Surface Mount Multilayer Ceramic Chip Capacitors (SMD MLCCs)

KPS HV, Large Case, SM Series, X7R Dielectric, 500 – 10,000 VDC (Industrial Grade)

Overview

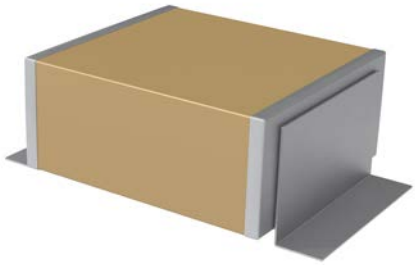
KPS HV (KEMET Power Solutions, High Voltage), Large Case (≥ 1515), SM Series capacitors in X7R dielectric are designed to meet robust performance standards required in higher reliability industrial applications. Utilizing lead-frame technology, SM Series devices isolate the multilayer ceramic chip component from the printed circuit board providing advanced mechanical and thermal stress performance. Isolation of the chip component also addresses concerns for audible, microphonic noise that may occur when a bias voltage is applied. Although this technology does not eliminate the potential for mechanical damage that may propagate during extreme environmental and handling conditions, it does demonstrate superior performance over non-isolating systems. Available in both formed "L" and "J" lead configurations, SM Series devices offer up to 10 mm of board flex capability and exhibit lower ESR, ESL and higher current discharge capability when compared to other dielectric solutions.

Combined with the stability of an X7R dielectric, KEMET's High Voltage SM Series devices exhibit a predictable change in capacitance with respect to time and voltage and boast a minimal change in capacitance with reference to ambient temperature. Capacitance change is limited to ±15% from −55°C to +125°C.

KEMET's Industrial grade products offer additional screening options for higher reliability applications. Both Group A and Group B testing/inspection options per MIL–PRF–49467 are available for the SM Series.

Benefits

- −55°C to +125°C operating temperature range
- Large Case Sizes (≥ 1515)
- Formed “L” or “J” leadframe configurations
- Group A and B screening per MIL–PRF–49467 available
- Reliable and robust leadframe termination system
- DC voltage ratings of 500 V, 1 KV, 2 KV, 3 KV, 4 KV, 5 KV, 7.5 KV, and 10 KV
- Capacitance offerings ranging from 150 pF up to 5.6 µF



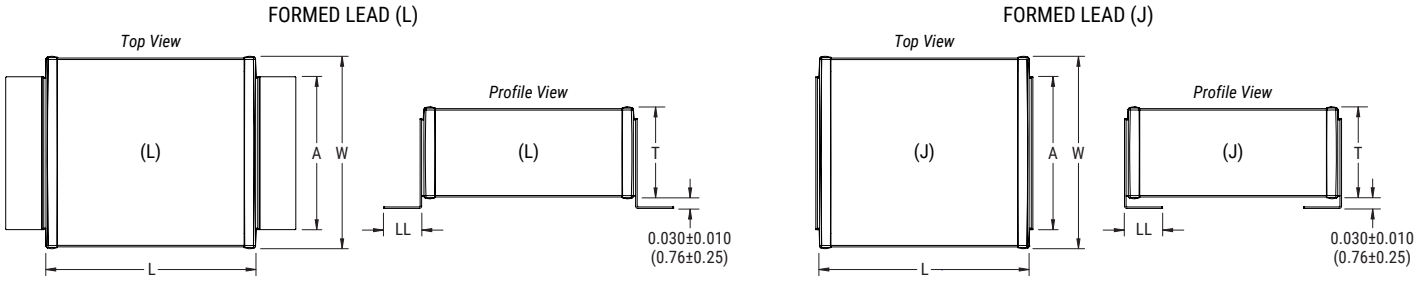
Ordering Information

SM20		B	153	K	501	B	M
Style/Size		Dielectric	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Lead Configuration[1]	Testing/ Inspection Option[2]
SM20 SM21 SM22 SM23 SM24 SM25 SM26	SM30 SM31 SM33 SM34 SM35 SM36	B = X7R	Two significant digits and number of zeros	K = ±10% M = ±20%	501 = 500 102 = 1,000 202 = 2,000 302 = 3,000 402 = 4,000 502 = 5,000 752 = 7,500 103 = 10,000	A = Formed L B = Formed J	Blank = None M = Group A per MIL-PRF-49467

[1] Standard lead configuration is formed "J". If the appropriate character is excluded from the ordering code, the assumed lead configuration will be formed "J".

[2] Group B testing/inspection option per MIL–PRF–49467 is available upon request. Please contact KEMET for ordering details.

Dimensions – Inches (Millimeters)



Style/ Size	L Length	W Width	T Thickness Max.	A Lead Width Max.	LL Lead Length (Formed "L")	LL Lead Length (Formed "J")
SM20	0.150±0.015 (3.81±0.38)	0.150±0.015 (3.81±0.38)	0.130 (3.30)	0.100 (2.54)	0.100±0.020 (2.54±0.51)	0.040±0.010 (1.02±0.25)
SM21	0.200±0.020 (5.08±0.51)	0.200±0.020 (5.08±0.51)	0.180 (4.57)			
SM22	0.250±0.020 (6.35±0.51)	0.200±0.020 (5.08±0.51)				
SM23	0.350±0.030 (8.89±0.76)	0.300±0.030 (7.62±0.76)	0.220 (5.59)	0.200 (5.08)		0.100±0.020 (2.54±0.51)
SM24	0.450±0.030 (11.43±0.76)	0.400±0.030 (10.20±0.76)		0.300 (7.62)		
SM25	0.550±0.030 (14.00±0.76)	0.500±0.030 (12.70±0.76)		0.400 (10.20)		
SM26	0.650±0.030 (16.50±0.76)	0.600±0.030 (15.20±0.76)		0.500 (12.70)		
SM30	0.300±0.030 (7.62±0.76)	0.150±0.015 (3.81±0.38)	0.140 (3.55)	0.100 (2.54)		
SM31	0.400±0.030 (10.20±0.76)	0.200±0.020 (5.08±0.51)	0.130 (3.30)			
SM33	0.700±0.030 (17.08±0.76)	0.300±0.030 (7.62±0.76)	0.180 (4.57)	0.200 (5.08)		
SM34	0.900±0.030 (22.90±0.76)	0.400±0.030 (10.20±0.76)	0.220 (5.59)	0.300 (7.62)		
SM35	1.100±0.030 (27.90±0.76)	0.500±0.030 (12.70±0.76)		0.400 (10.2)		
SM36	1.350±0.030 (33.00±0.76)	0.600±0.030 (15.20±0.76)		0.500 (12.7)		

Benefits cont.

- Advanced protection against thermal and mechanical stress
- Provides up to 10 mm of board flex capability
- Reduces audible, microphonic noise
- Low ESR and ESL
- Non-polar device, minimizing installation concerns
- Silver plated copper alloy leadframe termination system

Applications

Typical applications include switch mode power supplies (input filters, resonators, tank circuits, snubber circuits, output filters), high voltage coupling and DC blocking, voltage multiplier circuits, DC/DC converters and coupling capacitors in Ćuk converters, noise reduction (piezoelectric/mechanical), circuits with a direct battery or power source connection, critical and safety relevant circuits without (integrated) current limitation and any application that is subject to high levels of board flexure or temperature cycling. Markets include power supply, LCD fluorescent backlight ballasts, HID lighting, telecom equipment, industrial and medical equipment/control and Military.

Qualification/Certification

Industrial Grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 3, Performance & Reliability.

Environmental Compliance

RoHS Compliant with Exemption(s).

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 (Maximum % Capacitance Loss/Decade Hour)	3.0%
Dielectric Withstanding Voltage (DWV)	150% of rated voltage for voltage rating of ≤ 1,250 VDC 120% of rated voltage for voltage rating of > 1,250 VDC (5±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit at 25ºC	2.5%
Insulation Resistance (IR) Limit at 25°C	1,000 megohm microfarads or 100 GΩ (Rated voltage DC applied for 120±5 seconds at 25°C for voltage rating of ≤ 500 VDC) (500 VDC applied for 120±5 seconds at 25°C for voltage rating of > 500 VDC)

Regarding aging rate: Capacitance measurements (including tolerance) are indexed to a referee time of 1,000 hours.
To obtain IR limit, divide MΩ-µF value by the capacitance and compare to GΩ limit. Select the lower of the two limits.
Capacitance and dissipation factor (DF) measured under the following conditions:
1 kHz ±50 Hz and 1.0 Vrms ±0.2 V if capacitance > 100 pF
Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 and 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	Dissipation Factor (Maximum %)	Capacitance Shift
X7R	All	All	3.0	±20%

Table 1A – Capacitance Range/Selection Waterfall SM20 – SM24 Style/Size

Style/Size	SM20			SM21				SM22				SM23					SM24						
Dimensions – inches (mm)																							
Length	0.150 ± 0.015 (3.81 ± 0.38)			0.200 ± 0.020 (5.08 ± 0.51)				0.250 ± 0.020 (6.35 ± 0.51)				0.350 ± 0.030 (8.89 ± 0.76)					0.450 ± 0.030 (11.43 ± 0.76)						
Width	0.150 ± 0.015 (3.81 ± 0.38)			0.200 ± 0.020 (5.08 ± 0.51)				0.200 ± 0.020 (5.08 ± 0.51)				0.300 ± 0.030 (7.62 ± 0.76)					0.400 ± 0.030 (10.20 ± 0.76)						
Thickness Maximum	0.130 (3.30)			0.180 (4.57)				0.180 (4.57)				0.220 (5.59)					0.220 (5.59)						
Lead Width Maximum	0.100 (2.54)			0.100 (2.54)				0.100 (2.54)				0.200 (5.08)					0.300 (7.62)						
Lead Length "L"	0.100 ± 0.020 (2.54 ± 0.51)			0.100 ± 0.020 (2.54 ± 0.51)				0.100 ± 0.020 (2.54 ± 0.51)				0.100 ± 0.020 (2.54 ± 0.51)					0.100 ± 0.020 (2.54 ± 0.51)						
Lead Length "J"	0.040 ± 0.010 (1.02 ± 0.25)			0.040 ± 0.010 (1.02 ± 0.25)				0.040 ± 0.010 (1.02 ± 0.25)				0.100 ± 0.020 (2.54 ± 0.51)					0.100 ± 0.020 (2.54 ± 0.51)						
X7R Dielectric																							
Voltage Code	**501**	**102**	**202**	**501**	**102**	**202**	**302**	**501**	**102**	**202**	**302**	**501**	**102**	**202**	**302**	**402**	**501**	**102**	**202**	**302**	**402**	**502**	**Capacitance Tolerance**
Voltage DC	**500**	**1 K**	**2 K**	**500**	**1 K**	**2 K**	**3 K**	**500**	**1 K**	**2 K**	**3 K**	**500**	**1 K**	**2 K**	**3 K**	**4 K**	**500**	**1 K**	**2 K**	**3 K**	**4 K**	**5 K**	
Capacitance	Capacitance Code																						
330 pF	331	331	331																				**K, M**
390 pF	391	391	391																				
470 pF	471	471	471																				
560 pF	561	561	561																				
680 pF	681	681	681					681	681	681	681												
820 pF	821	821	821	821	821	821	821	821	821	821	821												
1,000 pF	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	
1,200 pF	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122	
1,500 pF	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	
1,800 pF	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182	
2,200 pF	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222	
2,700 pF	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	
3,300 pF	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	
3,900 pF	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	
4,700 pF	472	472		472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	
5,600 pF	562	562		562	562	562		562	562	562	562	562	562	562	562	562	562	562	562	562	562	562	
6,800 pF	682	682		682	682	682		682	682	682		682	682	682	682	682	682	682	682	682	682	682	
8,200 pF	822	822		822	822	822		822	822	822		822	822	822	822		822	822	822	822	822		
0.01 µF	103	103		103	103	103		103	103	103		103	103	103	103		103	103	103	103	103		
0.012 µF	123	123		123	123	123		123	123	123		123	123	123	123		123	123	123	123	123		
0.015 µF	153	153		153	153			153	153	153		153	153	153	153		153	153	153	153			
0.018 µF	183	183		183	183			183	183			183	183	183			183	183	183	183			
0.022 µF	223	223		223	223			223	223			223	223	223			223	223	223	223			
0.027 µF	273			273	273			273	273			273	273	273			273	273	273	273			
0.033 µF	333			333	333			333	333			333	333	333			333	333	333	333			
0.039 µF	393			393	393			393	393			393	393				393	393	393				
0.047 µF	473			473	473			473	473			473	473				473	473	473				
0.056 µF	563			563	563			563	563			563	563				563	563	563				
0.068 µF	683			683	683			683	683			683	683				683	683	683				
0.082 µF	823			823				823	823			823	823				823	823	823				
0.1 µF				104				104	104			104	104				104	104	104				
0.12 µF				124				124				124	124				124	124					
0.15 µF				154				154				154	154				154	154					
0.18 µF				184				184				184	184				184	184					
0.22 µF								224				224	224				224	224					
0.27 µF								274				274	274				274	274					
0.33 µF												334					334	334					
0.39 µF												394					394	394					
0.47 µF												474					474	474					
0.56 µF												564					564						
0.68 µF																	684						
0.82 µF																	824						
1.0 µF																	105						
1.2 µF																	125						

Table 1B – Capacitance Range/Selection Waterfall SM25 – SM31 Style/Size

Style/Size	SM25						SM26						SM30					SM31						
Dimensions – inches (mm)																								
Length	0.550 ± 0.030 (14.00 ± 0.76)						0.650 ± 0.030 (16.50 ± 0.76)						0.300 ± 0.030 (7.62 ± 0.76)					0.400 ± 0.030 (10.20 ± 0.76)						
Width	0.500 ± 0.030 (12.70 ± 0.76)						0.600 ± 0.030 (15.20 ± 0.76)						0.150 ± 0.015 (3.81 ± 0.38)					0.200 ± 0.020 (5.08 ± 0.51)						
Thickness Maximum	0.220 (5.59)						0.220 (5.59)						0.140 (3.55)					0.130 (3.30)						
Lead Width Maximum	0.400 (10.20)						0.500 (12.70)						0.100 (2.54)					0.100 (2.54)						
Lead Length "L"	0.100 ± 0.020 (2.54 ± 0.51)						0.100 ± 0.020 (2.54 ± 0.51)						0.100 ± 0.020 (2.54 ± 0.51)					0.100 ± 0.020 (2.54 ± 0.51)						
Lead Length "J"	0.100 ± 0.020 (2.54 ± 0.51)						0.100 ± 0.020 (2.54 ± 0.51)						0.100 ± 0.020 (2.54 ± 0.51)					0.100 ± 0.020 (2.54 ± 0.51)						
X7R Dielectric																								
Voltage Code	**501**	**102**	**202**	**302**	**402**	**502**	**501**	**102**	**202**	**302**	**402**	**502**	**501**	**102**	**202**	**302**	**402**	**501**	**102**	**202**	**302**	**402**	**502**	**Capacitance Tolerance**
Voltage DC	**500**	**1 K**	**2 K**	**3 K**	**4 K**	**5 K**	**500**	**1 K**	**2 K**	**3 K**	**4 K**	**5 K**	**500**	**1 K**	**2 K**	**3 K**	**4 K**	**500**	**1 K**	**2 K**	**3 K**	**4 K**	**5 K**	
Capacitance	Capacitance Code																							
150 pF													151	151	151	151	151							K, M
180 pF													181	181	181	181	181							
220 pF													221	221	221	221	221							
270 pF													271	271	271	271	271							
330 pF													331	331	331	331	331							
390 pF													391	391	391	391	391							
470 pF													471	471	471	471	471							
560 pF													561	561	561	561	561							
680 pF													681	681	681	681	681	681	681	681	681	681	681	
820 pF													821	821	821	821	821	821	821	821	821	821	821	
1,000 pF													102	102	102	102	102	102	102	102	102	102	102	
1,200 pF													122	122	122	122	122	122	122	122	122	122	122	
1,500 pF													152	152	152	152	152	152	152	152	152	152	152	
1,800 pF													182	182	182	182		182	182	182	182	182		
2,200 pF	222	222	222	222	222	222	222	222	222	222			222	222	222	222		222	222	222	222	222		
2,700 pF	272	272	272	272	272	272	272	272	272	272			272	272	272	272		272	272	272	272	272		
3,300 pF	332	332	332	332	332	332	332	332	332	332			332	332	332	332		332	332	332	332	332		
3,900 pF	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392			392	392	392	392	392		
4,700 pF	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472			472	472	472	472			
5,600 pF	562	562	562	562	562	562	562	562	562	562	562	562	562	562	562			562	562	562	562			
6,800 pF	682	682	682	682	682	682	682	682	682	682	682	682	682	682	682			682	682	682	682			
8,200 pF	822	822	822	822	822	822	822	822	822	822	822	822	822	822	822			822	822	822	822			
0.01 µF	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103			103	103	103				
0.012 µF	123	123	123	123	123		123	123	123	123	123	123	123	123				123	123	123				
0.015 µF	153	153	153	153	153		153	153	153	153	153	153	153	153				153	153	153				
0.018 µF	183	183	183	183			183	183	183	183	183		183	183				183	183	183				
0.022 µF	223	223	223	223			223	223	223	223	223		223	223				223	223	223				
0.027 µF	273	273	273	273			273	273	273	273	273		273	273				273	273					
0.033 µF	333	333	333	333			333	333	333	333	333		333	333				333	333					
0.039 µF	393	393	393	393			393	393	393	393			393	393				393	393					
0.047 µF	473	473	473	473			473	473	473	473			473	473				473	473					
0.056 µF	563	563	563				563	563	563	563			563	563				563	563					
0.068 µF	683	683	683				683	683	683	683			683					683	683					
0.082 µF	823	823	823				823	823	823	823			823					823	823					
0.1 µF	104	104	104				104	104	104	104			104					104	104					
0.12 µF	124	124	124				124	124	124				124					124						
0.15 µF	154	154					154	154	154				154					154						
0.18 µF	184	184					184	184	184				184					184						
0.22 µF	224	224					224	224										224						
0.27 µF	274	274					274	274										274						
0.33 µF	334	334					334	334										334						
0.39 µF	394	394					394	394										394						
0.47 µF	474	474					474	474																
0.56 µF	564						564	564																
0.68 µF	684						684	684																
0.82 µF	824						824	824																

Table 1B – Capacitance Range/Selection Waterfall SM25 – SM31 Style/Size cont.

Style/Size	SM25						SM26						SM30					SM31						
Dimensions – inches (mm)																								
Length	0.550 ± 0.030 (14.00 ± 0.76)						0.650 ± 0.030 (16.50 ± 0.76)						0.300 ± 0.030 (7.62 ± 0.76)					0.400 ± 0.030 (10.20 ± 0.76)						
Width	0.500 ± 0.030 (12.70 ± 0.76)						0.600 ± 0.030 (15.20 ± 0.76)						0.150 ± 0.015 (3.81 ± 0.38)					0.200 ± 0.020 (5.08 ± 0.51)						
Thickness Maximum	0.220 (5.59)						0.220 (5.59)						0.140 (3.55)					0.130 (3.30)						
Lead Width Maximum	0.400 (10.20)						0.500 (12.70)						0.100 (2.54)					0.100 (2.54)						
Lead Length "L"	0.100 ± 0.020 (2.54 ± 0.51)						0.100 ± 0.020 (2.54 ± 0.51)						0.100 ± 0.020 (2.54 ± 0.51)					0.100 ± 0.020 (2.54 ± 0.51)						
Lead Length "J"	0.100 ± 0.020 (2.54 ± 0.51)						0.100 ± 0.020 (2.54 ± 0.51)						0.100 ± 0.020 (2.54 ± 0.51)					0.100 ± 0.020 (2.54 ± 0.51)						
X7R Dielectric																								
Voltage Code	**501**	**102**	**202**	**302**	**402**	**502**	**501**	**102**	**202**	**302**	**402**	**502**	**501**	**102**	**202**	**302**	**402**	**501**	**102**	**202**	**302**	**402**	**502**	**Capacitance Tolerance**
Voltage DC	**500**	**1 K**	**2 K**	**3 K**	**4 K**	**5 K**	**500**	**1 K**	**2 K**	**3 K**	**4 K**	**5 K**	**500**	**1 K**	**2 K**	**3 K**	**4 K**	**500**	**1 K**	**2 K**	**3 K**	**4 K**	**5 K**	
Capacitance	Capacitance Code																							
1.0 µF	105						105	105																
1.2 µF	125						125																	
1.5 µF	155						155																	
1.8 µF	185						185																	**K, M**
2.2 µF							225																	
2.7 µF							275																	
2.9 µF							295																	

Table 1C – Capacitance Range/Selection Waterfall SM33 – SM35 Style/Size

Style/Size	SM33							SM34								SM35								
Dimensions – inches (mm)																								
Length	0.700 ± 0.030 (17.08 ± 0.76)							0.900 ± 0.030 (22.90 ± 0.76)								1.100 ± 0.030 (27.90 ± 0.76)								
Width	0.300 ± 0.030 (7.62 ± 0.76)							0.400 ± 0.030 (10.20 ± 0.76)								0.500 ± 0.030 (12.70 ± 0.76)								
Thickness Maximum	0.180 (4.57)							0.220 (5.59)								0.220 (5.59)								
Lead Width Maximum	0.200 (5.08)							0.300 (7.62)								0.400 (10.2)								
Lead Length "L"	0.100 ± 0.020 (2.54 ± 0.51)							0.100 ± 0.020 (2.54 ± 0.51)								0.100 ± 0.020 (2.54 ± 0.51)								
Lead Length "J"	0.100 ± 0.020 (2.54 ± 0.51)							0.100 ± 0.020 (2.54 ± 0.51)								0.100 ± 0.020 (2.54 ± 0.51)								
X7R Dielectric																								
Voltage Code	**501**	**102**	**202**	**302**	**402**	**502**	**752**	**501**	**102**	**202**	**302**	**402**	**502**	**752**	**103**	**501**	**102**	**202**	**302**	**402**	**502**	**752**	**103**	**Capacitance Tolerance**
Voltage DC	**500**	**1 K**	**2 K**	**3 K**	**4 K**	**5 K**	**7.5 K**	**500**	**1 K**	**2 K**	**3 K**	**4 K**	**5 K**	**7.5 K**	**10 K**	**500**	**1 K**	**2 K**	**3 K**	**4 K**	**5 K**	**7.5 K**	**10 K**	
Capacitance	Capacitance Code																							
820 pF	821	821	821	821	821	821	821																	K, M
1,000 pF	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102								102	
1,200 pF	122	122	122	122	122	122	122	122	122	122	122	122	122	122	122								122	
1,500 pF	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152								152	
1,800 pF	182	182	182	182	182	182	182	182	182	182	182	182	182	182	182								182	
2,200 pF	222	222	222	222	222	222	222	222	222	222	222	222	222	222	222								222	
2,700 pF	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272								272	
3,300 pF	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	
3,900 pF	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	392	
4,700 pF	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	472	
5,600 pF	562	562	562	562	562	562		562	562	562	562	562	562	562	562	562	562	562	562	562	562	562	562	
6,800 pF	682	682	682	682	682	682		682	682	682	682	682	682	682		682	682	682	682	682	682	682	682	
8,200 pF	822	822	822	822	822			822	822	822	822	822	822			822	822	822	822	822	822	822		
0.01 µF	103	103	103	103	103			103	103	103	103	103	103			103	103	103	103	103	103	103		
0.012 µF	123	123	123	123	123			123	123	123	123	123	123			123	123	123	123	123	123			
0.015 µF	153	153	153	153				153	153	153	153	153	153			153	153	153	153	153	153			
0.018 µF	183	183	183	183				183	183	183	183	183	183			183	183	183	183	183	183			
0.022 µF	223	223	223	223				223	223	223	223	223	223			223	223	223	223	223	223			
0.027 µF	273	273	273	273				273	273	273	273	273				273	273	273	273	273	273			
0.033 µF	333	333	333	333				333	333	333	333	333				333	333	333	333	333				
0.039 µF	393	393	393	393				393	393	393	393					393	393	393	393	393				
0.047 µF	473	473	473					473	473	473	473					473	473	473	473	473				
0.056 µF	563	563	563					563	563	563	563					563	563	563	563					
0.068 µF	683	683	683					683	683	683	683					683	683	683	683					
0.082 µF	823	823	823					823	823	823	823					823	823	823	823					
0.1 µF	104	104						104	104	104						104	104	104	104					
0.12 µF	124	124						124	124	124						124	124	124						
0.15 µF	154	154						154	154	154						154	154	154						
0.18 µF	184	184						184	184	184						184	184	184						
0.22 µF	224	224						224	224	224						224	224	224						
0.27 µF	274	274						274	274	274						274	274	274						
0.33 µF	334	334						334	334							334	334							
0.39 µF	394	394						394	394							394	394							
0.47 µF	474	474						474	474							474	474							
0.56 µF	564	564						564	564							564	564							
0.68 µF	684	684						684	684							684	684							
0.82 µF	824							824	824							824	824							
1.0 µF	105							105	105							105	105							
1.2 µF	125							125								125	125							
1.5 µF	155							155								155								
1.8 µF								185								185								
2.2 µF								225								225								
2.7 µF																275								
2.9 µF																295								
3.3 µF																335								
3.9 µF																395								

Table 1D – Capacitance Range/Selection Waterfall SM36 Style/Size

Style/Size	SM36								
Dimensions – inches (mm)									
Length	1.350 ± 0.030 (33.00 ± 0.76)								
Width	0.600 ± 0.030 (15.20 ± 0.76)								
Thickness Maximum	0.220 (5.59)								
Lead Width Maximum	0.500 (12.7)								
Lead Length "L"	0.100 ± 0.020 (2.54 ± 0.51)								
Lead Length "J"	0.100 ± 0.020 (2.54 ± 0.51)								
X7R Dielectric									
Voltage Code	**501**	**102**	**202**	**302**	**402**	**502**	**752**	**103**	**Capacitance Tolerance**
Voltage DC	**500**	**1 K**	**2 K**	**3 K**	**4 K**	**5 K**	**7.5 K**	**10 K**	
Capacitance	Capacitance Code								
1,500 pF								152	
1,800 pF								182	
2,200 pF								222	
2,700 pF								272	
3,300 pF								332	
3,900 pF								392	
4,700 pF	472	472	472	472	472	472	472	472	
5,600 pF	562	562	562	562	562	562	562	562	
6,800 pF	682	682	682	682	682	682	682	682	
8,200 pF	822	822	822	822	822	822	822	822	
0.01 µF	103	103	103	103	103	103	103	103	
0.012 µF	123	123	123	123	123	123	123		
0.015 µF	153	153	153	153	153	153	153		
0.018 µF	183	183	183	183	183	183	183		
0.022 µF	223	223	223	223	223	223	223		
0.027 µF	273	273	273	273	273	273			
0.033 µF	333	333	333	333	333	333			
0.039 µF	393	393	393	393	393				
0.047 µF	473	473	473	473	473				
0.056 µF	563	563	563	563	563				
0.068 µF	683	683	683	683	683				
0.082 µF	823	823	823	823					
0.1 µF	104	104	104	104					**K, M, P, Z**
0.12 µF	124	124	124	124					
0.15 µF	154	154	154	154					
0.18 µF	184	184	184						
0.22 µF	224	224	224						
0.27 µF	274	274	274						
0.33 µF	334	334	334						
0.39 µF	394	394							
0.47 µF	474	474							
0.56 µF	564	564							
0.68 µF	684	684							
0.82 µF	824	824							
1.0 µF	105	105							
1.2 µF	125	125							
1.5 µF	155	155							
1.8 µF	185	185							
2.2 µF	225	225							
2.7 µF	275								
2.9 µF	295								
3.3 µF	335								
3.9 µF	395								
4.7 µF	475								
5.6 µF	565								

Table 2 – Chip Thickness/Packaging Quantities

Series	Style/Size	Tray Quantity Minimum[1]	Tray Quantity Maximum[1]
SM	SM20	1	50
	SM21		
	SM22		
	SM23		
	SM24		
	SM25		
	SM26		
	SM30		
	SM31		
	SM33		25
	SM34		10
	SM35		
	SM36		

[1] *Minimum order value applies. Contact KEMET for details.*

Soldering Process

The capacitors and assemblies outlined in this specification sheet are susceptible to thermal shock damage due to their large ceramic mass. Temperature profiles used should provide adequate temperature rise and cool-down time to prevent damage from thermal shock. In general, KEMET recommends against hand soldering for these types of large ceramic devices.

Recommended Soldering Technique:

- Solder reflow only

Preheating and Reflow Profile Notes:
Due to differences in the coefficient of thermal expansion for the different materials of construction, it is critical to monitor and control the heating and cooling rates during the soldering process. During the reflow soldering process, the maximum recommended heating and cooling rate (dT/dt) is 4°C/second. To ensure optimal component reliability, KEMET's recommended heating and cooling rate is 2°C/second. After soldering, the capacitors should be air cooled to room temperature before further processing. Forced air cooling is not recommended.

Recommended Reflow Soldering Profile:

Profile Feature	SnPb Assembly
Preheat/Soak	
Temperature Minimum (T_{Smin})	100°C
Temperature Maximum (T_{Smax})	150°C
Time (t_s) from Tsmin to T_{smax})	60 – 90 seconds
Ramp-up Rate (T_L to T_P)	2°C/seconds
Liquidous Temperature (T_L)	183°C
Time Above Liquidous (t_L)	95 seconds
Peak Temperature (T_P)	240°C
Time within 5°C of Maximum Peak Temperature (t_P)	5 seconds
Ramp-down Rate (T_P to T_L)	2°C/seconds
Time 25°C to Peak Temperature	3.5 minutes

Note 1: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.

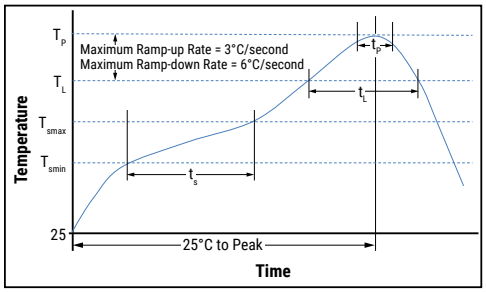


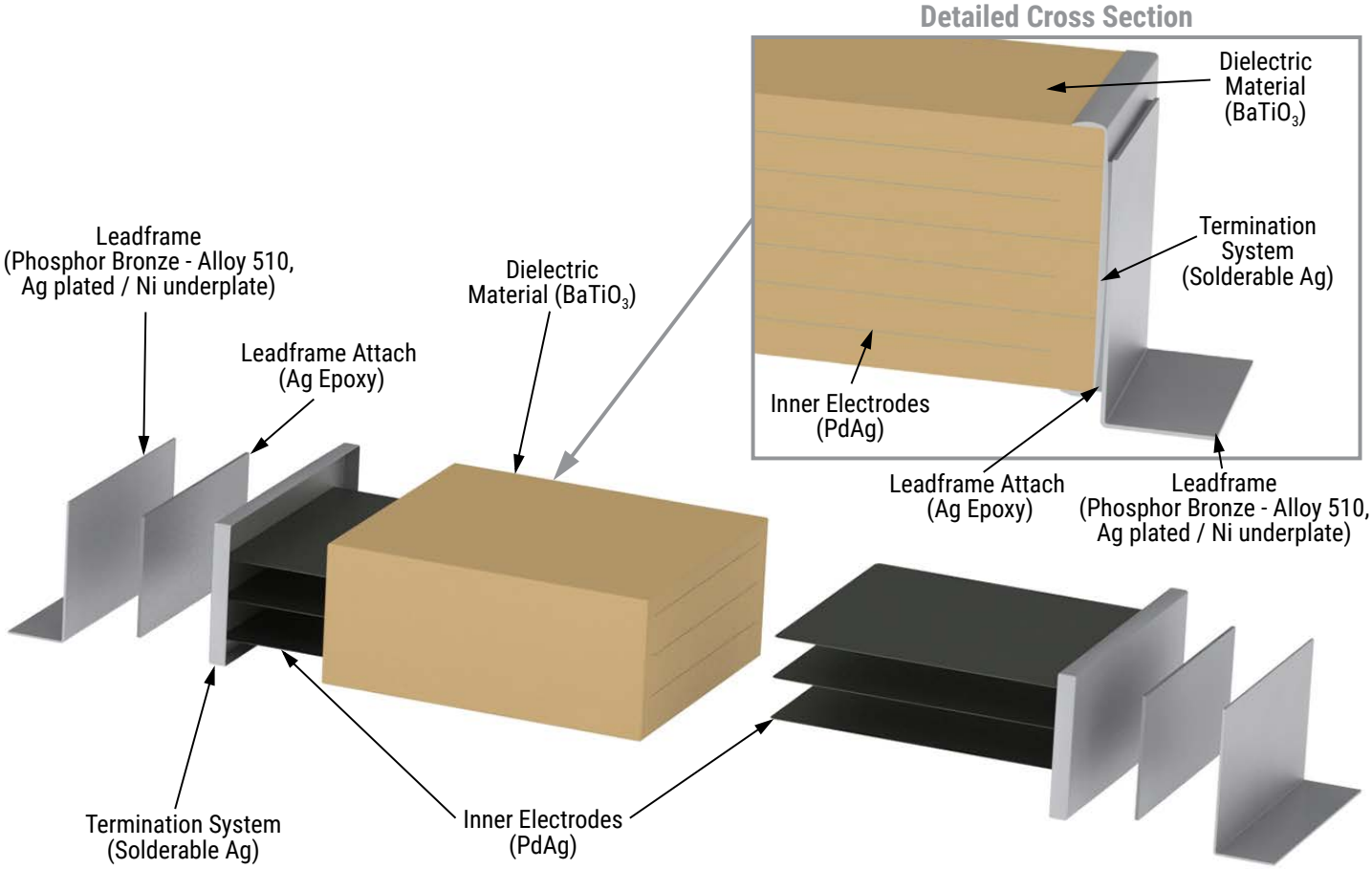
Table 3 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
Board Flex	JIS–C–6429	Appendix 2, Note: 2 mm (minimum) for all except 3 mm for C0G.
Solderability	J–STD–002	Magnification 50 X. Conditions:
		a) Method B, 4 hours at 155°C, dry heat at 235°C
		b) Method B at 215°C category 3
		c) Method D, category 3 at 260°C
		1,000 cycles (–55°C to +125°C). Measurement at 24 hours +/–2 hours after test conclusion.
Biased Humidity	MIL–STD–202 Method 103	Load Humidity: 1,000 hours 85°C/85% RH and 300 VDC Maximum Add 100 K ohm resistor. Measurement at 24 hours +/–2 hours after test conclusion.
		Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours +/–2 hours after test conclusion.
		t = 24 hours/cycle. Steps 7a and 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. D14 dwell time – 15 minutes. Air – Air.
High Temperature Life	MIL–STD–202 Method 108 /EIA -198	1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with rated voltage applied.
Storage Life	MIL–STD–202 Method 108	150°C, 0 VDC, for 1,000 hours.
Vibration	MIL–STD–202 Method 204	5 g for 20 minutes, 12 cycles each of 3 orientations. Note: Use 8 "X5" PCB 0.031" thick 7 secure points on one long side and 2 secure points at corners of opposite sides. Parts mounted within 2" from any secure point. Test from 10–2,000 Hz.
Resistance to Soldering Heat	MIL–STD–202 Method 210	Condition B. No preheat of samples. Note: single wave solder – procedure 2.
Terminal Strength	MIL–STD–202 Method 211	Conditions A (2.3 kg or 5 lbs).
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 40ºC and maximum storage humidity not exceed 70% relative humidity. 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.

Construction



Product Marking

Product marking is an extra-cost option. These devises will be supplied unmarked unless otherwise specified and/or requested. For more detailed information regarding marked product and how to request this option, please contact KEMET.

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Although all product–related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicated or that other measures may not be required.