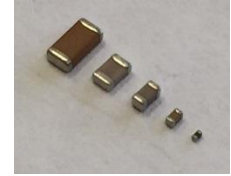
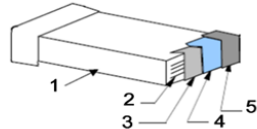


Features:

- Lead free, Halogen free, RoHS and REACH compliant
- -55 °C to 85 °C operating temperature range
- EIA sizes 0402, 0603, 0805, 1206, 1210 and 1812
- Capacitance offering from 0.047 uF to 100 uF



Construction



- 1 - Ceramic layers (dielectric)
- 2 - Inner electrodes
- 3 - Base termination
- 4 - Nickel plating layer
- 5 - Tin plating layer

Electrical Specifications

Type / Code	Dielectric Code	Standard Tolerance		Capacitance Range			
		Code	Description	10 V	16 V	25 V	50 V
CML0402	X5R	K	± 10%	120 pF - 0.039 uF			
				0.012 uF - 0.1 uF			
CML0603	X5R	K	± 10%	0.12 uF - 0.47 uF			
				0.47 uF - 1 uF			
CML0805	X5R	K	± 10%	0.47 uF - 2.2 uF			
				150 pF - 0.39 uF			
CML1206	X5R	K	± 10%	0.12 uF - 2.2 uF			
				0.12 uF - 0.47 uF			
CML1210	X5R	K	± 10%	150 pF - 4.7 uF			
				10 uF			
CML1812	X5R	K	± 10%	4.7 uF - 22 uF			
				33 uF - 47 uF			
CML1812	X5R	K	± 10%	68 uF - 100 uF			
				4.7 uF - 6.8 uF			
CML1812	X5R	K	± 10%	10 uF			
				15 uF - 22 uF			
CML1812	X5R	K	± 10%	33 uF - 47 uF			
				-			

Note: J = ± 5% tolerance may be available

How to Order

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
C	M	L	0	4	0	2	X	5	R	1	0	4	K	T	5	0	V
Product Series		Size	Dielectric	Capacitance Range		Tolerance (*)		Packaging				Max Working Voltage					
Code	Description	Code	Code	0.1pF to 0.10uF (E12)		Code	Description	Code	Description	Size	Quantity						
CML	Multilayer Ceramic	0402	X5R	EIA Code	Capacitance	J	± 5%	T	7" Paper Reel	Refer to Packaging Specifications		10 V					
		0603		473	0.047 uF	K	± 10%		7" Plastic Tape			16 V					
		0805		104	0.1 uF							25 V					
		1206		105	1 uF							50 V					
		1210		106	10 uF												
		1812		107	100 uF												

(*) Other tolerances may be available. Contact factory.

Capacitance and Voltage Available																								
Dielectric		X5R																						
EIA	Size	0402				0603				0805			1206				1210			1812				
Code	VDCW	10V	16V	25V	50V	10V	16V	25V	50V	10V	16V	25V	10V	16V	25V	50V	10V	16V	25V	10V	16V	25V		
473	0.047 uF																							
563	0.056 uF																							
683	0.068 uF																							
823	0.082 uF																							
104	0.1 uF																							
154	0.15 uF																							
224	0.22 uF																							
334	0.33 uF																							
474	0.47 uF																							
684	0.68 uF																							
105	1 uF																							
155	1.5 uF																							
225	2.2 uF																							
335	3.3 uF																							
475	4.7 uF																							
685	6.8 uF																							
106	10 uF																							
156	15 uF																							
226	22 uF																							
336	33 uF																							
476	47 uF																							
686	68 uF																							
107	100 uF																							

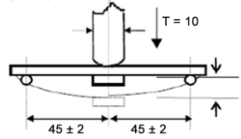
Mechanical Specifications and Packaging Specifications										
Type / Code	Voltage	Capacitance Range	L	W	H	a	Unit	Packaging (7" Reel) Qty.		
								Paper Tape	Plastic Tape	
CML0402X5R	10 V - 50 V	0.1 uF - 4.7 uF	0.039 ± 0.008 1.00 ± 0.20	0.020 ± 0.008 0.50 ± 0.20	0.020 ± 0.002 0.50 ± 0.05	0.010 ± 0.004 0.25 ± 0.10	inches mm	10000	-	
CML0603X5R	10 V - 50 V	0.47 uF - 10 uF	0.063 ± 0.008 1.60 ± 0.20	0.031 ± 0.008 0.80 ± 0.20	0.031 ± 0.004 0.80 ± 0.10	0.012 ± 0.004 0.30 ± 0.10	inches mm	4000	-	
CML0805X5R	10 V - 16 V	1 uF	0.079 ± 0.008 2.00 ± 0.20	0.049 ± 0.008 1.25 ± 0.20	0.039 ± 0.004 1.00 ± 0.10	0.020 ± 0.008 0.50 ± 0.20	inches mm	-	3000	
		1.5 uF	0.079 ± 0.008 2.00 ± 0.20	0.049 ± 0.008 1.25 ± 0.20	0.047 ± 0.004 1.20 ± 0.10	0.020 ± 0.008 0.50 ± 0.20	inches mm	-	3000	
		2.2 uF	0.079 ± 0.008 2.00 ± 0.20	0.049 ± 0.008 1.25 ± 0.20	0.031 ± 0.004 0.80 ± 0.10	0.020 ± 0.008 0.50 ± 0.20	inches mm	4000	-	
		3.3 uF - 22 uF	0.079 ± 0.008 2.00 ± 0.20	0.049 ± 0.008 1.25 ± 0.20	0.047 ± 0.004 1.20 ± 0.10	0.020 ± 0.008 0.50 ± 0.20	inches mm	-	2000	
	25 V	1 uF	0.079 ± 0.008 2.00 ± 0.20	0.049 ± 0.008 1.25 ± 0.20	0.039 ± 0.004 1.00 ± 0.10	0.020 ± 0.008 0.50 ± 0.20	inches mm	-	3000	
		1.5 uF - 2.2 uF	0.079 ± 0.008 2.00 ± 0.20	0.049 ± 0.008 1.25 ± 0.20	0.047 ± 0.004 1.20 ± 0.10	0.020 ± 0.008 0.50 ± 0.20	inches mm	-	3000	
3.3 uF - 10 uF		0.079 ± 0.008 2.00 ± 0.20	0.049 ± 0.008 1.25 ± 0.20	0.047 ± 0.004 1.20 ± 0.10	0.020 ± 0.008 0.50 ± 0.20	inches mm	-	2000		

Mechanical Specifications and Packaging Specifications (cont.)

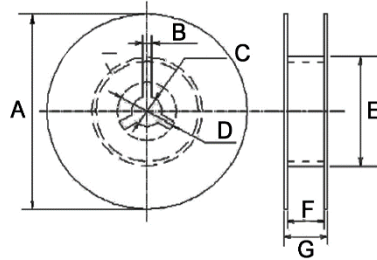
Type / Code	Voltage	Capacitance Range	L	W	H	a	Unit	Packaging (7" Reel) Qty.	
								Paper Tape	Plastic Tape
CML1206X5R	10 V	2.2 uF - 3.3 uF	0.126 ± 0.012 3.20 ± 0.30	0.063 ± 0.012 1.60 ± 0.30	0.047 ± 0.004 1.20 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	3000
		4.7 uF - 22 uF	0.126 ± 0.012 3.20 ± 0.30	0.063 ± 0.012 1.60 ± 0.30	0.063 ± 0.004 1.60 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	2000
		47 uF	0.126 ± 0.012 3.20 ± 0.30	0.063 ± 0.012 1.60 ± 0.30	0.071 ± 0.004 1.80 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	2000
	16 V - 25 V	2.2 uF - 3.3 uF	0.126 ± 0.012 3.20 ± 0.30	0.063 ± 0.012 1.60 ± 0.30	0.047 ± 0.004 1.20 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	3000
		4.7 uF - 22 uF	0.126 ± 0.012 3.20 ± 0.30	0.063 ± 0.012 1.60 ± 0.30	0.063 ± 0.004 1.60 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	2000
	50 V	2.2 uF - 3.3 uF	0.126 ± 0.012 3.20 ± 0.30	0.063 ± 0.012 1.60 ± 0.30	0.047 ± 0.004 1.20 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	3000
4.7 uF - 10 uF		0.126 ± 0.012 3.20 ± 0.30	0.063 ± 0.012 1.60 ± 0.30	0.063 ± 0.004 1.60 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	2000	
CML1210X5R	10 V	4.7 uF	0.126 ± 0.012 3.20 ± 0.30	0.098 ± 0.012 2.50 ± 0.30	0.047 ± 0.004 1.20 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	2000
		6.8 uF - 10 uF	0.126 ± 0.012 3.20 ± 0.30	0.098 ± 0.012 2.50 ± 0.30	0.071 ± 0.004 1.80 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	2000
		15 uF - 100 uF	0.126 ± 0.012 3.20 ± 0.30	0.098 ± 0.012 2.50 ± 0.30	0.098 ± 0.010 2.50 ± 0.25	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	500
	16 V	4.7 uF	0.126 ± 0.012 3.20 ± 0.30	0.098 ± 0.012 2.50 ± 0.30	0.047 ± 0.004 1.20 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	2000
		6.8 uF - 10 uF	0.126 ± 0.012 3.20 ± 0.30	0.098 ± 0.012 2.50 ± 0.30	0.071 ± 0.004 1.80 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	2000
		15 uF - 47 uF	0.126 ± 0.012 3.20 ± 0.30	0.098 ± 0.012 2.50 ± 0.30	0.098 ± 0.010 2.50 ± 0.25	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	500
	25 V	4.7 uF	0.126 ± 0.012 3.20 ± 0.30	0.098 ± 0.012 2.50 ± 0.30	0.047 ± 0.004 1.20 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	2000
		6.8 uF - 10 uF	0.126 ± 0.012 3.20 ± 0.30	0.098 ± 0.012 2.50 ± 0.30	0.071 ± 0.004 1.80 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	2000
		15 uF - 22 uF	0.126 ± 0.012 3.20 ± 0.30	0.098 ± 0.012 2.50 ± 0.30	0.098 ± 0.010 2.50 ± 0.25	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	500
CML1812X5R	10 V - 25 V	4.7 uF - 47 uF	0.177 ± 0.016 4.50 ± 0.40	0.126 ± 0.012 3.20 ± 0.30	0.071 ± 0.004 1.80 ± 0.10	0.024 ± 0.012 0.60 ± 0.30	inches mm	-	1000

Environmental Characteristics

Test	Test Specification				Test Condition		
Capacitance	Should be within the specified tolerance.				X5R: (Class II) Cap ≤ 10 uF 1.0 ± 0.2 Vrms, 1 KHz ± 10% Cap > 10 uF 0.5 ± 0.1 Vrms, 120 Hz ± 10%		
Dissipation Factor (DF)	X5R (Class II)	X5R (≥ 0402)	≥ 50V	25V	16V	10V	
			≤ 2.5%	≤ 3.5% (C < 0.47 uF) ≤ 10.0% (C ≥ 0.47 uF)	≤ 5% (C < 0.15 uF) ≤ 10.0% (C ≥ 0.15 uF)		
Insulation Resistance	X5R (Class II)	C ≤ 25 nF, Ri ≥ 10,000 M Ω C > 25 nF, Ri*CR > 100 S				Measuring Voltage: Rated Voltage (Max 500 V) Duration: 60 ± 5 seconds Test Humidity: ≤ 75% Test Temperature: 25 °C ± 5 °C Test Current: ≤ 50 mA	
Dielectric Withstanding Voltage	No breakdown or damage.				Measuring voltage: Class II: 250% rated voltage Duration: 1 ~ 5 seconds Charge/Discharge Current: 50 mA max.		

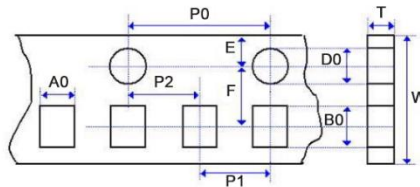
Environmental Characteristics (cont.)																	
Test	Test Specification	Test Condition															
Solderability	At least 95% of the terminal electrode is covered by new solder. Visual appearance: No visible damage.	Preheating Conditions: 80 to 120 °C, 10 ~ 30 seconds															
		Solder Temperature: 235 ± 5% (Sn/Pb: 63/37) Duration: 2 ± 0.5 seconds															
		Solder Temperature: 245 ± 5 °C (Lead-free) Duration: 2 ± 0.5 seconds															
Resistance to Soldering Heat	Item	X5R															
	Δ C/C	-5 ~ + 10%															
	DF	Same to initial value															
	IR	Same to initial value															
	Appearance: No visible damage. At least 95% of the terminal electrode is covered by new solder.		Preheating Conditions: 100 to 200 °C; 10 ± 2 minutes Solder Temperature: 265 ± 5 °C Duration: 10 ± 1 seconds Clean the capacitor with solvent and examine it with a 10X (min.) microscope. Recovery Time: 24 ± 2 hours Recovery Condition: Room temperature.														
Resistance to Flexure of Substrate (Bending Strength)	Appearance: No visible damage. Δ C/C: ≤ ± 10%	Test Board: Al2O3 or PCB Warp: 1 mm Speed: 0.5 mm / second The measurement should be made with the board in the bending position. Unit: mm															
																	
Termination Adhesion	No visible damage	Applied Force: 5 N Duration: 10 ± 1 seconds															
Temperature Cycle	X5R: Δ C/C: ≤ ± 10%	Preheating Conditions: up-category temperature 1 hour Recovery Time: 24 ± 1 hours Initial Measurement															
		Cycling times: 5 times, 1 cycle, 4 steps:															
		<table border="1"> <thead> <tr> <th>Step</th> <th>Temp. (°C)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Low-category temp. X5R: -55</td> <td>30 ± 3</td> </tr> <tr> <td>2</td> <td>Normal temp. (+20)</td> <td>2 - 3</td> </tr> <tr> <td>3</td> <td>Up-category temp. X5R: +85</td> <td>30 ± 3</td> </tr> <tr> <td>4</td> <td>Normal temp. (+20)</td> <td>2 - 3</td> </tr> </tbody> </table>	Step	Temp. (°C)	Time (min.)	1	Low-category temp. X5R: -55	30 ± 3	2	Normal temp. (+20)	2 - 3	3	Up-category temp. X5R: +85	30 ± 3	4	Normal temp. (+20)	2 - 3
		Step	Temp. (°C)	Time (min.)													
		1	Low-category temp. X5R: -55	30 ± 3													
2	Normal temp. (+20)	2 - 3															
3	Up-category temp. X5R: +85	30 ± 3															
4	Normal temp. (+20)	2 - 3															
Recovery time after test: 24 ± 2 hours																	
Moisture Resistance	X5R: Δ C/C: ≤ ± 10% DF: Not more than twice of initial value. IR: X5R: Ri ≥ 1000 M Ω or Ri*CR ≥ 25 S whichever is smaller Appearance: No visible damage	Temperature: 40 ± 2 °C Humidity: 90 ~ 95% R.H. Duration: 500 hours Recovery Conditions: Room temperature Recovery Time: 48 hours (Class II)															
Life Test	X5R: Δ C/C: ≤ ± 20% DF: Not more than twice of initial value. IR: X5R: Ri ≥ 2000 M Ω or Ri*CR ≥ 50 S whichever is smaller Appearance: No visible damage	Low-voltage (< 100 V) Applied Voltage: 1.5 x rated voltage Duration: 1000 hours Temperature: 85 °C (X5R) Charge/Discharge Current: 50 mA max. Recovery Conditions: Room temperature Recovery Time: 48 hours (Class II)															

Reel Specifications



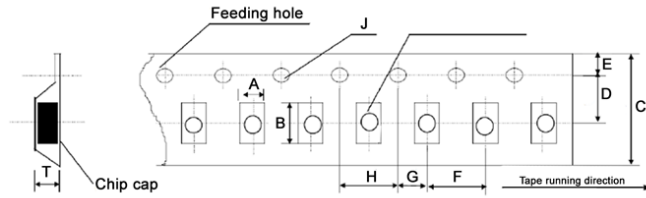
Type / Code	A	B	C	D	E	F	G	Unit
CML_X5R (all sizes)	7.008 ± 0.079 178.00 ± 2.00	0.118 3.00	0.512 ± 0.020 13.00 ± 0.50	0.827 ± 0.031 21.00 ± 0.80	1.969 or more 50.00 or more	0.394 ± 0.059 10.00 ± 1.50	0.472 max 12.00 max	inches mm

Paper Tape Specifications



Type / Code	A0	B0	T	W	P0	Unit
CML0402X5R	0.026 ± 0.004 0.65 ± 0.10	0.045 ± 0.004 1.15 ± 0.10	0.031 below 0.80 below	0.315 ± 0.004 8.00 ± 0.10	0.157 ± 0.004 4.00 ± 0.10	inches mm
CML0603X5R	0.043 ± 0.004 1.10 ± 0.10	0.075 ± 0.004 1.90 ± 0.10	0.043 max 1.10 max	0.315 ± 0.004 8.00 ± 0.10	0.157 ± 0.004 4.00 ± 0.10	inches mm
CML0805X5R	0.057 ± 0.006 1.45 ± 0.15	0.091 ± 0.006 2.30 ± 0.15	0.043 max 1.10 max	0.315 ± 0.006 8.00 ± 0.15	0.157 ± 0.004 4.00 ± 0.10	inches mm
CML1206X5R	0.071 ± 0.008 1.80 ± 0.20	0.134 ± 0.008 3.40 ± 0.20	0.043 max 1.10 max	0.315 ± 0.008 8.00 ± 0.20	0.157 ± 0.004 4.00 ± 0.10	inches mm
Type / Code	P1	P2	D0	E	F	Unit
CML0402X5R	0.079 ± 0.002 2.00 ± 0.05	0.079 ± 0.002 2.00 ± 0.05	0.059-0/+0.004 1.5-0/+0.10	0.069 ± 0.002 1.75 ± 0.05	0.138 ± 0.002 3.50 ± 0.05	inches mm
CML0603X5R	0.079 ± 0.004 2.00 ± 0.10	0.157 ± 0.002 4.00 ± 0.05	0.059-0/+0.004 1.5-0/+0.10	0.069 ± 0.002 1.75 ± 0.05	0.138 ± 0.002 3.50 ± 0.05	inches mm
CML0805X5R	0.079 ± 0.004 2.00 ± 0.10	0.157 ± 0.004 4.00 ± 0.10	0.059-0/+0.004 1.5-0/+0.10	0.069 ± 0.002 1.75 ± 0.05	0.138 ± 0.002 3.50 ± 0.05	inches mm
CML1206X5R	0.079 ± 0.004 2.00 ± 0.10	0.157 ± 0.004 4.00 ± 0.10	0.059-0/+0.004 1.5-0/+0.10	0.069 ± 0.004 1.75 ± 0.10	0.138 ± 0.002 3.50 ± 0.05	inches mm

Plastic Tape Specifications



Type / Code	A	B	C	D	E	Unit
CML0805X5R	0.061 ± 0.008	0.093 ± 0.008	0.315 ± 0.008	0.138 ± 0.002	0.069 ± 0.004	inches
	1.55 ± 0.20	2.35 ± 0.20	8.00 ± 0.20	3.50 ± 0.05	1.75 ± 0.10	mm
CML1206X5R	0.077 ± 0.008	0.142 ± 0.008	0.315 ± 0.008	0.138 ± 0.002	0.069 ± 0.004	inches
	1.95 ± 0.20	3.60 ± 0.20	8.00 ± 0.20	3.50 ± 0.05	1.75 ± 0.10	mm
CML1210X5R	0.106 ± 0.004	0.135 ± 0.004	0.315 ± 0.004	0.138 ± 0.002	0.069 ± 0.004	inches
	2.70 ± 0.10	3.42 ± 0.10	8.00 ± 0.10	3.50 ± 0.05	1.75 ± 0.10	mm
CML1812X5R	0.144 ± 0.004	0.195 ± 0.004	0.472 ± 0.004	0.217 ± 0.002	0.069 ± 0.004	inches
	3.66 ± 0.10	4.95 ± 0.10	12.00 ± 0.10	5.50 ± 0.05	1.75 ± 0.10	mm
Type / Code	F	G	H	J	T	Unit
CML0805X5R	0.157 ± 0.004	0.079 ± 0.004	0.157 ± 0.004	0.059-0/+0.004	0.059 max	inches
	4.00 ± 0.10	2.00 ± 0.10	4.00 ± 0.10	1.5-0/+0.10	1.50 max	mm
CML1206X5R	0.157 ± 0.004	0.079 ± 0.004	0.157 ± 0.004	0.059-0/+0.004	0.073 max	inches
	4.00 ± 0.10	2.00 ± 0.10	4.00 ± 0.10	1.5-0/+0.10	1.85 max	mm
CML1210X5R	0.157 ± 0.004	0.079 ± 0.002	0.157 ± 0.004	0.059-0/+0.004	0.126 max	inches
	4.00 ± 0.10	2.00 ± 0.05	4.00 ± 0.10	1.5-0/+0.10	3.20 max	mm
CML1812X5R	0.315 ± 0.004	0.079 ± 0.002	0.157 ± 0.004	0.059-0/+0.004	0.157 max	inches
	8.00 ± 0.10	2.00 ± 0.05	4.00 ± 0.10	1.5-0/+0.10	4.00 max	mm