Surface Mount Multilayer Ceramic Chip Capacitors MIL Qualified, Type MIL-123

FEATURES

- Space-level reliability
- Military qualified products
- Federal stock control number, CAGE CODE 2770A
- High reliability tested per MIL-PRF-123
- Lead-bearing (min. 4 %) termination finish “Z”
- Silver / palladium alloy finish “M”
- Guarded termination finish “S”
- Wet build process
- Reliable Noble Metal Electrode (NME) system
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- Space systems
- Satellite systems
- Avionic systems
- Sonar systems
- Missiles applications
- Global positioning systems

ELECTRICAL SPECIFICATIONS

Note

- Electrical characteristics at +25 °C, unless otherwise specified

Operating Temperature: -55 °C to +125 °C

Capacitance Range: 1.0 pF to 470 nF

Voltage Range: 50 V_{DC} to 100 V_{DC}

Temperature Coefficient of Capacitance (TCC):
BP: 0 ppm/°C ± 30 ppm/°C from -55 °C to +125 °C, with 0 V_{DC} applied
BX: ± 15 % from -55 °C to +125 °C, with 0 V_{DC} applied
BX: +15 %, -25 % from -55 °C to +125 °C, with 100 % rated V_{DC} applied

Dissipation Factor (DF):
BP: 0.15 % maximum
BX: 2.50 % maximum
Test frequency:
1 MHz ± 50 kHz for BP capacitors ≤ 1000 pF
All other BP and BX at 1 kHz ± 50 Hz

Aging Rate:
BP: 0 % maximum per decade
BX: 1 % maximum per decade

Insulation Resistance (IR):
at +25 °C and rated voltage 100 000 MΩ minimum or 1000 ΩF, whichever is less

Dielectric Strength Test:
performed per method 103 of EIA-198-2-E.
Applied test voltages:
≤ 100 V_{DC}-rated: 250 % of rated voltage

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QUICK REFERENCE DATA

DIELECTRIC	STYLE (CASE)	MAXIMUM VOLTAGE (V)	CAPACITANCE	
			MINIMUM	MAXIMUM
BP	CKS51 (0805)	100	1.0 pF	680 pF
BP	CKS55 (1206)	100	1.0 pF	2200 pF
BP	CKS52 (1210)	100	300 pF	3300 pF
BP	CKS53 (1808)	100	300 pF	1000 pF
BP	CKS56 (1812)	100	1200 pF	10 000 pF
BP	CKS57 (1825)	100	3600 pF	22 000 pF
BP	CKS54 (2225)	50	1100 pF	10 000 pF
BX	CKS51 (0805)	100	330 pF	18 000 pF
BX	CKS55 (1206)	100	4700 pF	39 000 pF
BX	CKS52 (1210)	100	5600 pF	100 000 pF
BX	CKS53 (1808)	100	5600 pF	100 000 pF
BX	CKS56 (1812)	100	27 000 pF	56 000 pF
BX	CKS57 (1825)	100	56 000 pF	470 000 pF
BX	CKS54 (2225)	50	120 000 pF	470 000 pF

Note

- Detail ratings see “Selection Chart”

ORDERING INFORMATION - MIL-PRF-123 [1]

M123A	10	BX	B	103	K	Z	W
MILITARY STYLE	SLASH SHEET	DIELECTRIC	DC VOLTAGE	CAPACITANCE VALUE	CAPACITANCE TOLERANCE	TERMINATION	PACKAGING
MIL-PRF-123	10 = CKS51 (0805) 11 = CKS52 (1210) 12 = CKS53 (1808) 13 = CKS54 (2225) 21 = CKS55 (1206) 22 = CKS56 (1812) 23 = CKS57 (1825)	BP BX	B = 50 V C = 100 V	Expressed in picofarads (pF). The first two digits are significant, the third is a multiplier. R denotes decimal place. Examples: 1R0 = 1.0 pF 103 = 10 000 pF 104 = 100 000 pF	B = ± 0.10 pF C = ± 0.25 pF D = ± 0.50 pF F = ± 1 % J = ± 5 % K = ± 10 % M = ± 20 % See table “Available Tolerances”	Z = Ni barrier with tin / lead plate min. 4 % lead S = guarded termination M = silver / palladium alloy	W = waffle pack J = full 7" reel A = 7" reel, customer defined quantity

Note

[1] DC voltage rating should not be exceeded in application. Other application factors may affect the MLCC performance
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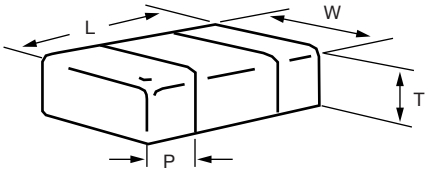
AVAILABLE TOLERANCES

MILITARY STYLE	SLASH SHEET	DIELECTRIC	CAPACITANCE RANGE	AVAILABLE CAPACITANCE TOLERANCES
MIL-PRF-123	10: CKS51 (0805)	BP	≤ 10 pF	C, D
			10 pF to 24 pF	C, J, K
			≥ 27 pF	F, J, K
		BX	All	K
	11: CKS52 (1210)	BP	All	F, J, K
		BX	All	K, M
	12: CKS53 (1808)	BP	All	F, J, K
		BX	All	K
	13: CKS54 (2225)	BP	All	F, J, K
		BX	All	K
	21: CKS55 (1206)	BP	≤ 2.4 pF	B, C
			2.7 pF to 9.1 pF	B, C, D
			≥ 10 pF	F, J, K
		BX	All	K, M
	22: CKS56 (1812)	BP	All	F, J, K
		BX	All	K, M
	23: CKS57 (1825)	BP	All	F, J, K
		BX	All	K, M

DIMENSIONS in inches (millimeters)



MIL-PRF-123	STYLE	LENGTH (L)	WIDTH (W)	THICKNESS (T)		TERM. (P)
				MINIMUM	MAXIMUM	
/10	CKS51	0.080 ± 0.015 (2.03 ± 0.38)	0.050 ± 0.015 (1.27 ± 0.38)	0.020 (0.51)	0.055 (1.40)	0.020 ± 0.010 (0.51 ± 0.25)
/11	CKS52	0.120 ± 0.015 (3.05 ± 0.38)	0.100 ± 0.015 (2.54 ± 0.38)	0.020 (0.51)	0.065 (1.65)	0.020 ± 0.010 (0.51 ± 0.25)
/12	CKS53	0.180 ± 0.015 (4.57 ± 0.38)	0.080 ± 0.015 (2.03 ± 0.38)	0.020 (0.51)	0.065 (1.65)	0.020 ± 0.010 (0.51 ± 0.25)
/13	CKS54	0.220 ± 0.015 (5.59 ± 0.38)	0.250 ± 0.015 (6.35 ± 0.38)	0.020 (0.51)	0.070 (1.78)	0.020 ± 0.010 (0.51 ± 0.25)
/21	CKS55	0.120 ± 0.015 (3.05 ± 0.38)	0.060 ± 0.015 (1.52 ± 0.38)	0.020 (0.51)	0.065 (1.65)	0.020 ± 0.010 (0.51 ± 0.25)
/22	CKS56	0.180 ± 0.015 (4.57 ± 0.38)	0.125 ± 0.015 (3.18 ± 0.38)	0.022 (0.56)	0.080 (2.03)	0.020 ± 0.010 (0.51 ± 0.25)
/23	CKS57	0.180 ± 0.015 (4.57 ± 0.38)	0.250 ± 0.015 (6.35 ± 0.38)	0.020 (0.51)	0.080 (2.03)	0.020 ± 0.010 (0.51 ± 0.25)

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SELECTION CHART

DIELECTRIC		BP												
STYLE		CKS51		CKS55		CKS52		CKS53		CKS56		CKS57		CKS54
SLASH SHEET		/10		/21		/11		/12		/22		/23		/13
CASE CODE		0805		1206		1210		1808		1812		1825		2225
VOLTAGE (V_{DC})		50 V	100 V	50 V	100 V	50 V	100 V	50 V	100 V	50 V	100 V	50 V	100 V	50 V
VOLTAGE CODE		B	C	B	C	B	C	B	C	B	C	B	C	B
CAP. CODE	CAP.													
1R0	1.0 pF	•	•		•									
1R1	1.1 pF	•	•		•									
1R2	1.2 pF	•	•		•									
1R3	1.3 pF	•	•		•									
1R5	1.5 pF	•	•		•									
1R6	1.6 pF	•	•		•									
1R8	1.8 pF	•	•		•									
2R0	2.0 pF	•	•		•									
2R2	2.2 pF	•	•		•									
2R4	2.4 pF	•	•		•									
2R7	2.7 pF	•	•		•									
3R0	3.0 pF	•	•		•									
3R3	3.3 pF	•	•		•									
3R6	3.6 pF	•	•		•									
3R9	3.9 pF	•	•		•									
4R3	4.3 pF	•	•		•									
4R7	4.7 pF	•	•		•									
5R1	5.1 pF	•	•		•									
5R6	5.6 pF	•	•		•									
6R2	6.2 pF	•	•		•									
6R8	6.8 pF	•	•		•									
7R5	7.5 pF	•	•		•									
8R2	8.2 pF	•	•		•									
9R1	9.1 pF	•	•		•									
100	10 pF	•	•		•									
110	11 pF	•	•		•									
120	12 pF	•	•		•									
130	13 pF	•	•		•									
150	15 pF	•	•		•									
160	16 pF	•	•		•									
180	18 pF	•	•		•									
200	20 pF	•	•		•									
220	22 pF	•	•											
240	24 pF	•	•		•									
270	27 pF	•	•		•									
300	30 pF	•	•											
330	33 pF	•	•		•									
360	36 pF	•	•		•									
390	39 pF	•	•		•									
430	43 pF	•	•		•									
470	47 pF	•	•		•									
510	51 pF	•	•		•									
560	56 pF	•	•		•									
620	62 pF	•	•		•									
680	68 pF	•	•		•									
750	75 pF	•	•		•									
820	82 pF	•	•		•									
910	91 pF	•	•		•									
101	100 pF	•	•		•									
111	110 pF	•	•		•									
121	120 pF	•	•		•									
131	130 pF	•	•		•									
151	150 pF	•	•		•									

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SELECTION CHART

DIELECTRIC		BP												
STYLE		CKS51		CKS55		CKS52		CKS53		CKS56		CKS57		CKS54
SLASH SHEET		/10		/21		/11		/12		/22		/23		/13
CASE CODE		0805		1206		1210		1808		1812		1825		2225
VOLTAGE (V_{DC})		50 V	100 V	50 V	100 V	50 V	100 V	50 V	100 V	50 V	100 V	50 V	100 V	50 V
VOLTAGE CODE		B	C	B	C	B	C	B	C	B	C	B	C	B
CAP. CODE	CAP.													
161	160 pF	•	•		•									
181	180 pF	•	•		•									
201	200 pF	•	•		•									
221	220 pF	•	•		•									
241	240 pF	•	•		•									
271	270 pF	•	•		•									
301	300 pF	•	•		•	•	•	•	•					
331	330 pF	•	•		•	•	•	•	•					
361	360 pF	•	•		•	•	•	•	•					
391	390 pF	•	•		•	•	•	•	•					
431	430 pF	•	•		•	•	•	•	•					
471	470 pF	•	•		•	•	•	•	•					
511	510 pF	•			•	•	•	•	•					
561	560 pF	•			•	•	•	•	•					
621	620 pF	•			•	•	•	•	•					
681	680 pF	•			•	•	•	•	•					
751	750 pF				•	•	•	•	•					
821	820 pF				•	•	•	•	•					
911	910 pF				•	•	•	•	•					
102	1.0 nF				•	•	•	•	•					
112	1.1 nF			•		•	•							•
122	1.2 nF			•		•	•				•			•
132	1.3 nF			•		•	•							•
152	1.5 nF			•		•	•				•			•
162	1.6 nF			•		•	•							•
182	1.8 nF			•		•	•				•			•
202	2.0 nF			•		•	•							•
222	2.2 nF			•		•	•				•			•
242	2.4 nF					•					•			•
272	2.7 nF					•					•			•
302	3.0 nF					•					•			•
332	3.3 nF					•					•			•
362	3.6 nF										•			•
392	3.9 nF										•		•	•
432	4.3 nF										•			•
472	4.7 nF										•		•	•
512	5.1 nF									•			•	•
562	5.6 nF									•			•	•
622	6.2 nF									•			•	•
682	6.8 nF									•			•	•
752	7.5 nF									•			•	•
822	8.2 nF									•			•	•
912	9.1 nF									•			•	•
103	10 nF									•			•	•
113	11 nF											•		
123	12 nF											•		
133	13 nF											•		
153	15 nF											•		
163	16 nF											•		
183	18 nF											•		
203	20 nF											•		
223	22 nF											•		

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SELECTION CHART													
DIELECTRIC		BX											
STYLE		CKS51		CKS55		CKS52		CKS53		CKS56	CKS57		CKS54
SLASH SHEET		/10		/21		/11		/12		/22	/23		/13
CASE CODE		0805		1206		1210		1808		1812	1825		2225
VOLTAGE (V_{DC})		50 V	100 V	50 V	100 V	50 V	100 V	50 V	100 V	100 V	50 V	100 V	50 V
VOLTAGE CODE		B	C	B	C	B	C	B	C	C	B	C	B
CAP. CODE	CAP.												
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										•		•

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PACKAGE QUANTITIES (1)(2)(3)

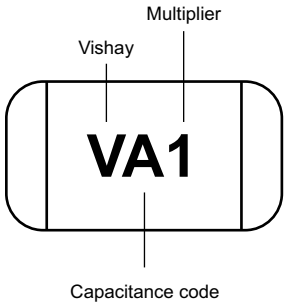
STYLE	BODY SIZE	WAFFLE PACK "W" (4)	TAPE AND REEL		TAPE SIZE
			"A" (5)	"J" (6)	
CKS51	0805	666	≥ 100	1000	8 mm
CKS55	1206	511	≥ 100	1000	8 mm
CKS52	1210	475	≥ 100	1000	8 mm
CKS53	1808	430	≥ 100	500	12 mm
CKS56	1812	350	≥ 100	500	12 mm
CKS57	1825	244	≥ 100	500	12 mm
CKS54	2225	216	≥ 100	250	12 mm

Notes

(1) Vishay Vitramon uses embossed plastic carrier tape
(2) Reference: EIA standard RS 481 - "Taping of Surface Mount Components for Automatic Placement"
(3) Maximum single lot date code quantity (SLDC) is 5000 pieces
(4) The quantities in the table are the maximum number of pieces per waffle package. Order quantity can be any amount
(5) Order quantity for "A" package code can be any amount greater than or equal to 100 pieces
(6) Orders for "J" package code product must be in increments of the quantity listed in the table

PART MARKING EXPLANATION

FIRST DIGIT	SECOND DIGIT		THIRD DIGIT		EXAMPLES
	ALPHABETIC CHARACTER	SIGNIFICANT FIGURES	NUMERICAL CHARACTER	DECIMAL MULTIPLIER	
V = Vishay	A	1.0	0	10^0	
	B	1.1	1	10^1	
	C	1.2	2	10^2	
	D	1.3	3	10^3	
	E	1.5	4	10^4	
	F	1.6	5	10^5	
	G	1.8	6	10^6	
	H	2.0	7	10^7	
	J	2.2	8	10^8	
	K	2.4	9	10^9	
	L	2.7			
	M	3.0			
	N	3.3			
	P	3.6			
	Q	3.9			
	R	4.3			
	S	4.7			**VL0 = 2.7 pF**
	T	5.1			
	U	5.6			**VA2 = 100 pF**
	V	6.2			
	W	6.8			**VR1 = 43 pF**
	X	7.5			
	Y	8.2			**Vd3 = 4000 pF**
	Z	9.1			
	a	2.5			
	b	3.5			
	d	4.0			
	e	4.5			
	f	5.0			
	m	6.0			
	n	7.0			
	t	8.0			
	y	9.0			



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STORAGE AND HANDLING CONDITIONS

(1) Store the components at 5 °C to +40 °C ambient temperature and ≤ 70 % related humidity conditions.
(2) The product is recommended to be used within a time-frame of 2 years after shipment.
Check solderability in case extended shelf life beyond the expiry date is needed.

Precautions:

a. 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.
b. Store products on the shelf and avoid exposure to moisture or dust.
c. Do not expose products to excessive shock, vibration, direct sunlight and so on.

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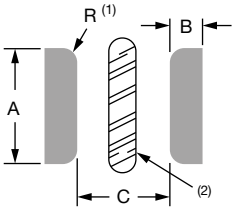
Solder Pad Dimensions for Vishay Surface-Mount Multilayer Ceramic Chip Capacitors

DIMENSIONS in millimeters



CASE CODE	A	B	C
0402	0.50	0.50	0.40
0505	1.35	1.00	0.60
0603	0.90	1.00	1.00 (3)
0805	1.30	1.20	1.00
1111	2.90	1.30	1.75
1206	1.80	1.20	2.10
1210	2.80	1.30	1.90
1808	2.40	1.50	3.00
1812	3.60	1.50	3.00
1825	6.50	1.50	3.00
2008	2.70	1.50	4.08
2220	5.50 (4)	1.50	4.20
2225	6.50	1.50	4.20
2525	6.60	1.50	4.50
3040	10.80	2.00	5.50
3640	10.80	2.00	7.00
3838	10.20	2.00	7.50
4044	12.30	2.00	8.00

Notes

(1) For safety capacitors and voltages above 3000 V, corner rounding (R) of 0.5 mm is recommended to suppress arcing
(2) Add a 1 mm slot in PCB between pads to allow cleaning and coating under MLCC
(3) For VJ HiFREQ Series, this dimension is 0.6 mm
(4) For safety capacitors, the A dimension should be 5.80 mm

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PRINTED CIRCUIT BOARD PCB DESIGN CONSIDERATIONS FOR HIGH VOLTAGE SURFACE-MOUNT MLCCS

Special assembly process and design considerations should be employed for today's high voltage rating MLCCs. As case sizes remain the same and voltage ratings increase, MLCC manufacturers must design, evaluate, and qualify their capacitors using methods that reduce the occurrence of corona discharge and arcover events. To meet similar capability in high voltage applications, users should employ similar cautionary design and assembly methods.

MLCC PAD LAYOUT

A capacitor's arcover inception point can degrade due to factors such as the MLCC termination, PCB pad design, PCB cleanliness, solder flux residue, surface contamination / deposits and environmental conditions. PCB pads and their design affect the air gap distance between the opposing polarities of the MLCC termination. For voltage rating greater than 1500 V_{DC} add a corner radius to the inward facing edge of the MLCC pads and as large a gap as possible between the pads. Too small of a pad gap distance will reduce the capacitor's own arcover inception voltage level. Refer to the Figure and Table Figure 1.0, MLCC Pad Layout and Table 1.0, Vishay MLCC Solder Pad Dimensions for the recommended MLCC solder pad dimensions.

SLOT OR TRENCH BETWEEN PADS

PCB assembly can deposit dust, trap solder balls, or flux residue underneath the capacitors. These contaminants will reduce conductive clearances and the arcover inception level. Assembly methods must include a final PCB cleaning process. A slot or trench can be cut into the PCB in between the pads to allow cleaners to penetrate underneath the MLCC. The slot will also allow conformal or epoxy coatings to flow underneath the MLCC and build an insulative barrier between pads. Refer to Figure 1.0 MLCC Pad Layout for slot reference location.

COATING PRINTED CIRCUIT BOARD

Coating a printed circuit board with materials such as acrylic, silicone and urethane resins provide a protective dielectric barrier that is non-conductive and will enhance the resistance to arcing. Various processes exist which include dipping, brushing, and spaying. Optimal performance will come from coating the MLCC on all sides, top and bottom. The PCB slot in between the pads should extend slightly beyond the width of the MLCC. Refer to Figure 1.0 MLCC Pad Layout for slot reference location.

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