

Overview

KEMET's X7R dielectric features a 125°C maximum operating temperature and is considered "temperature stable." The Electronics Components, Assemblies & Materials Association (EIA) characterizes X7R dielectric as a Class II material. Components of this classification are fixed, ceramic dielectric capacitors suited for bypass and decoupling applications or for frequency discriminating circuits where Q and stability of capacitance characteristics are not critical. X7R exhibits a predictable change in capacitance with respect to time and

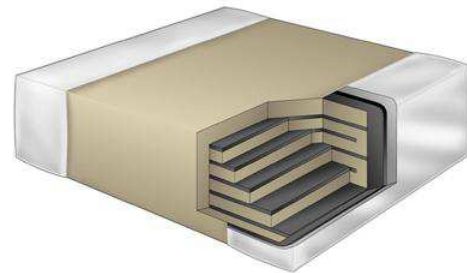
voltage and boasts a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to $\pm 15\%$ from -55°C to +125°C.

Benefits

- -55°C to +125°C operating temperature range
- Pb-Free and RoHS compliant
- Temperature stable dielectric
- EIA 0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220 and 2225 case sizes
- DC voltage ratings of 6.3V, 10V, 16V, 25V, 50V, 100V, 200V and 250V
- Capacitance offerings ranging from 150pF to 47 μ F
- Available capacitance tolerances of $\pm 5\%$, $\pm 10\%$ and $\pm 20\%$
- Non-polar device, minimizing installation concerns
- 100% pure matte tin-plated termination finish allowing for excellent solderability
- SnPb termination finish option available upon request (5% min)

Applications

Typical applications include decoupling, bypass, filtering and transient voltage suppression.



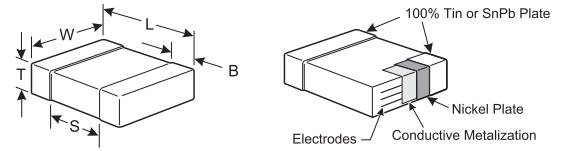
Ordering Information

C	1206	C	106	M	4	R	A	C	TU
Ceramic	Case Size (L" x W")	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance	Voltage	Dielectric	Failure Rate/ Design	Termination Finish ²	Packaging/Grade (C-Spec) ²
	0402 0603 0805 1206 1210 1808 1812 1825 2220 2225	C = Standard	2 Sig. Digits + Number of Zeros	J = $\pm 5\%$ K = $\pm 10\%$ M = $\pm 20\%$	9 = 6.3 8 = 10V 4 = 16V 3 = 25V 6 = 35V 5 = 50V 1 = 100V 2 = 200V A = 250V	R = X7R	A = N/A	C = 100% Matte Sn	Blank = Bulk TU = 7" Reel Unmarked TM = 7" Reel Marked

¹ Additional termination finish options may be available. Contact KEMET for details.

² Additional reeling or packaging options may be available. Contact KEMET for details.

Dimensions – Millimeters (Inches)



EIA Size Code	Metric Size Code	L Length	W Width	T Thickness	B Bandwidth	S Separation Min.	Mounting Technique
0402	1005	1.00 (.040) ± 0.05 (.002)	0.50 (.020) ± 0.05 (.002)	See Table 2 for Thickness	0.30 (.012) ± 0.10 (.004)	0.30 (.012)	Solder Reflow Only
0603	1608	1.60 (.063) ± 0.15 (.006)	0.80 (.032) ± 0.15 (.006)		0.35 (.014) ± 0.15 (.006)	0.70 (.028)	Solder Wave or Solder Reflow
0805	2012	2.00 (.079) ± 0.20 (.008)	1.25 (.049) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	0.75 (.030)	
1206	3216	3.20 (.126) ± 0.20 (.008)	1.60 (.063) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)	N/A	Solder Reflow Only
1210	3225	3.20 (.126) ± 0.20 (.008)	2.50 (.098) ± 0.20 (.008)		0.50 (0.02) ± 0.25 (.010)		
1808	4520	4.70 (.185) ± 0.50 (.020)	2.00 (.079) ± 0.20 (.008)		0.60 (.024) ± 0.35 (.014)		
1812	4532	4.50 (.177) ± 0.30 (.012)	3.20 (.126) ± 0.30 (.012)		0.60 (.024) ± 0.35 (.014)		
1825	4564	4.50 (.177) ± 0.30 (.012)	6.40 (.252) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		
2220	5650	5.70 (.224) ± 0.40 (.016)	5.00 (.197) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		
2225	5664	5.60 (.220) ± 0.40 (.016)	6.40 (.248) ± 0.40 (.016)		0.60 (.024) ± 0.35 (.014)		

Qualification/Certification

Commercial grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 4, Performance and Reliability.

Environmental Compliance

Pb-Free and RoHS compliant

Electrical Parameters/Characteristics

Item	Parameters/Characteristics
Operating Temperature Range	-55°C to +125°C
Capacitance Change with Reference to +25°C and 0 Vdc Applied (TCC)	±15%
Aging Rate (Max % Cap Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage	250% of rated voltage (5 ± 1 seconds and charge/discharge not exceeding 50mA)
Dissipation Factor (DF) Maximum Limits @ 25°C	5%(10V), 3.5%(16V & 25V) and 2.5%(50V to 250V)
Insulation Resistance (IR) Limit @ 25°C	See Insulation Resistance Limit Table (Rated voltage applied for 120 ± 5 secs @ 25°C)

Regarding Aging Rate: Capacitance measurements (including tolerance) are indexed to a referee time of 48 or 1000 Hours. Please refer to a part number specific datasheet for referee time details.

To obtain IR limit, divide $M\Omega\text{-}\mu F$ value by the capacitance and compare to $G\Omega$ limit. Select the lower of the two limits.

Capacitance and Dissipation Factor (DF) measured under the following conditions:

1kHz ± 50Hz and 1.0 ± 0.2 Vrms if capacitance $\leq 10\mu F$

120Hz ± 10Hz and 0.5 ± 0.1 Vrms if capacitance $> 10\mu F$

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 & Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON".

Post Environmental Limits

High Temperature Life, Biased Humidity, Moisture Resistance					
Dielectric	Rated DC Voltage	Capacitance Value	DF (%)	Cap Shift	IR
X7R	>25	All	3.0	± 20%	10% of Initial Limit
	16 / 25		5.0		
	< 16		7.5		

Insulation Resistance Limit Table

EIA Case Size	1000 megohm microfarads or 100GΩ	500 megohm microfarads or 10GΩ
0201	N/A	ALL
0402	< .012 μF	≥ .012 μF
0603	< .047 μF	≥ .047 μF
0805	< .047 μF	≥ .047 μF
1206	< 0.22 μF	≥ 0.22 μF
1210	< 0.39 μF	≥ 0.39 μF
1808	ALL	N/A
1812	< 2.2 μF	≥ 2.2 μF
1825	ALL	N/A
2220	< 10 μF	≥ 10 μF
2225	ALL	N/A

Table 1B – (1210 - 2225 Case Sizes) con't

Cap	Cap Code	Series			C1210								C1808			C1812					C1825				C2220					C2225								
		Voltage Code			9	8	4	3	5	1	2	A	5	1	2	3	5	1	2	A	5	1	2	A	3	5	1	2	A	5	1	2	A					
		Voltage DC			6.3	10	16	25	50	100	200	250	50	100	200	25	50	100	200	250	50	100	200	250	25	50	100	200	250	50	100	200	250					
		Cap Tolerance			Product Availability and Chip Thickness Codes - See Table 2 for Chip Thickness Dimensions																																	
0.22 µF	224	J	K	M	FC	FC	FC	FC	FC	FD									GB	GB	GB	GG	GG	GB	HB	HB	HB	HB	JC	JC	JC	JC	JC	KC	KC	KC	KC	
0.27 µF	274	J	K	M	FC	FC	FC	FC	FC	FD									GB	GB	GG	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KB	KC	KC	KC		
0.33 µF	334	J	K	M	FD	FD	FD	FD	FD	FD									GB	GB	GG	GG	GG	HB	HB	HB	HB	JC	JC	JC	JC	JC	KB	KC	KC	KC		
0.39 µF	394	J	K	M	FD	FD	FD	FD	FD	FD									GB	GB	GG	GG	GG	HB	HB	HD	HD	JC	JC	JC	JC	JC	KB	KC	KC	KC		
0.47 µF	474	J	K	M	FD	FD	FD	FD	FD	FD									GB	GB	GG	GJ	GJ	HB	HB	HD	HD	JC	JC	JC	JC	JC	KB	KC	KD	KD		
0.56 µF	564	J	K	M	FD	FD	FD	FD	FD	FF									GC	GC	GG			HB	HD	HD	HD	JC	JC	JC	JD	JD	KB	KC	KD	KD		
0.68 µF	684	J	K	M	FD	FD	FD	FD	FD	FG									GC	GC	GG			HB	HD	HD	HD	JC	JC	JD	JD	JD	KB	KC	KD	KD		
0.82 µF	824	J	K	M	FF	FF	FF	FF	FF	FL									GE	GE	GG			HB	HF	HF	HF	JC	JC	JF	JF	JF	KB	KC	KE	KE		
1.0 µF	105	J	K	M	FH	FH	FH	FH	FH	FM									GE	GE	GG			HB	HF	HF	HF	JC	JC	JF	JF	JF	KB	KD	KE	KE		
1.2 µF	125	J	K	M	FH	FH	FH	FH	FG														HB				JC	JC				KB	KE	KE	KE			
1.5 µF	155	J	K	M	FH	FH	FH	FH	FG														HC				JC	JC				KC						
1.8 µF	185	J	K	M	FH	FH	FH	FH	FG															HD				JD	JD				KD					
2.2 µF	225	J	K	M	FJ	FJ	FJ	FJ	FG	FT ¹									GO ¹	GO ¹	GO ¹				HF		JF	JF				KD						
2.7 µF	275	J	K	M	FE	FE	FE	FG	FH																													
3.3 µF	335	J	K	M	FF	FF	FF	FM	FM																													
3.9 µF	395	J	K	M	FG	FG	FG	FG	FK																													
4.7 µF	475	J	K	M	FC	FC	FC	FG	FS										GK	GK																		
5.6 µF	565	J	K	M	FF	FF	FF	FH																														
6.8 µF	685	J	K	M	FG	FG	FG	FM																														
8.2 µF	825	J	K	M	FH	FH	FH	FK																														
10 µF	106	J	K	M	FH	FH	FH	FS	UD										GK									JF	JO									
12 µF	126	J	K	M																																		
15 µF	156	J	K	M																								JO	JO									
18 µF	186	J	K	M																																		
22 µF	226	J	K	M	FS	FS	UD	UD																					JO									
47 µF	476	J	K	M	FS ²	UD																																
Cap	Cap Code	Voltage DC			6.3	10	16	25	50	100	200	250	50	100	200	25	50	100	200	250	50	100	200	250	25	50	100	200	250	25	50	100	200	250	50	100	200	250
		Voltage Code			9	8	4	3	5	1	2	A	5	1	2	3	5	1	2	A	5	1	2	A	3	5	1	2	A	5	1	2	A					
		Series			C1210								C1808			C1812					C1825				C2220					C2225								

UD = Under Development
 xx¹ Available only in K,M tolerance
 xx² Available only in M tolerance.

Table 2 – Chip Thickness/Packaging Quantities

Thickness Code	Chip Size	Thickness ± Range (mm)	QTY per Reel 7" Plastic	QTY per Reel 13" Plastic	QTY per Reel 7" Paper	QTY per Reel 13" Paper	QTY per Bulk Cassette
AA	1005	0.20 ± 0.02			15000		
AB	0201	0.30 ± 0.03			15000		
BB	0402	0.50 ± 0.05			10000	50000	50000
BC	0402	0.50 ± 0.10			10000	50000	50000
PA	0508	0.80 ± 0.10	4000	10000			
CB	0603	0.80 ± 0.07			4000	10000	15000
CC	0603	0.80 ± 0.10			4000	10000	15000
CD	0603	0.80 ± 0.15			4000	10000	15000
MA	0612	0.80 ± 0.10	4000	10000			
DB	0805	0.60 ± 0.10			4000	10000	15000
DC	0805	0.78 ± 0.10			4000	10000	15000
DD	0805	0.90 ± 0.10			4000	10000	15000
DL	0805	0.95 ± 0.10	4000	10000			
DE	0805	1.00 ± 0.10	2500	10000			
DF	0805	1.10 ± 0.10	2500	10000			
DG	0805	1.25 ± 0.15	2500	10000			
DH	0805	1.25 ± 0.20	2500	10000			
EB	1206	0.78 ± 0.10	4000	10000	4000	10000	
EK	1206	0.80 ± 0.10	2000	8000			
EC	1206	0.90 ± 0.10	4000	10000			
EN	1206	0.95 ± 0.10	4000	10000			
ED	1206	1.00 ± 0.10	2500	10000			
EE	1206	1.10 ± 0.10	2500	10000			
EF	1206	1.20 ± 0.15	2500	10000			
EM	1206	1.25 ± 0.15	2500	10000			
EG	1206	1.60 ± 0.15	2000	8000			
EH	1206	1.60 ± 0.20	2000	8000			
EJ	1206	1.70 ± 0.20	2000	8000			
FB	1210	0.78 ± 0.10	4000	10000			
FC	1210	0.90 ± 0.10	4000	10000			
FD	1210	0.95 ± 0.10	4000	10000			
FE	1210	1.00 ± 0.10	2500	10000			
FF	1210	1.10 ± 0.10	2500	10000			
FG	1210	1.25 ± 0.15	2500	10000			
FL	1210	1.40 ± 0.15	2000	8000			
FO	1210	1.50 ± 0.20	2000	8000			
FH	1210	1.55 ± 0.15	2000	8000			
FP	1210	1.60 ± 0.20	2000	8000			
FM	1210	1.70 ± 0.20	2000	8000			
FJ	1210	1.85 ± 0.20	2000	8000			
FN	1210	1.85 ± 0.20	2000	8000			
FT	1210	1.90 ± 0.20	1500	4000			
FK	1210	2.10 ± 0.20	2000	8000			
FR	1210	2.25 ± 0.20	2000	8000			
FS	1210	2.50 ± 0.20	1000	4000			
FV	1210	3.35 ± 0.10	500	1800			
FW	1210	6.15 ± 0.15	200	1000			
PA	1220	0.80 ± 0.10	4000	10000			
MA	1632	0.80 ± 0.10	4000	10000			
NA	1706	0.90 ± 0.10	4000	10000			
NB	1706	1.00 ± 0.10	4000	10000			
NC	1706	1.00 ± 0.15	4000	10000			
LD	1808	0.90 ± 0.10	2500	10000			
LE	1808	1.00 ± 0.10	2500	10000			
LF	1808	1.00 ± 0.15	2500	10000			
LA	1808	1.40 ± 0.15	1000	4000			
LB	1808	1.60 ± 0.15	1000	4000			
LC	1808	2.00 ± 0.15	1000	4000			
GB	1812	1.00 ± 0.10	1000	4000			
GC	1812	1.10 ± 0.10	1000	4000			
GD	1812	1.25 ± 0.15	1000	4000			
GE	1812	1.30 ± 0.10	1000	4000			
GH	1812	1.40 ± 0.15	1000	4000			
GF	1812	1.50 ± 0.10	1000	4000			
GG	1812	1.55 ± 0.10	1000	4000			
GK	1812	1.60 ± 0.20	1000	4000			
GJ	1812	1.70 ± 0.15	1000	4000			
GN	1812	1.70 ± 0.20	1000	4000			
GL	1812	1.90 ± 0.20	1000	4000			
GM	1812	2.00 ± 0.20	1000	4000			
GO	1812	2.50 ± 0.20	500	2000			
GP	1812	2.65 ± 0.35	500	1400			
GR	1812	5.00 ± 0.50	350	1000			
HB	1825	1.10 ± 0.15	1000	4000			
HC	1825	1.15 ± 0.15	1000	4000			
HD	1825	1.30 ± 0.15	1000	4000			
HE	1825	1.40 ± 0.15	1000	4000			
HF	1825	1.50 ± 0.15	1000	4000			
Thickness Code	Chip Size	Thickness ± Range (mm)	QTY per Reel 7" Plastic	QTY per Reel 13" Plastic	QTY per Reel 7" Paper	QTY per Reel 13" Paper	QTY per Bulk Cassette

Package Quantity
 Based on Finished Chip
 Thickness Specifications

Table 2 – Chip Thickness/Packaging Quantities con't

Thickness Code	Chip Size	Thickness ± Range (mm)	QTY per Reel 7" Plastic	QTY per Reel 13" Plastic	QTY per Reel 7" Paper	QTY per Reel 13" Paper	QTY per Bulk Cassette
HG	1825	1.60 ± 0.20	1000	4000			
JB	2220	1.00 ± 0.15	1000	4000			
JC	2220	1.10 ± 0.15	1000	4000			
JD	2220	1.30 ± 0.15	1000	4000			
JE	2220	1.40 ± 0.15	1000	4000			
JF	2220	1.50 ± 0.15	1000	4000			
JP	2220	1.60 ± 0.20	1000	4000			
JG	2220	1.70 ± 0.15	1000	4000			
JH	2220	1.80 ± 0.15	1000	4000			
JO	2220	2.40 ± 0.15	500	2000			
JP	2220	3.50 ± 0.30	250	850			
JR	2220	5.00 ± 0.50	150	600			
KB	2225	1.00 ± 0.15	1000	4000			
KC	2225	1.10 ± 0.15	1000	4000			
KD	2225	1.30 ± 0.15	1000	4000			
KE	2225	1.40 ± 0.15	1000	4000			
KF	2225	1.60 ± 0.20	1000	4000			
Thickness Code	Chip Size	Thickness ± Range (mm)	QTY per Reel 7" Plastic	QTY per Reel 13" Plastic	QTY per Reel 7" Paper	QTY per Reel 13" Paper	QTY per Bulk Cassette

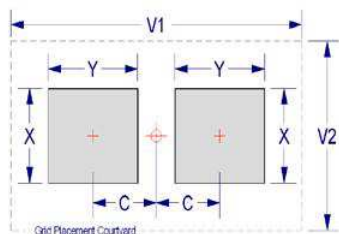
Table 3 – Chip Capacitor Land Pattern Design Recommendations per IPC-7351

EIA Size Code	Metric Size Code	Density Level A: Maximum (Most) Land Protrusion (mm)					Density Level B: Median (Nominal) Land Protrusion (mm)					Density Level C: Minimum (Least) Land Protrusion (mm)				
		C	Y	X	V1	V2	C	Y	X	V1	V2	C	Y	X	V1	V2
01005	0402	0.33	0.46	0.43	1.60	0.90	0.28	0.36	0.33	1.30	0.70	0.23	0.26	0.23	1.00	0.50
0201	0603	0.38	0.56	0.52	1.80	1.00	0.33	0.46	0.42	1.50	0.80	0.28	0.36	0.32	1.20	0.60
0402	1005	0.50	0.72	0.72	2.20	1.20	0.45	0.62	0.62	1.90	1.00	0.40	0.52	0.52	1.60	0.80
0603	1608	0.90	1.15	1.10	4.00	2.10	0.80	0.95	1.00	3.10	1.50	0.60	0.75	0.90	2.40	1.20
0805	2012	1.00	1.35	1.55	4.40	2.60	0.90	1.15	1.45	3.50	2.00	0.75	0.95	1.35	2.80	1.70
1206	3216	1.60	1.35	1.90	5.60	2.90	1.50	1.15	1.80	4.70	2.30	1.40	0.95	1.70	4.00	2.00
1210	3225	1.60	1.35	2.80	5.65	3.80	1.50	1.15	2.70	4.70	3.20	1.40	0.95	2.60	4.00	2.90
1808	4520	2.30	1.75	2.30	7.40	3.30	2.20	1.55	2.20	6.50	2.70	2.10	1.35	2.10	5.80	2.40
1812	4532	2.15	1.60	3.60	6.90	4.60	2.05	1.40	3.50	6.00	4.00	1.95	1.20	3.40	5.30	3.70
1825	4564	2.15	1.60	6.90	6.90	7.90	2.05	1.40	6.80	6.00	7.30	1.95	1.20	6.70	5.30	7.00
2220	5650	2.75	1.70	5.50	8.20	6.50	2.65	1.50	5.40	7.30	5.90	2.55	1.30	5.30	6.60	5.60
2225	5664	2.70	1.70	6.90	8.10	7.90	2.60	1.50	6.80	7.20	7.30	2.50	1.30	6.70	6.50	7.00

Density Level A: For low-density Product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes. KEMET only recommends wave soldering of EIA 0603, 0805 and 1206 case sizes.

Density Level B: For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes.

Density Level C: For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC standard 7351 (IPC-7351).



Soldering Process

Recommended Soldering Technique:

- Solder wave or solder reflow for EIA case sizes 0603, 0805 and 1206
- All other EIA case sizes are limited to solder reflow only

Recommended Soldering Profile:

- KEMET recommends following the guidelines outlined in IPC/JEDEC J-STD-020

Table 4 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Terminal Strength	JIS-C-6429	Appendix 1, Note: Force of 1.8kg for 60 seconds.
Board Flex	JIS-C-6429	Appendix 2, Note: 2mm (min) for all except 3mm for C0G.
Solderability	J-STD-002	Magnification 50 X. Conditions:
		a) Method B, 4 hours @ 155°C, dry heat @ 235°C
		b) Method B @ 215°C category 3
		c) Method D, category 3 @ 260°C
Temperature Cycling	JESD22 Method JA-104	1000 Cycles (-55°C to +125°C), Measurement at 24 hours. +/- 2 hours after test conclusion.
Biased Humidity	MIL-STD-202 Method 103	Load Humidity: 1000 hours 85°C/85%RH and Rated Voltage. Add 100K ohm resistor. Measurement at 24 hours. +/- 2 hours after test conclusion.
		Low Volt Humidity: 1000 hours 85°C/85%RH and 1.5V. Add 100K ohm resistor. Measurement at 24 hours. +/- 2 hours after test conclusion.
Moisture Resistance	MIL-STD-202 Method 106	t = 24 hours/cycle. Steps 7a & 7b not required. Unpowered. Measurement at 24 hours. +/- 2 hours after test conclusion.
Thermal Shock	MIL-STD-202 Method 107	-55°C/+125°C. Note: Number of cycles required-300, Maximum transfer time-20 seconds, Dwell time-15 minutes. Air-Air.
High Temperature Life	MIL-STD-202 Method 108 / EIA -198	1000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied.
Storage Life	MIL-STD-202 Method 108	150°C, 0VDC, for 1000 Hours.
Mechanical Shock	MIL-STD-202 Method 213	Figure 1 of Method 213, Condition F.
Resistance to Solvents	MIL-STD-202 Method 215	Add aqueous wash chemical - OKEM Clean or equivalent.

Storage and Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature – reels may soften or warp, and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40°C, and maximum storage humidity not exceed 70% relative humidity. In addition, temperature fluctuations should be minimized to avoid condensation on the parts, and atmospheres should be free of chlorine and sulfur bearing compounds. For optimized solderability, chip stock should be used promptly, preferably within 1.5 years of receipt.