

# 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 3kV 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				
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	-
	X8R	-	33nF	100nF	220nF	220nF	470nF	-	-	1.0µF	-	1.5µF	-	-
200/ 250V	COG/NPO	220pF	1nF	3.9nF	8.2nF	8.2nF	18nF	-	27nF	33nF	-	33nF	82nF	-
	X7R	10nF	47nF	150nF	330nF	-	680nF	1.0µF	1.0µF	1.0µF	-	1.5µF	1.5µF	-
	X8R	-	15nF	68nF	150nF	150nF	330nF	-	-	680nF	-	1.0µF	-	-
500V	COG/NPO	-	680pF	2.7nF	6.8nF	5.6nF	15nF	-	18nF	22nF	-	22nF	56nF	-
	X7R	-	15nF	68nF	150nF	-	330nF	470nF	560nF	560nF	-	680nF	1.0µF	-
	X8R	-	4.7nF	22nF	47nF	47nF	120nF	-	-	330nF	-	470nF	-	-
630V	COG/NPO	-	560pF	2.7nF	6.8nF †	3.9nF	15nF	-	10nF	15nF	-	15nF	39nF	-
	X7R	-	10nF	47nF	100nF	-	150nF	330nF	200nF	330nF	1.0µF	390nF	680nF	-
	X8R	-	2.2nF	10nF	33nF	33nF	68nF	-	-	180nF	-	220nF	-	-
1kV	COG/NPO	-	150pF	1.5nF	2.2nF	2.2nF	5.6nF	-	10nF	10nF	-	10nF	22nF	-
	X7R	-	4.7 nF	10nF	47nF	-	68nF	180nF	200nF	120nF	470nF	150nF	180nF	1.0µF
	X8R	-	1.5nF	3.3nF	6.8nF	6.8nF	27nF	-	-	68nF	-	82nF	-	-
1.2kV	COG/NPO	-	68pF	390pF	680pF	1.0nF	3.3nF	-	4.7nF	4.7nF	-	6.8nF	18nF	-
	X7R	-	-	3.3nF	18nF	-	33nF	100nF	68nF	82nF	-	100nF	150nF	-
	X8R	-	-	2.2nF	5.6nF	5.6nF	15nF	-	-	47nF	-	56nF	-	-
1.5kV	COG/NPO	-	68pF	390pF	680pF	680pF	2.2nF	-	3.9nF	4.7nF	-	4.7nF	12nF	-
	X7R	-	-	2.7nF	6.8nF	-	22nF	-	47nF	47nF	-	68nF	100nF	-
	X8R	-	-	1.5nF	3.3nF	3.3nF	10nF	-	-	27nF	-	33nF	-	-
2kV	COG/NPO	-	47pF	220pF	470pF	470pF	1.5nF	-	1.8nF	2.2nF	-	2.2nF	5.6nF	-
	X7R	-	-	2.2nF	4.7nF	-	10nF	-	10nF	27nF	-	33nF	47nF	-
	X8R	-	-	680pF	1.5nF	1.5nF	5.6nF	-	-	15nF	-	22nF	-	-
2.5kV	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 62 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 - 390pF	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 66 and 67 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
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	390nF
630V	-	-	22nF	33nF	27nF	100nF	180nF	220nF
1kV	-	-	6.8nF	15nF	15nF	47nF	82nF	100nF

See page 56 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 56 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/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. See page 92 for full details of the product range.

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

		0805	1206	1410	1812
		50V	COG/NPO	390pF - 470pF	1.2nF - 1.5nF
	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. See page 94 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	<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>J = Nickel barrier (100% matte tin plating). RoHS compliant. Lead free.</p> <p>A = Nickel barrier (Tin/lead plating with min. 10% lead). Not RoHS compliant.</p> <p>Note: AEC-Q200 X7R is only available in Y or H termination.</p>	<p>050 = 50V</p> <p>063 = 63V</p> <p>100 = 100V</p> <p>200 = 200V</p> <p>250 = 250V</p> <p>500 = 500V</p> <p>630 = 630V</p> <p>1K0 = 1kV</p> <p>1K2 = 1.2kV</p> <p>1K5 = 1.5kV</p> <p>2K0 = 2kV</p> <p>2K5 = 2.5kV</p> <p>3K0 = 3kV</p>	<p>First digit is 0.</p> <p>Second and third digits are significant figures of capacitance code.</p> <p>The fourth digit is number of zeros following</p> <p>Example: 0103 = 10nF</p>	<p>F = ±1%</p> <p>G = ±2%</p> <p>J = ±5%</p> <p>K = ±10%</p> <p>M = ±20%</p>	<p>S = X7R (BME) AEC-Q200</p> <p>E = X7R (2R1) AEC-Q200</p> <p>A = COG/NPO (1B/NPO) AEC-Q200</p> <p>T = X8R with AEC-Q200 release</p>	<p>T = 178mm (7") reel</p> <p>R = 330mm (13") reel</p> <p>B = Bulk pack - tubs or trays</p>	<p>WS2 = StackiCap™</p> <p>M01 = Open Mode</p> <p>T01 = Tandem</p> <p>E01 &amp; E07 = 3 terminal EMI component</p> <p>E03 = X2Y product</p>

# High Capacitance Chip - X7R, X5R

A range of High Capacitance value BME MLC chip capacitors, in stable Class II dielectrics X7R and X5R, with a spread of capacitance values offered up to 100µF.

Comparable circuit designs can be achieved at typically a third to a fifth of the capacitance values because of the low ESR characteristics these parts exhibit. As a consequence they are also ideal to replace Tantalum and Low ESR Electrolytic Capacitors without polarity concerns. They find application as power supply bypass capacitors, smoothing capacitors, input/output filters in DC-DC Converters and in digital circuits and LCD modules.

Parts are RoHS Compliant and suitable for reflow soldering process.

- Nickel Barrier terminations with tin, tin/lead or gold flash
- Capacitance tolerances available: ±10%, ±20%
- Available with high reliability screening. Contact the Knowles Capacitors Sales Office for details



## Capacitance values - High Capacitance Chip

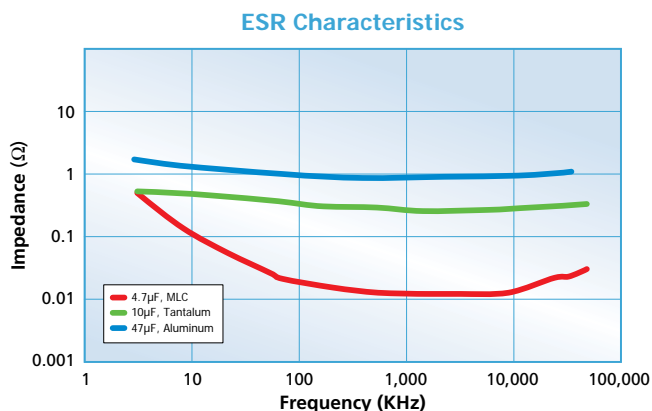
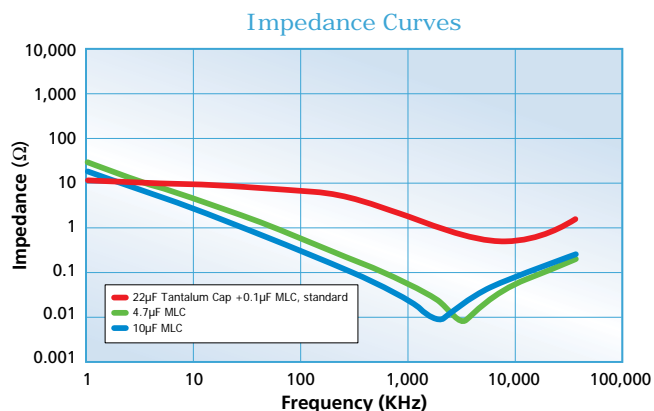
Size	0402		0603		0805		1206		1210				1812	
Tmax <small>inches: mm:</small>	0.024 0.61		0.035 0.89		0.054 1.37		0.072* 1.83		0.085* 2.16		0.110* 2.79		0.110* 2.79	
Dielectric	X7R	X5R	X7R	X5R	X7R	X5R	X7R	X5R	X7R	X5R	X7R	X5R	X7R	X5R
4V				22µF†				100µF†						-
6.3V	470nF	1µF 2.2µF† 4.7µF†		4.7µF 10µF†		22µF†		47µF†		47µF†	47µF†	100µF†		-
10V		1µF	2.2µF	4.7µF 10µF†	10µF†	10µF	22µF†	22µF†		22µF†		47µF†		-
16V	15nF 22nF 33nF 47nF 100nF 220nF	220nF 470nF 100nF 220nF 470nF	100nF 1µF	2.2µF 4.7µF	470nF 1.0µF 2.2µF 4.7µF†	4.7µF 10µF	10µF	10µF 22µF†	4.7µF† 10µF†			22µF†		-
25V	6.8nF 10nF 47nF 100nF	10nF 220nF	470nF 1.0µF	220nF 470nF 1.0µF 2.2µF	1.0µF 2.2µF 4.7µF	2.2µF 4.7µF	2.2µF 4.7µF 10µF	4.7µF 10µF	3.3µF† 4.7µF†	4.7µF† 10µF†	22µF†			-
35V										2.2µF† 4.7µF†		10µF		-
50V	10nF	100nF	220nF 470nF	100nF 470nF 1.0µF	220nF 470nF 1.0µF	220nF 470nF 1.0µF 2.2µF	470nF 1.0µF 2.2µF 4.7µF	4.7µF	1.0µF			4.7µF†	4.7µF† 10µF†	-
100V			100nF		220nF		1.0µF		1.0µF 2.2µF				1.0µF 2.2µF	-

\* Denotes non standard chip thickness. Order code needs to have an 'X' inserted together with the dimension in inches -e.g. X072 where dimension is 0.072".

† Denotes only available in ±20% capacitance tolerance

# High Capacitance Chip - X7R, X5R

## Comparison with other dielectric capacitors



## Dielectric characteristics

	X7R (BB) Stable	X5R (BW) Stable
Operating temperature range:	-55°C to 125°C	-55°C to 85°C
Temperature coefficient:	±15% ΔC Max.	±15% ΔC Max.
Dissipation factor:	3.5% max except: 0402 ≥ 0.1µF = 5%, 0603 ≥ 0.22µF = 10%, 0805 ≥ 1.0µF = 5%, 0805 ≥ 2.2µF = 10%, 1206 ≥ 2.2µF = 10%, 1210 ≥ 4.7µF = 5%, 1210 ≥ 22µF = 10%	5% max except: 0402 ≥ 1.0µF = 10%, 0603 ≥ 1.0µF = 10%, 0805 ≥ 4.7µF = 10%, 1206 ≥ 4.7µF = 10%, 1210 ≥ 10µF = 10%
Insulation resistance @25°C:	>10GΩ or >100ΩF whichever is less	>10GΩ or >100ΩF whichever is less
Dielectric withstanding voltage:	250%	250%
Ageing Rate:	X7R 3.5% typical	X5R 5% typical
Test parameters @ 25°C:	1KHz, 1.0 ±0.2 VRMS	1KHz, 1.0 ±0.2 VRMS 120Hz, 0.5 ±0.1 VRMS for 22µF, 47µF & 100µF

## Ordering information - High Capacitance Chip Capacitors

1206	W	476	K	6R3	N	X080	T
Chip sizes	Dielectric	Capacitance	Tolerance	Voltage-VDCW	Termination	Thickness option	Packing
0402 0603 0805 1206 1210 1812	BB* = X7R BW* = X5R  *Formerly B & W codes	Value in Picofarads. Two significant figures, followed by number of zeros: 476 = 47µF (47,000,000pF)	K = ± 10% M = ± 20%	Two significant figures, followed by number of zeros. R denotes decimal point: 6R3 = 6.3V 501 = 500V	N = Nickel Barrier (100% tin) Y = Nickel Barrier (90% tin/10% lead) NG = Nickel Barrier Gold Flash	Blank = Standard thickness X = special thickness, specified in inches: X085 = 0.085"	No suffix = Bulk T = Tape & Reel

Note: BME parts available with added high reliability test. Consult the factory.