6µF |
| | X8R | - | 15nF | 68nF | 150nF | 150nF | 330nF | - | - | 680nF | - | 1.0µF | - | - |
| 630V | COG/NPO | - | 680pF | 2.7nF | 6.8nF | 5.6nF | 15nF | - | 18nF | 22nF | - | 22nF | 56nF | - |
| | X7R | - | 15nF | 68nF | 150nF | - | 330nF | 470nF | 560nF | 560nF | 1.2µF | 680nF | 1.0µF | 2.7µF |
| 1kV | X8R | - | 4.7nF | 22nF | 47nF | 47nF | 120nF | - | - | 330nF | - | 470nF | - | - |
| | COG/NPO | - | 560pF | 2.7nF | 6.8nF † | 5.6nF | 15nF | - | 10nF | 15nF | - | 15nF | 39nF | - |
| 1.2kV | X7R | - | 10nF | 47nF | 100nF | - | 150nF | 330nF | 200nF | 330nF | 1.0µF | 390nF | 680nF | 2.2µF |
| | X8R | - | 2.2nF | 10nF | 33nF | 33nF | 68nF | - | - | 180nF | - | 220nF | - | - |
| 1.5kV | COG/NPO | - | 150pF | 1.5nF | 2.2nF | 2.2nF | 5.6nF | - | 10nF | 10nF | - | 10nF | 22nF | - |
| | X7R | - | 3.3nF | 10nF | 47nF | - | 68nF | 180nF | 200nF | 120nF | 470nF | 150nF | 180nF | 1.0µF |
| 2kV | X8R | - | 1.5nF | 3.3nF | 6.8nF | 6.8nF | 27nF | - | - | 68nF | - | 82nF | - | - |
| | COG/NPO | - | 68pF | 390pF | 680pF | 1.0nF | 3.3nF | - | 4.7nF | 4.7nF | - | 6.8nF | 18nF | - |
| 2.5kV | X7R | - | - | 3.3nF | 18nF | - | 33nF | 100nF | 68nF | 82nF | 220nF | 100nF | 150nF | 470nF |
| | X8R | - | - | 2.2nF | 5.6nF | 5.6nF | 15nF | - | - | 47nF | - | 56nF | - | - |
| 3kV | COG/NPO | - | 68pF | 390pF | 680pF | 680pF | 2.2nF | - | 3.9nF | 4.7nF | - | 4.7nF | 12nF | - |
| | X7R | - | - | 2.7nF | 6.8nF | - | 22nF | 56pF | 47nF | 47nF | 150nF | 68nF | 100nF | 330nF |
| 3kV | X8R | - | - | 1.5nF | 3.3nF | 3.3nF | 10nF | - | - | 27nF | - | 33nF | - | - |
| | COG/NPO | - | 47pF | 220pF | 390pF | 470pF | 1.5nF | - | 1.8nF | 2.2nF | - | 2.2nF | 5.6nF | - |
| 3kV | X7R | - | - | 2.2nF | 4.7nF | - | 10nF | 33pF | 10nF | 27nF | 100nF | 33nF | 47nF | 150nF |
| | X8R | - | - | 680pF | 1.5nF | 1.5nF | 5.6nF | - | - | 15nF | - | 22nF | - | - |
| 3kV | COG/NPO | - | - | 100pF | 180pF | 270pF | 680pF | - | - | 1.5nF | - | - | - | - |
| | X8R | - | - | - | - | 1.2nF | 3.3nF | - | - | 10nF | - | 12nF | - | - |
| 3kV | COG/NPO | - | - | 68pF | 150pF | 220pF | 470pF | - | - | 1nF | - | - | - | - |
| | X8R | - | - | - | - | 820pF | 2.7nF | - | - | 5.6nF | - | 6.8nF | - | - |

Notes: 1) * 0603 Max thickness 0.9mm above 56nF, FB6 suffix code. 2) † 1210 Max thickness 2.2mm as suffix AG1. 3) 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/NPO | TÜV, UL | 4.7pF - 390pF | 4.7pF - 470pF | 4.7pF - 1.5nF | 4.7pF - 1.0nF | 820pF - 1.0nF | - | - |
| X7R | TÜV, UL | 150pF - 1nF | 150pF - 2.2nF | 150pF - 4.7nF | 100pF - 3.9nF | 2.7nF - 3.9nF | 150pF - 10nF | 150pF - 22nF (TÜV approval only) |

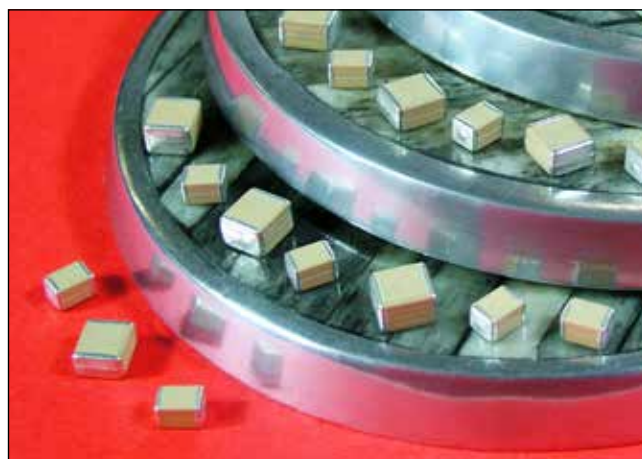
Note: See pages 7, 8 and 9 for full details of 250Vac Safety Certified AC Capacitors and ordering information.

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 |
|----------------|-------|-------|-------|
| Thickness max. | 3.2mm | 4.2mm | 4.2mm |
| 200/250V | 1.0µF | 2.2µF | 5.6µF |
| 500V | 470nF | 1.2µF | 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 |



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 of the Knowles MLC Capacitors catalogue 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 - 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 10nF | <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.

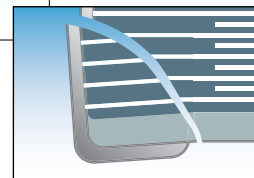
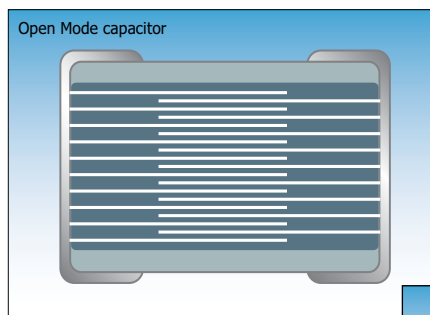


Open Mode and Tandem Capacitors - X7R

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%.

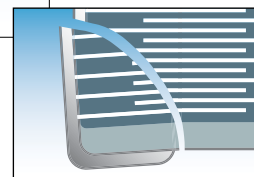
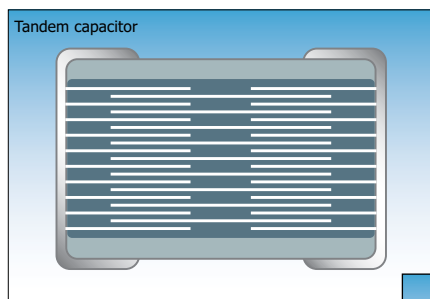
Open Mode max capacitance (X7R only) ■ = AEC-Q200 qualified

| | 0603 | 0805 | 1206 | 1210 | 1808 | 1812 | 2220 | 2225 |
|----------|-------|-------------|-------------|-------------|-------|-------|-------|-------------|
| 16V | 39nF | 100nF 150nF | 220nF 100nF | 470nF 680nF | 680nF | 1.5µF | 3.3µF | 4.7µF |
| 25V | 33nF | 100nF 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 | 100nF | 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. *H = FlexiCap™ (Tin/Lead) Not 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 |

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

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.

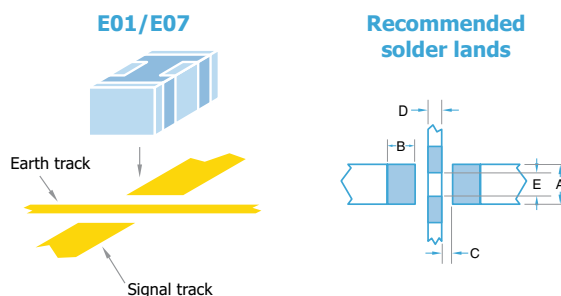
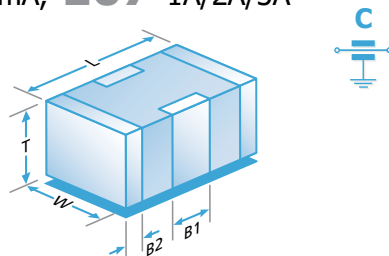
The filtered signal passes through the chip internal electrodes and the noise is filtered to the grounded side contacts, resulting in reduced length noise transmission paths.

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 AEC-Q200 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 |

Notes: ■ = AEC-Q200. For some lower capacitance parts, higher voltage rated parts may be supplied.

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/NP0

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.

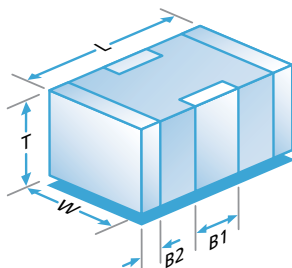
| Type | | E03 | | | |
|---------------|------------|---------------|---------------|---------------|---------------|
| Chip size | | 0805 | 1206 | 1410 | 1812 |
| Rated voltage | Dielectric | | | | |
| 25Vdc | COG/NP0 | 560pF - 820pF | 1.8nF - 3.3nF | 6.8nF - 8.2nF | 12nF - 15nF |
| | X7R | 56nF - 68nF | - | 470nF | 820nF |
| 50Vdc | COG/NP0 | 390pF - 470pF | 1.2nF - 1.5nF | 4.7nF - 5.6nF | 8.2nF - 10nF |
| | X7R | 18nF - 47nF | 56nF - 220nF | 180nF - 400nF | 390nF - 680nF |
| 100Vdc | 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 |
| 200Vdc | COG/NP0 | - | 22pF - 1.0nF | 100pF - 3.3nF | 820pF - 5.6nF |
| | X7R | - | 820pF - 33nF | 1.2nF - 120nF | 2.7nF - 180nF |
| 500Vdc | COG/NP0 | - | - | - | 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/NP0 | 390pF - 470pF | 1.2nF - 1.5nF | 4.7nF - 5.6nF | 8.2nF - 10nF |
| | X7R | 18nF - 33nF | 56nF - 150nF | 180nF - 330nF | 390nF - 560nF |
| 100Vdc | 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: ■ = AEC-Q200.



| | 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.



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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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