

Surface Mount Multilayer Ceramic Chip Capacitors for Automotive Applications



FEATURES

- AEC-Q200 qualified with PPAP available
- Available in 0402 to 1812 body size
- Three dielectric materials
- AgPd termination for silver epoxy bonding
- High operating temperature
- Wet build process
- Reliable Noble Metal Electrode (NME) system
- Parts compliant with ELV Directive
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE
GRADE

RoHS
COMPLIANT

HALOGEN
FREE
GREEN
(5-2008)

For more than 25 years Vishay Vitramon has supported the automotive industry with robust, highly reliable MLCCs that have made it a leader in this segment. All Vishay Vitramon MLCCs are manufactured in "Precious Metal Technology" (PMT/NME) with a wet build process. They are qualified according to AEC-Q200 with PPAP available on request. Applications for these devices include automotive "under the hood", safety and comfort electronics. Their termination finish is AgPd which is used with silver epoxy bonding.

COG (NP0) DIELECTRIC

GENERAL SPECIFICATION

Note

Electrical characteristics at +25 °C unless otherwise specified

Operating Temperature: -55 °C to +150 °C
(above +125 °C changed characteristics 2.3)

Capacitance Range: 1 pF to 22 nF

Voltage Range: 25 V_{DC} to 3000 V_{DC}

Temperature Coefficient of Capacitance (TCC):
0 ppm/°C ± 30 ppm/°C from -55 °C to +125 °C

Dissipation Factor (DF):

0.1 % maximum at 1.0 V_{RMS} and
1 MHz for values ≤ 1000 pF
0.1 % maximum at 1.0 V_{RMS} and
1 kHz for values > 1000 pF

Insulating Resistance:

at +25 °C 100 000 MΩ min. or 1000 ΩF whichever is less
at +125 °C 10 000 MΩ min. or 100 ΩF whichever is less

Aging: 0 % maximum per decade

Dielectric Strength Test:

Performed per method 103 of EIA 198-2-E.

Applied test voltages

≤ 250 V _{DC} -rated:	250 % of rated voltage
500 V _{DC} -rated:	200 % of rated voltage
630 V _{DC} , 1000 V _{DC} -rated:	150 % of rated voltage
3000 V _{DC} -rated:	120 % of rated voltage

X7R, X8R DIELECTRIC

GENERAL SPECIFICATION

Note

Electrical characteristics at +25 °C unless otherwise specified

Operating Temperature: -55 °C to +150 °C
(X7R above +125 °C changed characteristics 2.3)

Capacitance Range:

X7R: 120 pF to 1.0 μF
X8R: 330 pF to 220 nF

Voltage Range:

X7R: 16 V_{DC} to 630 V_{DC}
X8R: 25 V_{DC} to 100 V_{DC}

Temperature Coefficient of Capacitance (TCC):

X7R: ± 15 % from -55 °C to +125 °C, with 0 V_{DC} applied
X8R: ± 15 % from -55 °C to +150 °C, with 0 V_{DC} applied

Dissipation Factor (DF):

16 V, 25 V ratings: 3.5 % maximum at 1.0 V_{RMS} and 1 kHz
> 25 V ratings: 2.5 % maximum at 1.0 V_{RMS} and 1 kHz

Insulating Resistance:

at +25 °C 100 000 MΩ min. or 1000 ΩF whichever is less
at +125 °C 10 000 MΩ min. or 100 ΩF whichever is less

Aging Rate: 1 % maximum per decade

Dielectric Strength Test:

Performed per method 103 of EIA 198-2-E.

Applied test voltages

≤ 250 V _{DC} -rated:	250 % of rated voltage
500 V _{DC} -rated:	min. 150 % of rated voltage
630 V _{DC} -rated:	min. 120 % of rated voltage



QUICK REFERENCE DATA

DIELECTRIC	CASE CODE	MAXIMUM VOLTAGE (V)	CAPACITANCE	
			MINIMUM	MAXIMUM
C0G (NP0)	0402	100	1.0 pF	220 pF
	0603	200	1.0 pF	1.0 nF
	0805	500	1.0 pF	3.9 nF
	1206	630	1.0 pF	8.2 nF
	1210	630	100 pF	12 nF
	1812	3000	27 pF	22 nF
X7R	0402	100	120 pF	33 nF
	0603	200	330 pF	150 nF
	0805	250	330 pF	470 nF
	1206	630	220 pF	1.0 μ F
	1210	630	390 pF	1.0 μ F
	1812	630	10 nF	1.0 μ F
X8R	0402	100	330 pF	6.8 nF
	0603	100	470 pF	33 nF
	0805	100	470 pF	100 nF
	1206	50	1.0 nF	220 nF
	1210	50	10 nF	220 nF

Note

- Detail ratings see "Selection Chart"

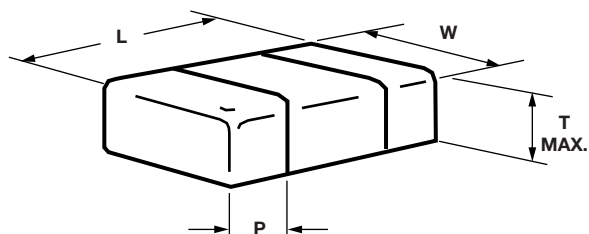
ORDERING INFORMATION - SILVER PALLADIUM TERMINATION

GA0805	Y	102	K	E	A	A	O	34G
CASE CODE	DIELECTRIC	CAPACITANCE NOMINAL CODE	CAPACITANCE TOLERANCE	TERMINATION	DC VOLTAGE RATING ⁽¹⁾	MARKING	PACKAGING	PROCESS CODE
0402 0603 0805 1206 1210 1812	A = C0G (NP0) Y = X7R H = X8R	Expressed in picofarads (pF). The first two digits are significant, the third is a multiplier. An "R" indicates a decimal point. Examples 102 = 1000 pF	B = ± 0.10 pF C = ± 0.25 pF D = ± 0.5 pF F = ± 1 % G = ± 2 % J = ± 5 % K = ± 10 % M = ± 20 % Note: C0G (NP0): B, C, D < 10 pF F, G, J, K ≥ 10 pF X7R/X8R: J, K, M	E = AgPd ⁽²⁾	J = 16 V X = 25 V A = 50 V B = 100 V C = 200 V P = 250 V E = 500 V L = 630 V G = 1000 V H = 3000 V	A = unmarked Note: marking is not available		34G = "Green" automotive AgPd finish
T = 7" reel / plastic tape O = 7" reel / flamed paper tape R = 11 1/4" / 13" reel / plastic tape I = 11 1/4" / 13" reel / flamed paper tape Note: "I" and "O" are used for size 0402 / 0603 / 0805								

Notes

- ⁽¹⁾ DC voltage rating should not be exceeded in application. Other application factors may affect the MLCC performance. Consult for questions: mlcc@vishay.com
- ⁽²⁾ Termination code "E" is for conductive epoxy assembly.

DIMENSIONS in inches (millimeters)



CASE CODE	STYLE	LENGTH (L)	WIDTH (W)	MAXIMUM THICKNESS (T)	TERMINATIONS PAD (P)	
					MINIMUM	MAXIMUM
0402	GA0402	0.040 + 0.004/- 0.002 (1.00 + 0.10/- 0.05)	0.020 + 0.004/- 0.002 (0.50 + 0.10/- 0.05)	0.024 (0.60)	0.004 (0.10)	0.016 (0.41)
0603	GA0603	0.063 ± 0.006 (1.60 ± 0.15)	0.031 ± 0.006 (0.80 ± 0.15)	0.038 (0.97)	0.012 (0.30)	0.018 (0.46)
0805	GA0805	0.079 ± 0.008 (2.00 ± 0.20)	0.049 ± 0.008 (1.25 ± 0.20)	0.057 (1.45)	0.010 (0.25)	0.028 (0.71)
1206	GA1206	0.126 ± 0.010 (3.20 ± 0.25)	0.063 ± 0.010 (1.60 ± 0.25)	0.067 (1.70)	0.010 (0.25)	0.028 (0.71)
1210	GA1210	0.126 ± 0.010 (3.20 ± 0.25)	0.098 ± 0.010 (2.50 ± 0.25)	0.076 (1.94)	0.010 (0.25)	0.028 (0.71)
1812	GA1812	0.177 ± 0.010 (4.50 ± 0.25)	0.126 ± 0.010 (3.20 ± 0.25)	0.086 (2.18)	0.010 (0.25)	0.030 (0.76)



SELECTION CHART

DIELECTRIC		C0G (NP0)									
STYLE		GA0402			GA0603			GA0805			
CASE CODE		0402			0603			0805			
VOLTAGE (V _{DC})		25	50	100	50	100	200	50	100	200	500
VOLTAGE CODE		X	A	B	A	B	C	A	B	C	E
CAP. CODE	CAP.										
1R0	1.0 pF	••	••	••	••	••	••	••	••	••	••
1R2	1.2 pF	••	••	••	••	••	••	••	••	••	••
1R5	1.5 pF	••	••	••	••	••	••	••	••	••	••
1R8	1.8 pF	••	••	••	••	••	••	••	••	••	••
2R2	2.2 pF	••	••	••	••	••	••	••	••	••	••
2R7	2.7 pF	••	••	••	••	••	••	••	••	••	••
3R3	3.3 pF	••	••	••	••	••	••	••	••	••	••
3R9	3.9 pF	••	••	••	••	••	••	••	••	••	••
4R7	4.7 pF	••	••	••	••	••	••	••	••	••	••
5R6	5.6 pF	••	••	••	••	••	••	••	••	••	••
6R8	6.8 pF	••	••	••	••	••	••	••	••	••	••
8R2	8.2 pF	••	••	••	••	••	••	••	••	••	••
100	10 pF				••	••	••	••	••	••	••
120	12 pF				••	••	••	••	••	••	••
150	15 pF				••	••	••	••	••	••	••
180	18 pF				••	••	••	••	••	••	••
220	22 pF	••	••	••	••	••	••	••	••	••	••
270	27 pF	••	••	••	••	••	••	••	••	••	••
330	33 pF	••	••	••	••	••	••	••	••	••	••
390	39 pF	••	••	••	••	••	••	••	••	••	••
470	47 pF	••	••	••	••	••	••	••	••	••	••
560	56 pF	••	••	••	••	••	••	••	••	••	••
680	68 pF	••	••	••	••	••	••	••	••	••	••
820	82 pF	••	••	••	••	••	••	••	••	••	••
101	100 pF	••	••	••	••	••	••	••	••	••	••
121	120 pF	••	••	••	••	••	••	••	••	••	••
151	150 pF	••	••		••	••	••	••	••	••	••
181	180 pF	••	••		••	••	•	••	••	••	••
221	220 pF	••	••		••	••	•	••	••	••	•
271	270 pF				••	••	•	••	••	••	•
331	330 pF				••	••		••	••	••	•
391	390 pF				••	••		••	••	••	•
471	470 pF				••	••		••	••	•	•
561	560 pF				••			••	••	•	
681	680 pF				••			••	••	•	
821	820 pF				••			••	••	•	
102	1.0 nF				••			••	••	•	
122	1.2 nF							••	•		
152	1.5 nF							••	•		
182	1.8 nF							•	•		
222	2.2 nF							•			
272	2.7 nF							•			
332	3.3 nF							•			
392	3.9 nF							•			
472	4.7 nF										
562	5.6 nF										
682	6.8 nF										
822	8.2 nF										
103	10 nF										
123	12 nF										
153	15 nF										
183	18 nF										
223	22 nF										
273	27 nF										
333	33 nF										
393	39 nF										
473	47 nF										
563	56 nF										

Note

•• Paper tape, • Plastic tape



SELECTION CHART																			
DIELECTRIC		C0G (NP0)																	
STYLE		GA1206 ⁽¹⁾						GA1210 ⁽¹⁾						GA1812 ⁽¹⁾					
CASE CODE		1206 ⁽¹⁾						1210 ⁽¹⁾						1812 ⁽¹⁾					
VOLTAGE (V _{DC})		50	100	200	250	500	630	50	100	200	500	630	50	100	200	500	630	1000	3000
VOLTAGE CODE		A	B	C	P	E	L	A	B	C	E	L	A	B	C	E	L	G	H
CAP. CODE	CAP.																		
1R0	1.0 pF	•	•	•		•	•												
1R2	1.2 pF	•	•	•		•	•												
1R5	1.5 pF	•	•	•		•	•												
1R8	1.8 pF	•	•	•		•	•												
2R2	2.2 pF	•	•	•		•	•												
2R7	2.7 pF	•	•	•		•	•												
3R3	3.3 pF	•	•	•		•	•												
3R9	3.9 pF	•	•	•		•	•												
4R7	4.7 pF	•	•	•		•	•												
5R6	5.6 pF	•	•	•		•	•												
6R8	6.8 pF	•	•	•		•	•												
8R2	8.2 pF	•	•	•		•	•												
100	10 pF	•	•	•		•	•												
120	12 pF	•	•	•		•	•												
150	15 pF	•	•	•		•	•												
180	18 pF	•	•	•		•	•												
220	22 pF	•	•	•		•	•												
270	27 pF	•	•	•		•	•											•	•
330	33 pF	•	•	•		•	•											•	•
390	39 pF	•	•	•		•	•						•	•	•	•	•	•	•
470	47 pF	•	•	•		•	•						•	•	•	•	•	•	•
560	56 pF	•	•	•		•	•						•	•	•	•	•	•	•
680	68 pF	•	•	•		•	•						•	•	•	•	•	•	•
820	82 pF	•	•	•		•	•						•	•	•	•	•	•	•
101	100 pF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
121	120 pF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
151	150 pF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
181	180 pF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
221	220 pF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
271	270 pF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
331	330 pF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
391	390 pF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
471	470 pF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
561	560 pF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
681	680 pF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
821	820 pF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
102	1.0 nF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
122	1.2 nF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
152	1.5 nF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
182	1.8 nF	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•
222	2.2 nF	•	•	•	•			•	•	•			•	•	•	•	•	•	•
272	2.7 nF	•	•	•				•	•	•			•	•	•	•	•	•	•
332	3.3 nF	•	•	•				•	•	•			•	•	•	•	•	•	•
392	3.9 nF	•	•					•	•	•			•	•	•	•	•	•	•
472	4.7 nF	•	•					•	•	•			•	•	•	•	•	•	•
562	5.6 nF	•	•					•	•	•			•	•	•	•	•	•	•
682	6.8 nF	•	•					•	•	•			•	•	•	•	•	•	•
822	8.2 nF	•	•					•	•	•			•	•	•	•	•	•	•
103	10 nF							•	•				•	•	•				
123	12 nF							•	•				•	•	•				
153	15 nF												•	•					
183	18 nF												•						
223	22 nF												•						
273	27 nF																		
333	33 nF																		
393	39 nF																		
473	47 nF																		
563	56 nF																		

Notes

•• Paper tape, • Plastic tape

⁽¹⁾ See soldering recommendations within this data book, or visit www.vishay.com/doc?45034



SELECTION CHART

DIELECTRIC		X7R														
STYLE		GA0402				GA0603					GA0805					
CASE CODE		0402				0603					0805					
VOLTAGE (V _{DC})		16	25	50	100	16	25	50	100	200	16	25	50	100	200	250
VOLTAGE CODE		J	X	A	B	J	X	A	B	C	J	X	A	B	C	P
CAP. CODE	CAP.															
121	120 pF	••	••	••	••											
151	150 pF	••	••	••	••											
181	180 pF	••	••	••	••											
221	220 pF	••	••	••	••											
271	270 pF	••	••	••	••											
331	330 pF	••	••	••	••			••	••	••	••	••	••	••	••	
391	390 pF	••	••	••	••	••	••	••	••	••	••	••	••	••	••	
471	470 pF	••	••	••	••	••	••	••	••	••	••	••	••	••	••	
561	560 pF	••	••	••	••	••	••	••	••	••	••	••	••	••	••	
681	680 pF	••	••	••	••	••	••	••	••	••	••	••	••	••	••	
821	820 pF	••	••	••	••	••	••	••	••	••	••	••	••	••	••	
102	1.0 nF	••	••	••	••	••	••	••	••	••	••	••	••	••	••	
122	1.2 nF	••	••	••	••	••	••	••	••	••	••	••	••	••	••	
152	1.5 nF	••	••	••	••	••	••	••	••	••	••	••	••	••	••	
182	1.8 nF	••	••	••	••	••	••	••	••	••	••	••	••	••	••	
222	2.2 nF	••	••	••	••	••	••	••	••	••	••	••	••	••	••	
272	2.7 nF	••	••	••	••	••	••	••	••	••	••	••	••	••	••	
332	3.3 nF	••	••	••	••	••	••	••	••	••	••	••	••	••	••	
392	3.9 nF	••	••	••	••	••	••	••	••	••	••	••	••	••	••	
472	4.7 nF	••	••	••	••	••	••	••	••	••	••	••	••	••	••	
562	5.6 nF	••	••	••		••	••	••	••		••	••	••	••	••	
682	6.8 nF	••	••	••		••	••	••	••		••	••	••	••	••	
822	8.2 nF	••	••	••		••	••	••	••		••	••	••	••	••	
103	10 nF	••	••	••		••	••	••	••		••	••	••	••	••	••
123	12 nF	••	••			••	••	••	••		••	••	••	••	•	
153	15 nF	••	••			••	••	••	••		••	••	••	••	•	
183	18 nF	••	••			••	••	••	••		••	••	••	••	•	
223	22 nF	••				••	••	••	••		••	••	••	••	•	
273	27 nF	••				••	••	••	••		••	••	••	••	•	
333	33 nF	••				••	••	••	••		••	••	••	•		
393	39 nF					••	••	••	••		••	••	••	•		
473	47 nF					••	••	••			••	••	••	•		
563	56 nF					••	••	••			••	••	••	•		
683	68 nF					••	••	••			•	•	•	•		
823	82 nF					••	••	••			•	•	•	•		
104	100 nF					••	••	••			•	•	•	•		
124	120 nF					•					•	•	•			
154	150 nF					•					•	•	•			
184	180 nF										•	•				
224	220 nF										•	•				
274	270 nF										•	•				
334	330 nF										•	•				
394	390 nF										•					
474	470 nF										•					
564	560 nF															
684	680 nF															
824	820 nF															
105	1.0 µF															
125	1.2 µF															
155	1.5 µF															
185	1.8 µF															
225	2.2 µF															
275	2.7 µF															
335	3.3 µF															
395	3.9 µF															
475	4.7 µF															
565	5.6 µF															
685	6.8 µF															

Note

•• Paper tape, • Plastic tape

[illegible]

(1) See soldering recommendations within this data book, or visit www.vishay.com/doc?45034



SELECTION CHART

DIELECTRIC		X8R												
STYLE		GA0402			GA0603			GA0805			GA1206		GA1210 ⁽¹⁾	
CASE CODE		0402			0603			0805			1206		1210 ⁽¹⁾	
VOLTAGE (V _{DC})		25	50	100	25	50	100	25	50	100	25	50	25	50
VOLTAGE CODE		X	A	B	X	A	B	X	A	B	X	A	X	A
CAP. CODE	CAP.													
101	100 pF													
121	120 pF													
151	150 pF													
181	180 pF													
221	220 pF													
271	270 pF													
331	330 pF	••	••	••										
391	390 pF	••	••	••										
471	470 pF	••	••	••		••	••	••	••	••				
561	560 pF	••	••	••		••	••	••	••	••				
681	680 pF	••	••	••	••	••	••	••	••	••				
821	820 pF	••	••	••	••	••	••	••	••	••				
102	1.0 nF	••	••	••	••	••	••	••	••	••	•	•		
122	1.2 nF	••	••	••	••	••	••	••	••	••	•	•		
152	1.5 nF	••	••		••	••	••	••	••	••	•	•		
182	1.8 nF	••	••		••	••	••	••	••	••	•	•		
222	2.2 nF	••	••		••	••	••	••	••	••	•	•		
272	2.7 nF	••			••	••	••	••	••	••	•	•		
332	3.3 nF	••			••	••	••	••	••	••	•	•		
392	3.9 nF	••			••	••	••	••	••	••	•	•		
472	4.7 nF	••			••	••	••	••	••	••	•	•		
562	5.6 nF	••			••	••		••	••	••	•	•		
682	6.8 nF	••			••	••		••	••	••	•	•		
822	8.2 nF				••	••		••	••	••	•	•		
103	10 nF				••	••		••	••	••	•	•	•	•
123	12 nF				••	••		••	••	••	•	•	•	•
153	15 nF				••	••		••	••	••	•	•	•	•
183	18 nF				••	••		••	••	••	•	•	•	•
223	22 nF				••			••	••	•	•	•	•	•
273	27 nF				••			••	•	•	•	•	•	•
333	33 nF				••			••	•		•	•	•	•
393	39 nF							••	•		•	•	•	•
473	47 nF							•	•		•	•	•	•
563	56 nF							•	•		•	•	•	•
683	68 nF							•			•	•	•	•
823	82 nF							•			•	•	•	•
104	100 nF							•			•	•	•	•
124	120 nF										•	•	•	•
154	150 nF										•		•	•
184	180 nF										•		•	
224	220 nF										•		•	
274	270 nF													
334	330 nF													
394	390 nF													
474	470 nF													
564	560 nF													
684	680 nF													
824	820 nF													
105	1.0 µF													
125	1.2 µF													

Notes

•• Paper tape, • Plastic tape

⁽¹⁾ See soldering recommendations within this data book, or visit www.vishay.com/doc?45034



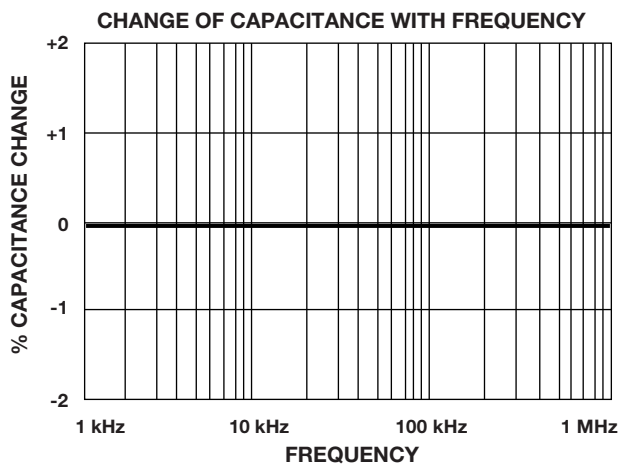
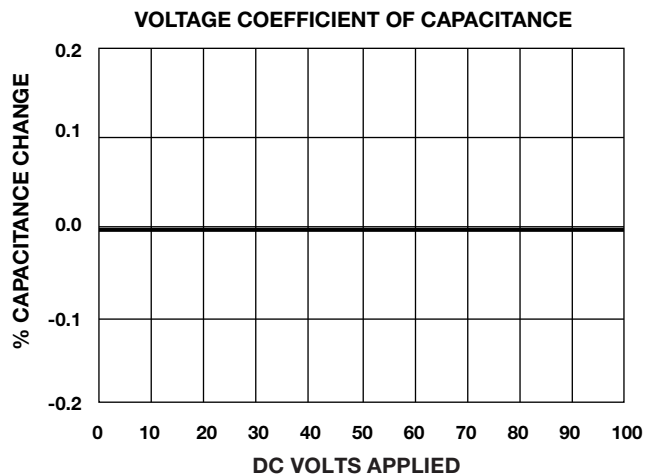
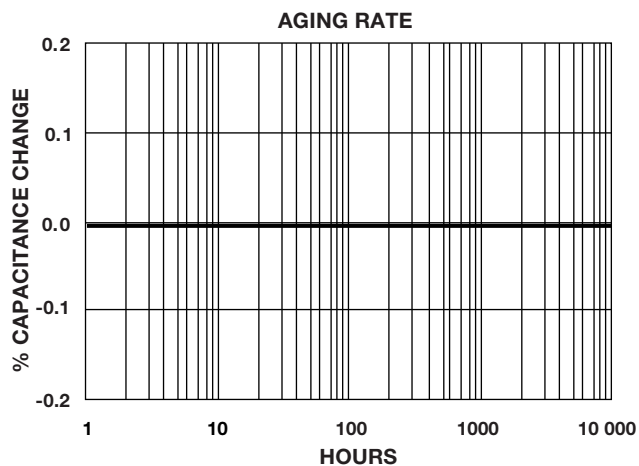
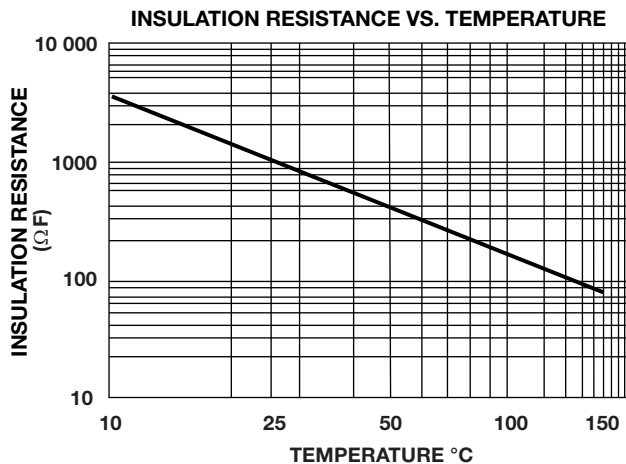
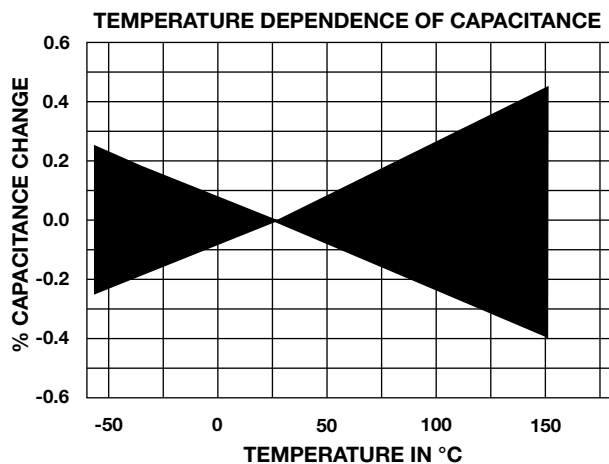
STANDARD PACKAGING QUANTITIES (1)(2)					
CASE CODE	TAPE SIZE	7" REEL QUANTITIES		11 1/4" AND 13" REEL QUANTITIES	
		PAPER TAPE PACKAGING CODE "O"	PLASTIC TAPE PACKAGING CODE "T"	PAPER TAPE PACKAGING CODE "I"	PLASTIC TAPE PACKAGING CODE "R"
0402	8 mm	5000 / 10 000 ⁽³⁾	n/a	10 000 / 30 000 ⁽³⁾	n/a
0603 ⁽⁴⁾	8 mm	4000	4000	10 000	10 000
0805 ⁽⁴⁾	8 mm	3000	3000	10 000	10 000
1206 ⁽⁴⁾	8 mm	n/a	2500 / 3000	n/a	9000 / 10 000
1210 ⁽⁴⁾	8 mm	n/a	2000 / 2500 / 3000	n/a	9000 / 10 000
1812	12 mm	n/a	1000	n/a	4000

Notes

- (1) Reference: EIA standard RS 481 - "Taping of Surface Mount Components for Automatic Placement"
- (2) n/a = Not available
- (3) Quantity can vary with customer request
- (4) Packaging "O / I" or "T / R" and quantity can depend from product thickness

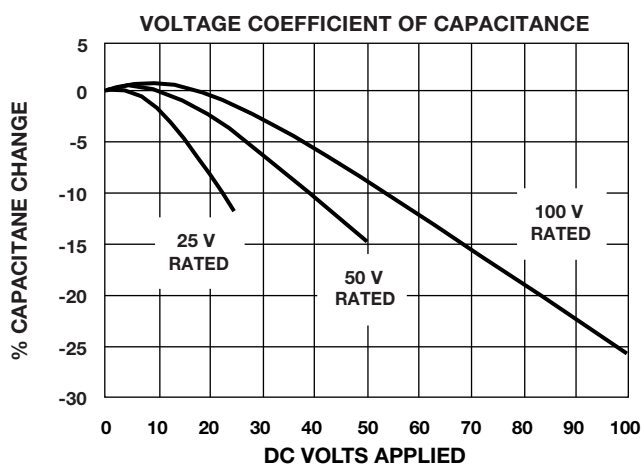
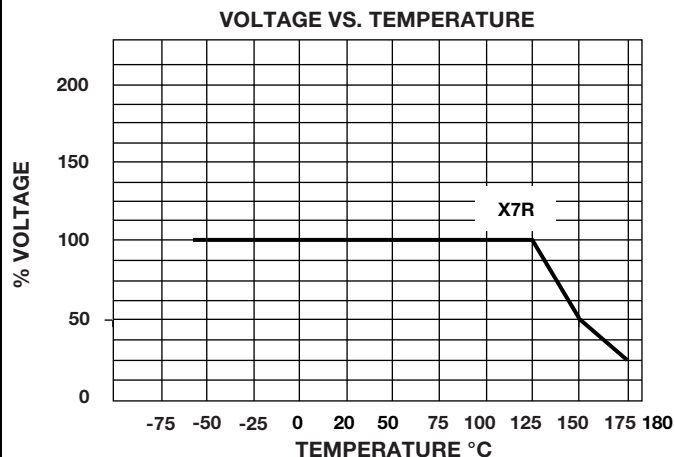
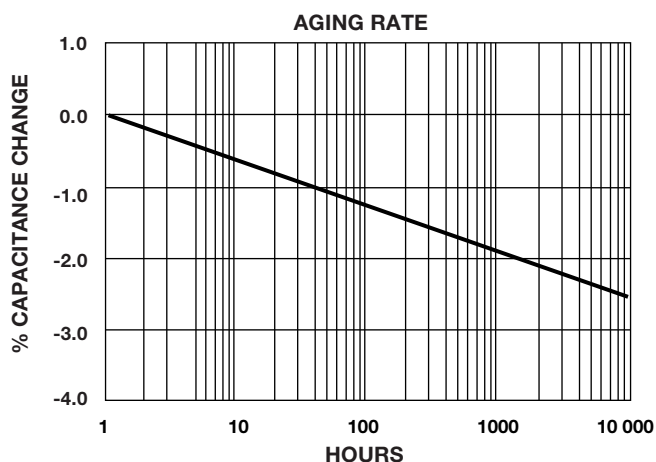
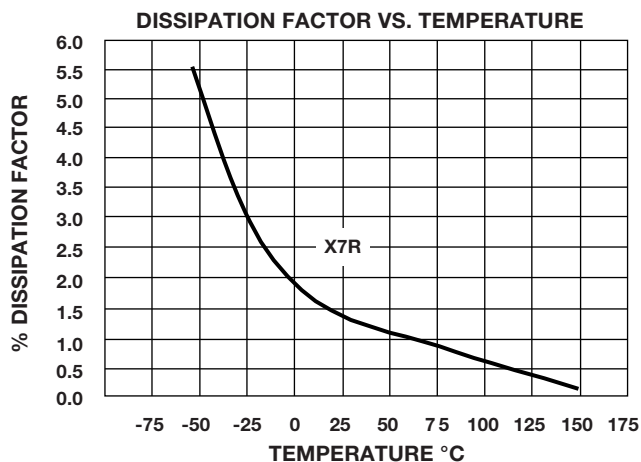
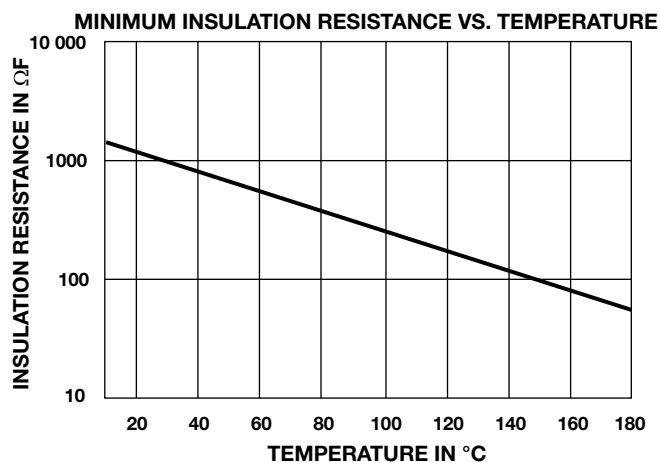
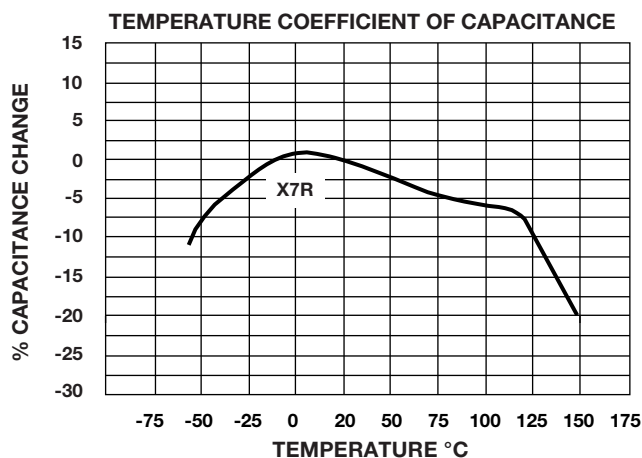


COG (NP0) DIELECTRIC - TYPICAL PARAMETERS



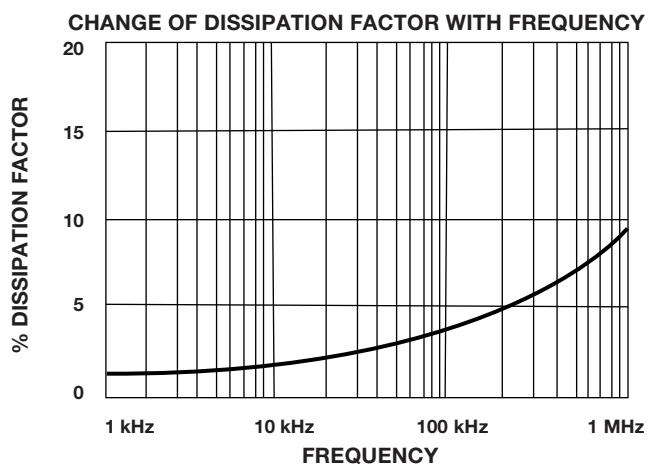
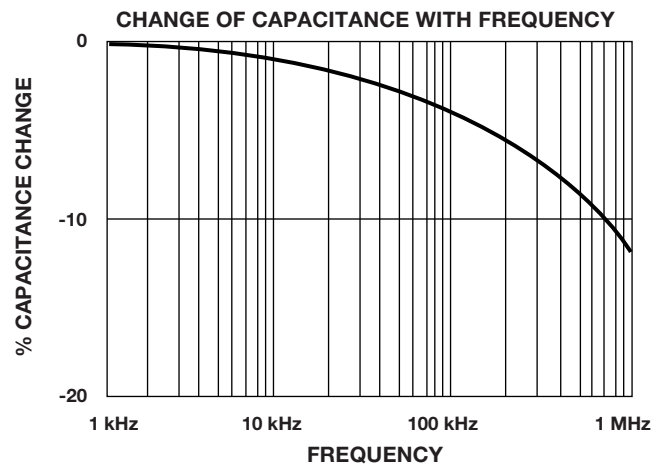
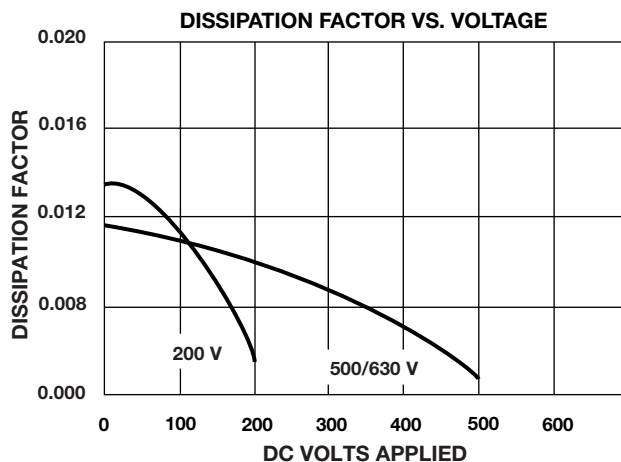
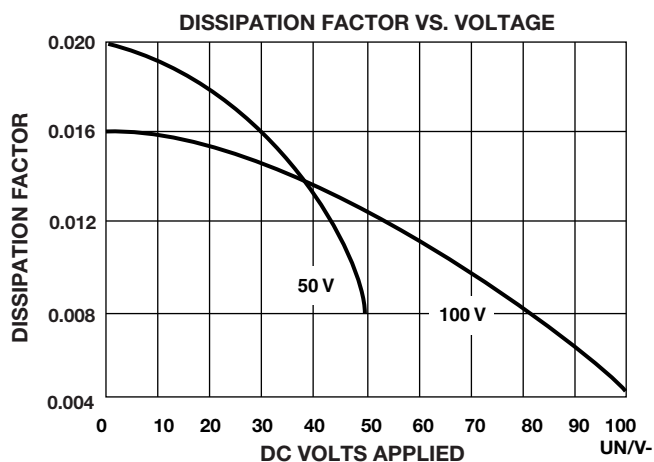


X7R DIELECTRIC - TYPICAL PARAMETERS



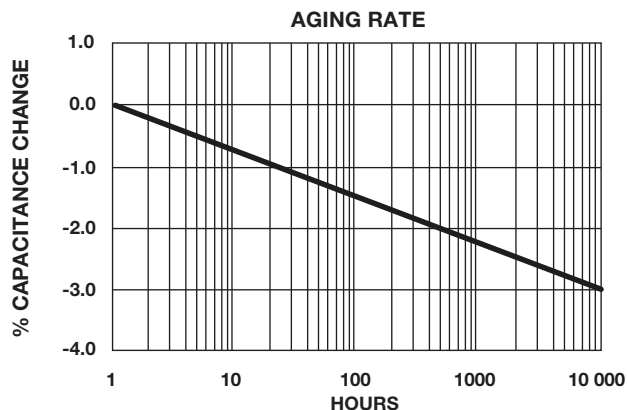
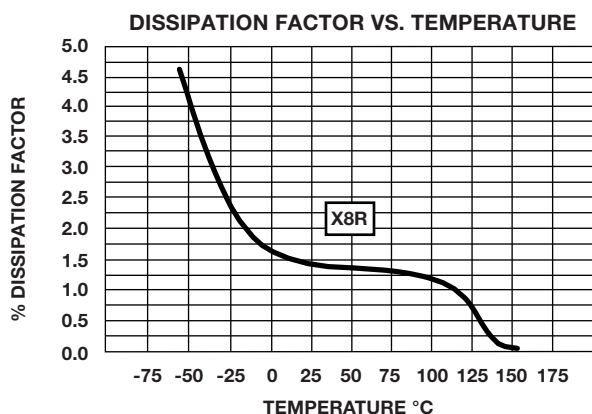
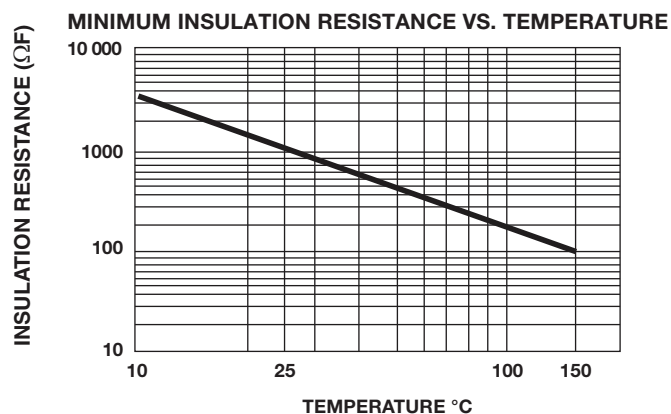
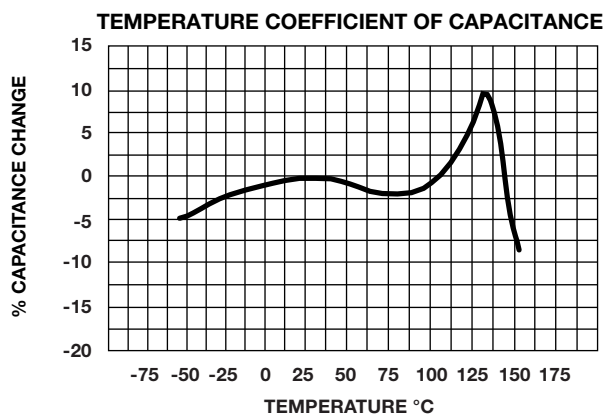


X7R DIELECTRIC - TYPICAL PARAMETERS





X8R DIELECTRIC - TYPICAL PARAMETERS



**1 - GENERAL CERTIFICATES**

# Quality management system according to ISO/TS 16949: 2009	Yes
# Quality management system according to ISO 9001: 2008	Yes
# Environmental certification according to ISO 14001: 2004	Yes
# Health and safety system according to OHSA 18001	Yes

2 - TECHNICAL REQUIREMENTS

Unless specified in component specification, these parameters are the minimum requirements for the components.

2.1 OPERATING TEMPERATURE RANGE

For standard applications	T _A : -55 °C to +125 °C	See characteristics 2.3
For high temperature applications	T _A : -55 °C to +150 °C	See characteristics 2.3
For ultra high temperature applications	T _A : -55 °C to +175 °C	See characteristics 2.3

2.2 STORAGE AND HANDLING CONDITIONS

- (1) Store the components at 5 °C to +40 °C ambient temperature and ≤ 70 % relative humidity conditions.
 (2) The product is recommended to be used within a time-frame of 2 years after shipment.

Precautions:

- Do not store products in an environment containing corrosive elements, especially where chloride gas, sulfide gas, acid, alkali, salt or the like are present. This may cause corrosion or oxidization of the terminations, which can easily lead to poor soldering.
- Store products on the shelf and avoid exposure to moisture or dust.
- Do not expose products to excessive shock, vibration, direct sunlight and so on.

2.3 CHARACTERISTICS

PARAMETER	CERAMIC TYPE	SYMBOL	RATINGS	TEST CONDITIONS/REMARKS
Rated voltage in temperature range -55 °C to +125 °C	C0G (NP0)	U _R	25 V to 3000 V	
	X7R		16 V to 630 V	
Rated voltage in temperature range -55 °C to +150 °C	X8R		25 V to 100 V	
Derating at higher temperature up to +150 °C	C0G (NP0)		25 V to 100 V	U _{DC} ≤ 1/2 U _R
	X7R		16 V to 100 V	U _{DC} ≤ 1/2 U _R
Derating at higher temperature up to +175 °C	C0G (NP0)		25 V to 100 V	U _{DC} ≤ 1/4 U _R
	X7R		16 V to 100 V	U _{DC} ≤ 1/4 U _R
	X8R		25 V to 100 V	U _{DC} ≤ 1/4 U _R
Temperature coefficient in temperature range -55 °C to +125 °C	C0G (NP0)	α _C	≤ ± 30 ppm/°C	if C _R < 10 pF: α _C ≤ ± 120 ppm/°C
	X7R	ΔC	≤ ± 15 %	
Temperature coefficient in temperature range -55 °C to +150 °C	C0G (NP0)	α _C	≤ ± 30 ppm/°C	if C _R < 10 pF: α _C ≤ ± 120 ppm/°C
	X7R	ΔC	+ 15 % / - 30 %	
	X8R		≤ ± 15 %	
Temperature coefficient in temperature range -55 °C to +175 °C	X7R	ΔC	+ 15 % / - 55 %	
Dissipation factor in temperature range -55 °C to +175 °C	C0G (NP0)	tan δ	≤ 0.002	
	X7R		≤ 0.06	
	X8R		≤ 0.06	

3 - LOT ACCEPTANCE TESTS

Process tests available in classes (on request)

GROUP	ACTION
A	Components are tested within the monitoring program of the supplier. The supplier shall submit the part numbers of the selected component to the customer during the component specification discussions.
B	Components (customer P/N) shall be tested quarterly. Records available only on special request by the customer.
C	Test with each shipment. Records are provided on a monthly basis. Customer special requirement; requirement should be determined in a specific component specification.

Upon request the records can be submitted in electronic format on monthly basis.

4 - ENVIRONMENTAL REQUIREMENTS

A list of the chemical substances content, which must not be used or whose use shall be limited by international law, is available on request.

Vishay confirms that the components specified in this specification do not contain asbestos nor cadmium, not even in the smallest volumes.

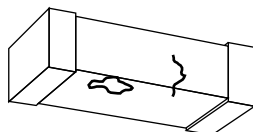
The manufacturer / supplier confirms that the component during normal handling, storage and assembly, as well as during operation in the automobile, is non-toxic.

5 - INSPECTION CRITERIA

The supplier shall carry out visual examination with suitable equipment with approximately 10 x magnification and lighting appropriate to the specimen under test and the required quality level.

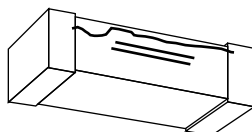
Chipping

The components shall be free of cracks or fissures. Small damages which do not deteriorate the performance of the component shall be less than 50 % of the surface of the MLCC as defined in EIA 595.



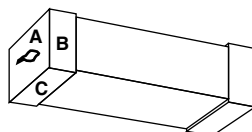
Delamination or Exposed Electrodes

No visible separation or delamination between layers of the capacitor and no exposed electrodes between the two terminals of the capacitor must be seen.



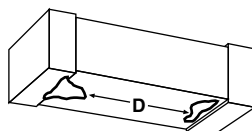
Metallization

For the metallization, no visible detachment of the metallized terminals and no exposed electrodes must be seen. Defects and gaps in the metallization on each sides of the terminal must not exceed 10 % of the total area (e.g. A, B, C, ...). Leaching shall not exceed 25 %.



Electrode Distance

The ceramic body shall be free of any conducting material between the terminals which reduces the distance of the electrodes. The minimum distance "d" is 400 µm for all package sizes, except 0603. For the component package "0603" the minimum distance is 200 µm.



**6 - AEC-Q200 QUALIFICATION TESTING**

NO.	AEC-Q200 TEST ITEM	REFERENCE
1	Pre- and post stress electrical test	User specification
3	High temp exposure (storage)	MIL-STD-202, method 108
4	Temperature cycling	JESD22, method JA-104
5	Destructive physical analysis	EIA-469
6	Moisture resistance	MIL-STD-202, method 106
7	Biased humidity	MIL-STD-202, method 103
8	Operation life	MIL-STD-202 method 108
9	External Visual	MIL-STD-883 method 209
10	Physical dimension	JESD22, method JB-100
13	Mechanical shock	MIL-STD-202, method 213
14	Vibration	MIL-STD-202, method 204
16	Thermal shock and immersion	MIL-STD-202, method 107
17	ESD	AEC-Q200-002
19	Electrical characterization	User specification Cap. / DF / IR / TCC / DWV
22	Terminal strength	JIS-C-6429
23	Beam load	AEC-Q200-003



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