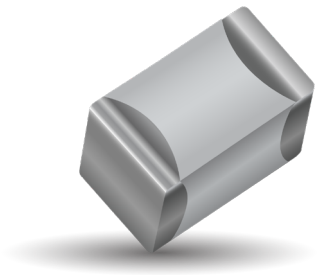
Automotive MLCC with FLEXITERM®, KAF Series

General Specifications



GENERAL DESCRIPTION

With increased requirements from the automotive industry for additional component robustness, KYOCERA AVX recognized the need to produce a MLCC with enhanced mechanical strength. It was noted that many components may be subject to severe flexing and vibration when used in various under the hood automotive and other harsh environment applications.

To satisfy the requirement for enhanced mechanical strength, KYOCERA AVX had to find a way of ensuring electrical integrity is maintained whilst external forces are being applied to the component. It was found that the structure of the termination needed to be flexible and after much research and development, KYOCERA AVX launched FLEXITERM®. FLEXITERM® is designed to enhance the mechanical flexure and temperature cycling performance of a standard ceramic capacitor. The industry standard for flexure is 2mm minimum. Using FLEXITERM®, KYOCERA AVX provides up to 5mm of flexure without internal cracks. Beyond 5mm, the capacitor will generally fail "open".

As well as for automotive applications FLEXITERM® will provide Design Engineers with a satisfactory solution when designing PCB's which may be subject to high levels of board flexure.

PRODUCT ADVANTAGES

- High mechanical performance able to withstand, 5mm bend test guaranteed
- Increased temperature cycling performance, 3000 cycles and beyond
- Flexible termination system
- Reduction in circuit board flex failures
- Base metal electrode system
- Automotive or commercial grade products available
- AECQ200 Qualified
- Approved to VW 80808 Specification

APPLICATIONS

High Flexure Stress Circuit Boards

- e.g. Depanelization: Components near edges of board.

Variable Temperature Applications

- Soft termination offers improved reliability performance in applications where there is temperature variation.
- e.g. All kind of engine sensors: Direct connection to battery rail.

Automotive Applications

- Improved reliability.
- Excellent mechanical performance and thermo mechanical performance.

HOW TO ORDER

KAF	31	G	R7	1H	475	K	U
Series AEC-Q200 FLEXITERM® SERIES	**Size** 15 = 0603 21 = 0805 31 = 1206 32 = 1210 42 = 1808 43 = 1812 55 = 2220	**Thickness** See Cap Chart	**Dielectric** CG = COG R7 = X7R R8 = X8R L8 = X8L G8 = X8G	0J = 6.3V 1A = 10V 1C = 16V 1E = 25V 1H = 50V 2A = 100V 2D = 200V 2E = 250V 2H = 500V 2J = 630V 3A = 1000V 3N = 1500V 3D =2000V 3E = 2500V 3U = 3000V	**Capacitance Code Code (in pF)** 2 Significant Digits +Number of zeros eg 10uF = 106 10nF = 103 47pF = 470	**Capacitance Tolerance** B = ± 0.1pF (<10pF)* C = ± 0.25pF (<10pF)* D = ± 0.5pF (<10pF)* F = ± 1%* G = ± 2%* J = ± 5% K = ± 10% M = ± 20% *COG only	**Packaging** See Table Below

NOTE: Contact factory for availability of Tolerance Options for Specific Part Numbers.

PACKAGING CODES

Code	EIA (inch)	IEC (mm)	7" Paper	7" Embossed	13" Paper	13" Embossed
15	0603	1608	T	U	M	L
21	0805	2012	T	U	M	L
31	1206	3216	T	U	M	L
32	1210	3225	T	U	M	L
42	1808	4520		Y		K
43	1812	4532		V		S
55	2220	5750		V		S

*thickness determines paper or plastic embossed packaging

PERFORMANCE TESTING

AEC-Q200 Qualification:

- Created by the Automotive Electronics Council
- Specification defining stress test qualification for passive components

Testing:

Key tests used to compare soft termination to AEC-Q200 qualification:

- Bend Test
- Temperature Cycle Test

BOARD BEND TEST RESULTS

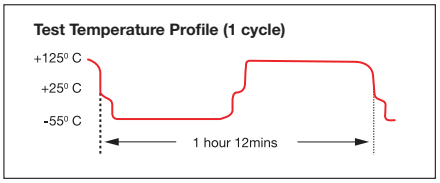
Style	Conventional Termination	FLEXITERM®
0603	>2mm	>5mm
0805	>2mm	>5mm
1206	>2mm	>5mm

TEMPERATURE CYCLE TEST PROCEDURE

Test Procedure as per AEC-Q200:

The test is conducted to determine the resistance of the component when it is exposed to extremes of alternating high and low temperatures.

- Sample lot size quantity 77 pieces
- TC chamber cycle from -55ºC to +125ºC for 1000 cycles
- Interim electrical measurements at 250, 500, 1000 cycles
- Measure parameter capacitance dissipation factor, insulation resistance



BOARD BEND TEST PROCEDURE

According to AEC-Q200

Test Procedure as per AEC-Q200:
Sample size: 20 components
Span: 90mm Minimum deflection spec: 2 mm

- Components soldered onto FR4 PCB (Figure 1)
- Board connected electrically to the test equipment (Figure 2)

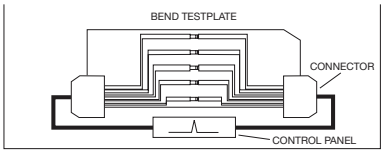


Fig 1 - PCB layout with electrical connections

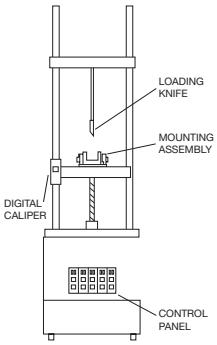
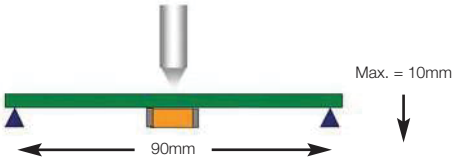


Fig 2 - Board Bend test equipment

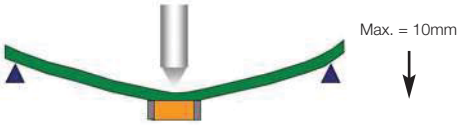
ENHANCED SOFT TERMINATION BEND TEST PROCEDURE

Bend Test

The capacitor is soldered to the printed circuit board as shown and is bent up to 10mm at 1mm per second:

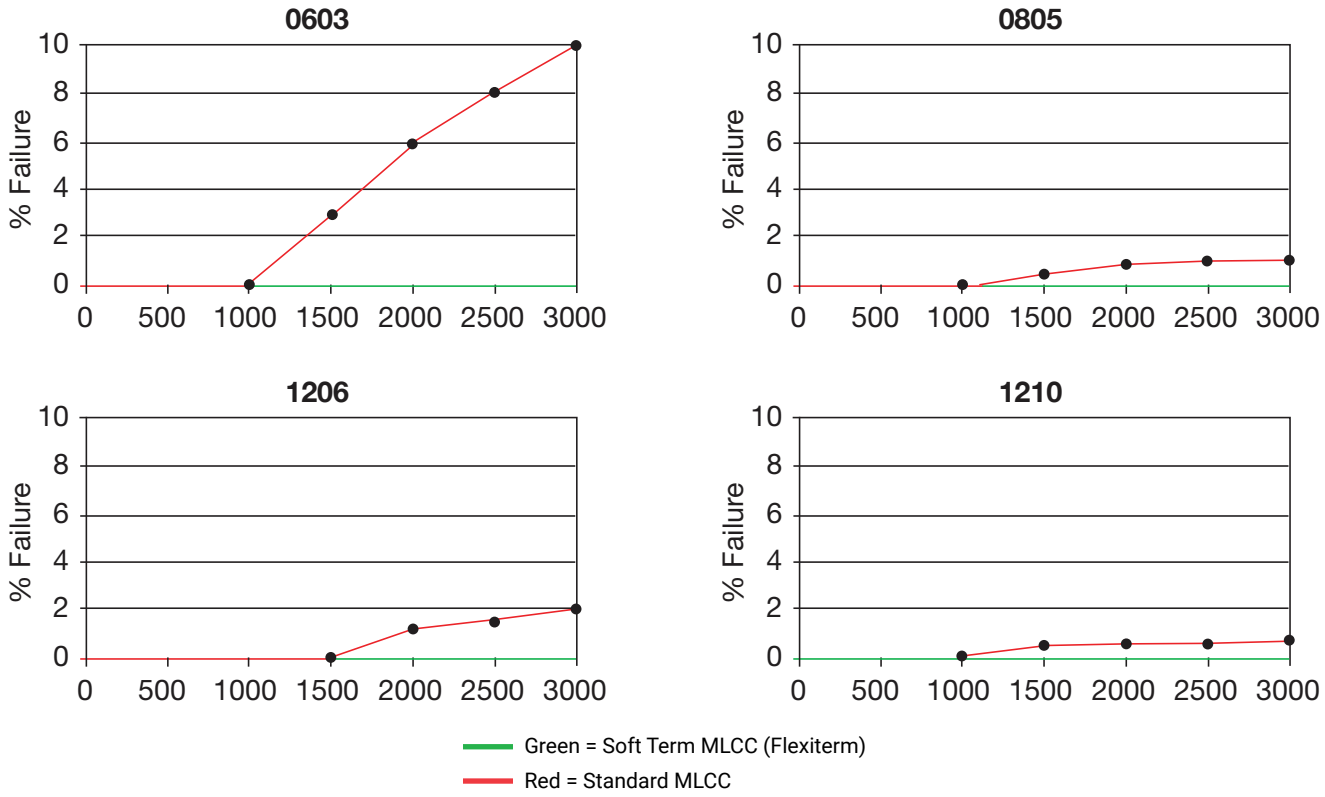


- The board is placed on 2 supports 90mm apart (capacitor side down)
- The row of capacitors is aligned with the load stressing knife



- The load is applied and the deflection where the part starts to crack is recorded (Note: Equipment detects the start of the crack using a highly sensitive current detection circuit)
- The maximum deflection capability is 10mm

BEYOND 1000 CYCLES: TEMPERATURE CYCLE TEST RESULTS



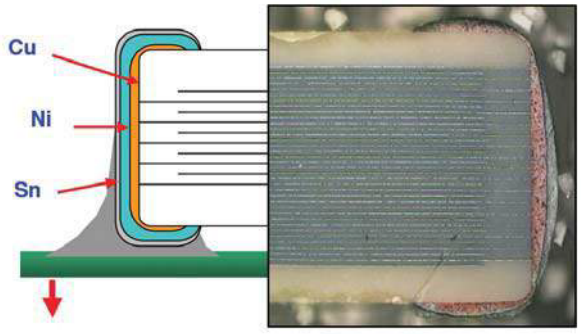
Soft Term - No Defects up to 3000 cycles

AEC-Q200 specification states 1000 cycles compared to 3000 temperature cycles.

FLEXITERM® TEST SUMMARY

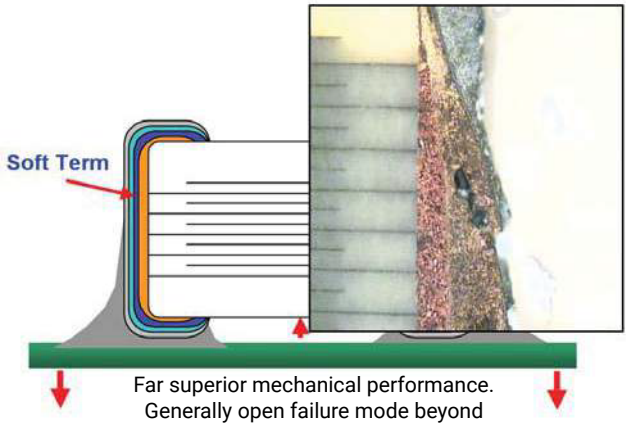
- Qualified to AEC-Q200 test/specification with the exception of using 3000 temperature cycles (up to +150°C bend test guaranteed greater than 5mm).
- FLEXITERM® provides improved performance compared to standard termination systems.
- Board bend test improvement by a factor of 2 to 4 times.
- Temperature Cycling:
  - 0% Failure up to 3000 cycles
  - No ESR change up to 3000 cycle

WITHOUT SOFT TERMINATION



Major fear is of latent board flex failures.

WITH SOFT TERMINATION



Far superior mechanical performance. Generally open failure mode beyond 5mm flexure

Automotive MLCC with FLEXITERM® - NP0

Capacitance Range

SIZE		0603			0805			1206							1210						
Soldering		Reflow/Wave			Reflow/Wave			Reflow/Wave							Reflow/Wave						
(L) Length	mm	1.6 ± 0.15			2.01 ± 0.2			3.2 ± 0.2							3.2 ± 0.2						
	(in.)	(0.063 ± 0.006)			(0.079 ± 0.008)			(0.126 ± 0.008)							(0.126 ± 0.008)						
(W) Width	mm	0.81 ± 0.15			1.25 ± 0.2			1.6 ± 0.2							2.5 ± 0.2						
	(in.)	(0.032 ± 0.006)			(0.049 ± 0.008)			(0.063 ± 0.008)							(0.098 ± 0.008)						
(t) Terminal	mm	0.35 ± 0.15			0.5 ± 0.25			0.5 ± 0.25							0.5 ± 0.25						
	(in.)	(0.014 ± 0.006)			(0.02 ± 0.01)			(0.02 ± 0.01)							(0.02 ± 0.01)						
WVDC		25V	50V	100V	25V	50V	100V	50V	100V	200V	250V	500V	630V	1000V	50V	100V	200V	250V	500V	630V	1000V
0R5	0.5	A	A	A	B	B	B														
1R0	1.0	A	A	A	B	B	B														
100	10	A	A	A	B	B	B														
120	12	A	A	A	B	B	B														
150	15	A	A	A	B	B	B														
180	18	A	A	A	B	B	B														
220	22	A	A	A	B	B	B														
270	27	A	A	A	B	B	B														
330	33	A	A	A	B	B	B														
390	39	A	A	A	B	B	B														
470	47	A	A	A	B	B	B														
560	56	A	A	A																	
680	68	A	A	A																	
820	82	A	A	A																	
101	100	A	A	A																	
121	120																				
151	150																				
181	180																				
221	220																				
271	270																				
331	330																				
391	390																				
471	470																				
561	560																				
681	680																				
821	820																				
102	1000	A	B																		K
122	1200	A	B																	F	K
152	1500	A	B																	G	G
222	2200	A						B	B	B	B	B	B						G	G	G
272	2700	A						B	B	B	B	B	B		G	G	G	G	G	G	G
332	3300	A						G	G	G	G	G	G		G	G	G	G	G	G	G
392	3900	A						G	G	G	G	G	G		G	G	G	G	G	G	G
472	4700	A						G	G	G	G	G	G		G	G	G	G	G	G	G
562	5600	A						G	G	G	G	G	G		G	G	G	G	G	G	G
682	6800	A						G	G	G	G	G	G		K	K	K	K	K	K	K
822	8200	A						G	G	G	G	G	G		K	K	K	K	K	K	K
103	10000	A						G	G	G	G	G	G		K	K	K	K	K	K	L
123	12000														K	K	K	K	K	K	
153	15000														L	L	L	L	L	L	
183	18000														L	L	L	L	L	L	
223	22000														L	L	L	L	L	L	
273	27000														L	L	L	L	L	L	
333	33000														L	L	L	L	L	L	
393	39000																				
473	47000																				
563	56000																				
683	68000																				
823	82000																				
104	100000																				
WVDC		25V	50V	100V	25V	50V	100V	50V	100V	200V	250V	500V	630V	1000V	50V	100V	200V	250V	500V	630V	1000V
Size		0603			0805			1206							1210						

Case Size	0603 (KAF15)	0805 (KAF21)		1206 (KAF31)				1210 (KAF32)					
Thickness Letter	A	B	A	B	N	D	G	Q	B	F	G	K	L
Max Thickness (mm)	0.90	0.94	1.45	0.94	1.27	1.45	1.78	0.94	1.02	1.52	1.78	2.29	2.80
Carrier Tape	PAPER	PAPER	EMB	PAPER	EMB	EMB	EMB	PAPER	EMB	EMB	EMB	EMB	EMB
Packaging Code 7" reel	T	T	U	T	U	U	U	T	U	U	U	U	U
Packaging Code 13" reel	M	M	L	M	L	L	L	M	L	L	L	L	L
				EMBOSSED (EMB)									

Automotive MLCC with FLEXITERM® - X8R / X8L

Capacitance Range

KYOCERA AVX has developed a range of multilayer ceramic capacitors designed for use in applications up to 150°C. These capacitors are manufactured with an X8R and an X8L dielectric material. X8R material has capacitance variation of ± 15% between -55°C and +150°C. The X8L material has capacitance variation of ±15% between -55°C to 125°C to 125°C and +15/40% from +125°C to +150°C.

The need for X8R and X8L performance has been driven by customer requirements for parts that operate at elevated temperatures. They provide a highly reliable capacitor with low loss and stable capacitance over temperature.

They are ideal for automotive under the hood sensors, and various industrial applications. Typical industrial application would be drilling monitoring system. They can also be used as bulk capacitors for high temperature camera modules.

X8R

SIZE		0603			0805			1206		
Soldering		Reflow/Wave			Reflow/Wave			Reflow/Wave		
(L) Length	mm (in.)	1.6 ± 0.15 (0.063 ± 0.006)			2.01 ± 0.2 (0.079 ± 0.008)			3.2 ± 0.2 (0.126 ± 0.008)		
(W) Width	mm (in.)	0.81 ± 0.15 (0.032 ± 0.006)			1.25 ± 0.2 (0.049 ± 0.008)			1.6 ± 0.2 (0.063 ± 0.008)		
(t) Terminal	mm (in.)	0.35 ± 0.15 (0.014 ± 0.006)			0.5 ± 0.25 (0.02 ± 0.01)			0.5 ± 0.25 (0.02 ± 0.01)		
WVDC		25V	50V	100V	25V	50V	100V	25V	50V	100V
271	Cap 270	A	A	A						
331	(pF) 330	A	A	A	B	B	B			
471	470	A	A	A	B	B	B			
681	680	A	A	A	B	B	B			
102	1000	A	A	A	B	B	B	B	B	B
152	1500	A	A	A	B	B	B	B	B	B
182	1800	A	A	A	B	B	B	B	B	B
222	2200	A	A	A	B	B	B	B	B	B
272	2700	A	A	A	B	B	B	B	B	B
332	3300	A	A	A	B	B	B	B	B	B
392	3900	A	A	A	B	B	B	B	B	B
472	4700	A	A	A	B	B	B	B	B	B
562	5600	A	A	A	B	B	B	B	B	B
682	6800	A	A	A	B	B	B	B	B	B
822	8200	A	A	A	B	B	B	B	B	B
103	Cap 0.01	A	A	A	B	B	B	B	B	B
123	(uF) 0.012	A	A		B	B	B	B	B	B
153	0.015	A	A		B	B	A	B	B	B
183	0.018	A	A		B	B	A	B	B	B
223	0.022	A	A		B	B	A	B	B	B
273	0.027	A	A		B	B		B	B	B
333	0.033	A	A		B	B		B	B	B
393	0.039	A	A		B	B		B	B	B
473	0.047	A	A		B	B		B	B	B
563	0.056	A			A	A		N	N	N
683	0.068	A			A	A		N	N	N
823	0.082				A	A		N	N	N
104	0.1				A	A		N	N	N
124	0.12				A	A		N	N	N
154	0.15				A	A		N	N	N
184	0.18				A			N	N	
224	0.22				A			N	N	
274	0.27							N	N	
334	0.33							N	N	
394	0.39							E	G	
474	0.47							E	G	
684	0.68							G	G	
824	0.82							G	G	
105	1							G	G	
WVDC		25V	50V	100V	25V	50V	100V	25V	50V	100V
SIZE		0603			0805			1206		

Case Size	0603(KAF15)		0805(KAF21)		1206(KAF31)				1210(KAF32)
Thickness Letter	A	B	B	A	B	N	E	G	L
Max Thickness	0.90	0.95	0.94	1.45	0.94	1.27	1.52	1.78	2.79
Carrier Tape	PAPER	PAPER	PAPER	EMB	PAPER	EMB	EMB	EMB	EMB
Packaging Code 7"reel	T	T	T	U	T	U	U	U	U
Packaging Code 13"reel	M	M	M	L	M	L	L	L	L
					EMBOSSED (EMB)				

X8L

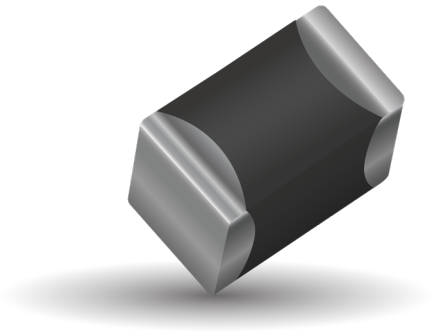
SIZE		0603			0805			1206				1210			
Soldering		Reflow/Wave			Reflow/Wave			Reflow/Wave				Reflow/Wave			
(L) Length	mm (in.)	1.6 ± 0.15 (0.063 ± 0.006)			2.01 ± 0.2 (0.079 ± 0.008)			3.2 ± 0.2 (0.126 ± 0.008)				3.2 ± 0.2 (0.126 ± 0.008)			
(W) Width	mm (in.)	0.81 ± 0.15 (0.032 ± 0.006)			1.25 ± 0.2 (0.049 ± 0.008)			1.6 ± 0.2 (0.063 ± 0.008)				2.5 ± 0.2 (0.098 ± 0.008)			
(t) Terminal	mm (in.)	0.35 ± 0.15 (0.014 ± 0.006)			0.5 ± 0.25 (0.02 ± 0.01)			0.5 ± 0.25 (0.02 ± 0.01)				0.5 ± 0.25 (0.02 ± 0.01)			
WVDC		25V	50V	100V	25V	50V	100V	16V	25V	50V	100V	10V	25V	50V	100V
271	Cap 270	A	A												
331	(pF) 330	A	A	A	B	B	B								
471	470	A	A	A	B	B	B								
681	680	A	A	A	B	B	B								
102	1000	A	A	A	B	B	B		B	B					
152	1500	A	A	A	B	B	B		B	B	B				
182	1800	A	A	A	B	B	B		B	B	B				
222	2200	A	A	A	B	B	B		B	B	B				
272	2700	A	A	A	B	B	B		B	B	B				
332	3300	A	A	A	B	B	B		B	B	B				
392	3900	A	A	A	B	B	B		B	B	B				
472	4700	A	A	A	B	B	B		B	B	B				
562	5600	A	A	A	B	B	B		B	B	B				
682	6800	A	A	A	B	B	B		B	B	B				
822	8200	A	A	A	B	B	B		B	B	B				
103	Cap 0.01	A	A	A	B	B	B		B	B	B				
123	(uF) 0.012	A	A	A	B	B	B		B	B	B				
153	0.015	A	A	A	B	B	B		B	B	B				
183	0.018	A	A	A	B	B	B		B	B	B				
223	0.022	A	A	A	B	B	B		B	B	B				
273	0.027	A	A	A	B	B	B		B	B	B				
333	0.033	A	A	B	B	B	A		B	B	B				
393	0.039	A	A		B	B	A		B	B	B				
473	0.047	A	A		B	B	A		B	B	B				
563	0.056	A	A		B	B	A		B	B	B				
683	0.068	A	A		B	B	A		B	B	B				
823	0.082	A	A		B	B	A		B	B	N				
104	0.1	A	A		B	B	A		B	B	N				
124	0.12				B	A			B	B	N				
154	0.15				B	A		B	B	B	N				
184	0.18				A	A		B	B	B	G				
224	0.22				A	A		B	B	B	G				
274	0.27				A	A		B	N	N					
334	0.33				A	A		B	N	E					
394	0.39				A	A		N	N	E					
474	0.47				A	A		N	N	E					
684	0.68				A	A		N	G	G					
824	0.82				A	A		N	G	G					
105	1				A	A		N	G	G					
155	1.5				A			G	G	G					
225	2.2				A			G	G	G				L	L
475	4.7							G	G					L	
106	10											L	L		
WVDC		25V	50V	100V	25V	50V	100V	16V	25V	50V	100V	10V	25V	50V	100V
SIZE		0603			0805			1206				1210			

Automotive MLCC with FLEXITERM® - X8R / X8L

General Specifications

APPLICATIONS FOR X8R AND X8L CAPACITORS

- All market sectors with a 150°C requirement
- Automotive on engine applications
- Oil exploration applications
- Hybrid automotive applications
  - Battery control
  - Inverter / converter circuits
  - Motor control applications
  - Water pump
- Hybrid commercial applications
  - Emergency circuits
  - Sensors
  - Temperature regulation



ADVANTAGES OF X8R AND X8L MLC CAPACITORS

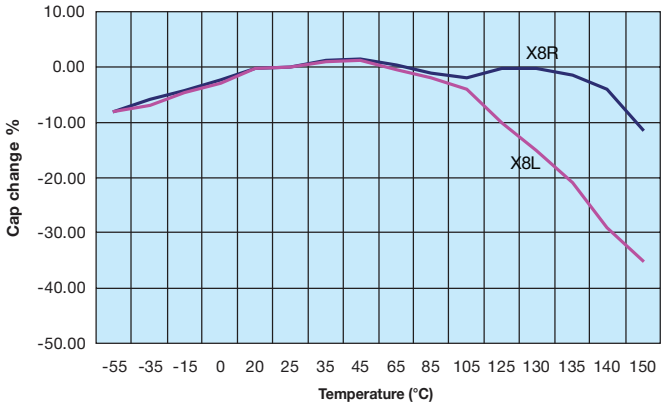
- Both ranges are qualified to the highest automotive AEC-Q200 standards
- Excellent reliability compared to other capacitor technologies
- RoHS compliant
- Low ESR / ESL compared to other technologies
- Tin solder finish
- FLEXITERM® available
- 100V range available

ENGINEERING TOOLS FOR HIGH VOLTAGE MLC CAPACITORS

- Samples
- Technical Articles
- Application Engineering
- Application Support

X8R/X8L Dielectric

0805, 50V, X8R/X8L Typical Temperature Coefficient



Automotive MLCC with FLEXITERM® - X7R , 4V to 500V

Capacitance Range

SIZE		0603								0805								1206								1210								1812		2220					
Soldering		Reflow/Wave								Reflow/Wave								Reflow/Wave								Reflow Only								Reflow Only		Reflow Only					
(L) Length	mm	1.6 ± 0.15								2.01 ± 0.2								3.2 ± 0.2								3.2 ± 0.2								4.5 ± 0.3		5.7 ± 0.5					
	(in.)	(0.063 ± 0.006)								(0.079 ± 0.008)								(0.126 ± 0.008)								(0.126 ± 0.008)								(0.177 ± 0.012)		(0.224 ± 0.02)					
(W) Width	mm	0.81 ± 0.15								1.25 ± 0.2								1.6 ± 0.2								2.5 ± 0.2								3.2 ± 0.2		5 ± 0.4					
	(in.)	(0.032 ± 0.006)								(0.049 ± 0.008)								(0.063 ± 0.008)								(0.098 ± 0.008)								(0.126 ± 0.008)		(0.197 ± 0.016)					
(t) Terminal	mm	0.35 ± 0.15								0.5 ± 0.25								0.5 ± 0.25								0.5 ± 0.25								0.61 ± 0.36		0.64 ± 0.39					
	(in.)	(0.014 ± 0.006)								(0.02 ± 0.01)								(0.02 ± 0.01)								(0.02 ± 0.01)								(0.024 ± 0.014)		(0.025 ± 0.015)					
WVDC		6.3V	10V	16V	25V	50V	100V	200V	250V	6.3V	10V	16V	25V	50V	100V	200V	250V	16V	25V	50V	100V	200V	250V	500V	16V	25V	50V	100V	200V	250V	50V	100V	25V	50V	100V	200V	250V	500V				
101	100																												Q	Q												
221	220																												Q	Q												
271	270																												Q	Q												
331	330																												Q	Q												
391	390																												Q	Q												
471	470																												Q	Q												
561	560																												Q	Q												
681	680																												Q	Q												
821	820																												Q	Q												
102	1000		A	A	A	A	A	A	A			B	B	B	B	B	B	B	B	B	B	B	B	B	Q	Q	Q	Q	Q	Q	Y	Y										
122	1220		A	A	A	A	A	A	A			B	B	B	B	B	B	B	B	B	B	B	B	B	Q	Q	Q	Q	Q	Q	Y	Y										
152	1500		A	A	A	A	A	A	A			B	B	B	B	B	B	B	B	B	B	B	B	B	Q	Q	Q	Q	Q	Q	Y	Y										
182	1800		A	A	A	A	A	A	A			B	B	B	B	B	B	B	B	B	B	B	B	B	Q	Q	Q	Q	Q	Q	Y	Y										
222	2200		A	A	A	A	A	A	A			B	B	B	B	B	B	B	B	B	B	B	B	B	Q	Q	Q	Q	Q	Q	Y	Y										
272	2700		A	A	A	A	A	A	A			B	B	B	B	B	B	B	B	B	B	B	B	B	Q	Q	Q	Q	Q	Q	Y	Y										
332	3300		A	A	A	A	A	A	A			B	B	B	B	B	B	B	B	B	B	B	B	B	Q	Q	Q	Q	Q	Q	Y	Y										
392	3900		A	A	A	A	A	A	A			B	B	B	B	B	B	B	B	B	B	B	B	B	Q	Q	Q	Q	Q	Q	Y	Y										
472	4700		A	A	A	A	A	A	A			B	B	B	B	B	B	B	B	B	B	B	B	B	Q	Q	Q	Q	Q	Q	Y	Y										
562	5600		A	A	A	A	A	A	A			B	B	B	B	B	B	B	B	B	B	B	B	B	Q	Q	Q	Q	Q	Q	Y	Y										
682	6800		A	A	A	A	A	A	A			B	B	B	B	B	B	B	B	B	B	B	B	B	Q	Q	Q	Q	Q	Q	Y	Y										
822	8200		A	A	A	A	A	A	A			B	B	B	B	B	B	B	B	B	B	B	B	B	Q	Q	Q	Q	Q	Q	Y	Y										
103	Cap 0.01		A	A	A	A	A	A	A			B	B	B	B	B	B	B	B	B	B	B	B	G	Q	Q	Q	Q	Q	Q	Y	Y										
123	(F) 0.012		A	A	A	A	A					B	B	B	B	B	K	B	B	B	B	B	N		Q	Q	Q	Q	Q	G	Y	Y										
153	0.015		A	A	A	A	A					B	B	B	B	B	K	B	B	B	B	B	N		Q	Q	Q	Q	Q	G	Y	Y										
183	0.018		A	A	A	A	A					B	B	B	B	K	K	B	B	B	B	B	N		Q	Q	Q	Q	Q	G	Y	Y										
223	0.022		A	A	A	A	A					B	B	B	B	K	K	B	B	B	B	G	G		Q	Q	Q	Q	Q	G	Y	Y										
273	0.027		A	A	A	A	B					B	B	B	B	K	K	B	B	B	B	G	G		Q	Q	Q	Q	Q	G	Y	Y										
333	0.033		A	A	A	A	B					B	B	B	K	K	K	B	B	B	B	G	G		Q	Q	Q	Q	Q	G	Y	Y										
393	0.039		A	A	A	A	B					B	B	B	K	K	K	B	B	B	B	G	G		Q	Q	Q	Q	Q	G	Y	Y										
473	0.047		A	A	A	A	B					B	B	B	K	K	K	B	B	B	N	G	G		Q	Q	Q	Q	Q	G	Y	Y										
563	0.056		A	A	A	A	B					B	B	B	K			B	B	B	N	G	G		Q	Q	Q	Q	C	G	Y	Y										
683	0.068		A	A	A	A	B					B	B	B	K			B	B	B	N	G	G		Q	Q	Q	Q	C	G	Y	Y										
823	0.082		A	A	A	A	B					B	B	B	K			B	B	B	N	G	G		Q	Q	Q	Q	G	G	Y	Y										
104	0.1		A	A	A	A	B					B	B	B	K			B	B	B	N	G	G		Q	Q	Q	Q	G	G	Y	Y										A
124	0.12		A	B	B							B	B	K	K			B	B	B	N	G	G		Q	Q	Q	F	G	G	Y	Y										
154	0.15		A	B	B							B	B	K	K			B	B	B	N	G	G		Q	Q	Q	F	K	G	Y	Y										
224	0.22		A	B	B							J	K	K	K			B	B	B	G	G	G		Q	Q	Q	F	G	G	Z	Z										
334	0.33											K	K	K	K			B	N	E	G	G	G		Q	Q	Q	G	L	L	G	G										
474	0.47											K	K	K	K			N	N	E	G				F	F	F	G			G	G										
684	0.68											K	K	K	K			N	G	G	G				F	F	G	K			G	G										
105	1.0											K	K	K	K			N	G	G	G				F	G	G	L			G	G		C	C	A	A				
155	1.5											K	K	K				G	G	G	G				F	G	L	L			G	G		C	C	C	C				
225	2.2											K	K	K				G	G	G	G				L	L	L	L			J	J		C	C						
335	3.3																	G	G	G					K	L	L	L			J			C	C						
475	4.7																	G	G	G					K	L	L	L			J			C	C						
106	10										A	A						G							L	L	L				J		C	C	C						
226	22																																C									
WVDC		6.3V	10V	16V	25V	50V	100V	200V	250V	6.3V	10V	16V	25V	50V	100V	200V	250V	16V	25V	50V	100V	200V	250V	500V	16V	25V	50V	100V	200V	250V	50V	100V	25V	50V	100V	200V	250V	500V				
Size		0603								0805								1206							1210						1812		2220									

Case Size	0603(KAM15)			0805(KAM21)				1206(KAM31)				1210(KAM32)						1812(KAM43)				2220(KAM55)	
Thickness Letter	A	B	C	B	J	K	A	B	N	E	G	Q	C	F	G	K	L	Y	Z	G	J	A	C
Max Thickness(mm)	0.90	0.95	1.00	0.94	1.27	1.40	1.45	0.94	1.27	1.52	1.78	0.94	1.27	1.52	1.78	2.29	2.80	1.02	1.27	2.29	2.80	2.29	2.80
Carrier Tape	PAPER	PAPER	PAPER	PAPER	EMB	EMB	EMB	PAPER	EMB	EMB	EMB	PAPER	EMB	EMB	EMB	EMB	EMB	EMB	EMB	EMB	EMB	EMB	EMB
Packaging Code 7"reel	T	T	T	T	U	U	U	T	U	U	U	T	U	U	U	U	U	V	V	V	V	V	V
Packaging Code 13"reel	M	M	M	M	L	L	L	M	L	L	L	M	L	L	L	L	L	S	S	S	S	S	S
												EMBOSSED (EMB)											

Automotive MLCC with FLEXITERM® - X7R, 630V to 3000V

Capacitance Range

Case Size			1206					1210				1808						1812						2220				
Soldering			Reflow/Wave					Reflow/Wave				Reflow Only						Reflow Only						Reflow Only				
(L) Length		mm (in.)	3.2 ± 0.2 (0.126 ± 0.008)					3.2 ± 0.2 (0.126 ± 0.008)				4.57 ± 0.25 (0.18 ± 0.01)						4.5 ± 0.3 (0.177 ± 0.012)						5.7 ± 0.5 (0.224 ± 0.02)				
W) Width		mm (in.)	1.6 ± 0.2 (0.063 ± 0.008)					2.5 ± 0.2 (0.098 ± 0.008)				2.03 ± 0.25 (0.08 ± 0.01)						3.2 ± 0.2 (0.126 ± 0.008)						5 ± 0.4 (0.197 ± 0.016)				
(t) Terminal		mm max	0.5 ± 0.25 (0.02 ± 0.01)					0.5 ± 0.25 (0.02 ± 0.01)				0.61 ± 0.36 (0.024 ± 0.014)						0.61 ± 0.36 (0.024 ± 0.014)						0.64 ± 0.39 (0.025 ± 0.015)				
Voltage (V)			630	1000	1500	2000	2500	630	1000	1500	2000	630	1000	1500	2000	2500	3000	630	1000	1500	2000	2500	3000	630	1000	1500	2000	3000
Cap (pF)	101	100	B	B	B	B	B																					
	121	120	B	B	B	B	B																					
	151	150	B	B	B	B	B																					
	181	180	B	B	B	B	B																					
	221	220	B	B	B	B	B					B	B	B	B	B	B											
	271	270	B	B	B	B	B	H	H	H	H	B	B	B	B	B	B											
	331	330	B	B	B	B	B	H	H	H	H	B	B	B	B	B	B	E										
	391	390	B	B	B	B	B	H	H	H	H	B	B	B	B	B	B	E										
	471	470	B	B	B	B	B	H	H	H	H	B	B	B	B	B	B	E	E	E	E	E	E					
	561	560	B	B	B	B	B	H	H	H	H	B	B	B	B	B	B	E	E	E	E	E	E					
	681	680	B	B	B	B	B	H	H	H	H	B	B	B	B	B	B	E	E	E	E	E	E					
	821	820	B	B	B	B	B	H	H	H	H	B	B	C	C	C	C	E	E	E	E	E	E					
	102	1000	B	B	B	B	B	H	H	H	H	B	B	C	C	C	C	E	E	E	E	E	E	Z	Z	Z	Z	C
	122	1220	D	A	A	A		H	H	H	H							F	F	F	F	F		Z	Z	Z	Z	C
	152	1500	D	A	A	A		H	H	H	H							F	F	F	F	F		Z	Z	Z	Z	C
	182	1800	D	A	A			H	H	H	H							F	F	F	F	F		Z	Z	Z	Z	C
	222	2200	D	A	A			H	H	H	H							F	F	F	F	F		Z	Z	Z	Z	C
	272	2700	D	A	A			H	H	H	H							F	F	F	F	F		Z	Z	Z	Z	C
	332	3300	D	A				H	H	H	H							F	F	F	F			Z	Z	Z	Z	
	392	3900	D	A				H	H	H								F	F	F	F			Z	Z	Z	Z	
	472	4700	D	A				H	H	H								F	F	J	J			Z	Z	Z	Z	
	562	5600	D	A				H	H	H								F	F	J	J			Z	Z	Z	Z	
	682	6800	A	A				H	H									F	F	J	J			Z	Z	Z	Z	
	822	8200	A					H	H									F	F	J	J			Z	Z	C	C	
	103	0.01	A					H	H									F	F	J				C	C	C	C	
	123	0.012						H	H									F	F	J				C	C	C	C	
	153	0.015						H	H									F	F	J				C	C	C	C	
	183	0.018						H	H									F	F	J				C	C	C	C	
	223	0.022						H										F	F					C	C	C	C	
	273	0.027						H										F	F					C	C	C	C	
	333	0.033																F						C	C			
	393	0.039																F						C	C			
	473	0.047																F						C	C			
	563	0.056																						C	C			
	683	0.068																						C	C			
	823	0.082																						C	C			
	104	0.1																						C	C			
	124	0.12																						C				
	154	0.15																						C				
	224	0.22																										
	334	0.33																										
	474	0.47																										
	684	0.68																										
	105	1																										
WVDC			630	1000	1500	2000	2500	630	1000	1500	2000	630	1000	1500	2000	2500	3000	630	1000	1500	2000	2500	3000	630	1000	1500	2000	3000
Size			1206					1210				1808						1812						2220				

NOTE: Contact factory for non-specified capacitance values

Case Size	1206(KAF31)			1210(KAF32)	1808(KAF42)		1812(KAF43)			2220(KAF55)	
Thickness Letter	B	D	A	H	B	C	E	F	J	Z	C
Max Thickness	0.94	1.45	1.80	1.80	1.80	2.21	1.80	2.21	2.80	2.21	2.80
Carrier Tape	PAPER	EMB	EMB	EMB	EMB	EMB	EMB	EMB	EMB	EMB	EMB
Packaging Code 7"reel	T	U	U	U	Y	Y	V	V	V	V	V
Packaging Code 13"reel	M	L	L	L	K	K	S	S	S	S	S
	PAPER						EMBOSSED (EMB)				