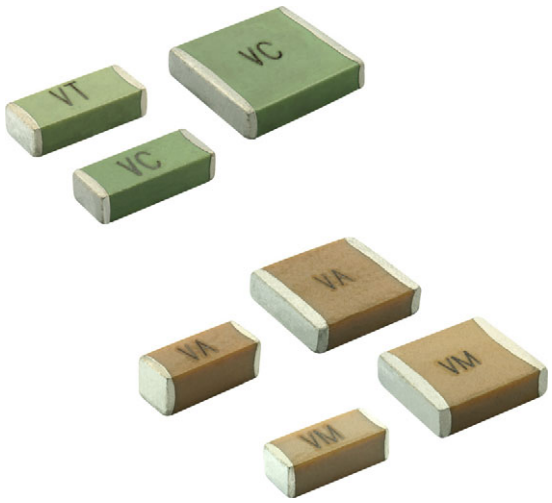
Surface Mount Multilayer Ceramic Chip Capacitors for Safety Certified Applications



FEATURES

- Approved IEC 60384-14
- Specialty: safety certified capacitors
- AEC-Q200 qualified available with PPAP
- Wet build process
- Reliable Noble Metal Electrode (NME) system
- Flexible termination “W” for improved bending capability performance available for selected values
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE Available

Pb-free

RoHS COMPLIANT

HALOGEN FREE

GREEN (5-2008)

APPLICATIONS

- Power supplies
- EMI and AC line filtering
- EV charging systems
- AC equipment and appliances
- Lighting strike and voltage surge protection
- Isolators
- Facsimile and telephone

LINKS TO ADDITIONAL RESOURCES

Packages | Technical Notes | Related Documents

ELECTRICAL SPECIFICATIONS

Note

- Electrical characteristics at +25 °C unless otherwise specified

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

Capacitance Range X1 / Y2 (1):

C0G (NP0): 10 pF to 1.0 nF

X7R: 100 pF to 4.7 nF

Capacitance Range X2 (1):

C0G (NP0): 10 pF to 390 pF

X7R: 100 pF to 12 nF

Voltage Range: 250 V_{AC}

Temperature Coefficient of Capacitance (TCC):

C0G (NP0): 0 ppm/°C ± 30 ppm/°C from -55 °C to +125 °C

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

Dissipation Factor (DF) (1):

C0G (NP0): 0.1 % maximum

X7R: 2.5 % maximum

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:

C0G (NP0): 0 % maximum per decade

X7R: 1 % maximum per decade

Voltage Proof Test:

X1 / Y2: min. 1500 V_{AC}

X2: min. 1075 V_{DC}

Peak Impulse Voltage:

X1 / Y2: 5000 V

X2: 2500 V

Voltage Rating DC:

X1 / Y2: 2000 V_{DC}

X2: 1500 V_{DC}

Climatic Category According to EN 60068-1:
55/125/21

Note

(1) Test conditions per IEC 60384-14:
C0G (NP0): 1.0 V_{RMS} at 1 MHz
X7R: 1.0 V_{RMS} at 1 kHz

QUICK REFERENCE DATA

DIELECTRIC	CASE	MAXIMUM VOLTAGE (V_{AC})	CAPACITANCE	
			MINIMUM	MAXIMUM
C0G (NP0) (X1 / Y2)	2008	250	10 pF	220 pF
	2220	250	47 pF	1.0 nF
C0G (NP0) (X2)	2008	250	10 pF	390 pF
X7R (X1 / Y2)	2008	250	100 pF	1.0 nF
	2220	250	270 pF	4.7 nF
X7R (X2)	2008	250	100 pF	2.7 nF
	2220	250	270 pF	12 nF

Notes

- Detail ratings see “Selection Chart”
- Size 2008 is compatible with 1808 solderlands and full conform with the IEC-60384-14 requirements for creepage distance

ORDERING INFORMATION

VJ2008	Y	102	K	X	U	S	T	### (1)
CASE CODE	DIELECTRIC	CAPACITANCE NOMINAL CODE	CAPACITANCE TOLERANCE	TERMINATION	AC VOLTAGE RATING	MARKING	PACKAGING	PROCESS CODE
2008 2220	A = C0G (NP0) Y = X7R	Expressed in picofarads (pF). The first two digits are significant, the third is a multiplier. **Examples:** 101 = 100 pF 102 = 1000 pF 103 = 10 000 pF	C0G (NP0): J = ± 5 % K = ± 10 % X7R: K = ± 10 % M = ± 20 %	X = Ni barrier 100 % matte tin plate finish W = Ni barrier with flexible layer, 100 % matte tin plate finish	U = 250 V_{AC}	S = marked (see Part Marking table below)	T = 7" reel / plastic tape	X1 = X1 / Y2 X2 = X2 Vishay automotive grade per customer request, add “A”: X1A = X1 / Y2 X2A = X2

Notes

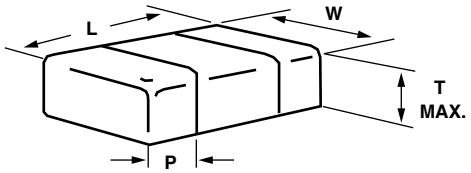
- Detail ratings see “Selection Chart”

(1) Process code must be added to control products and requirements

PART MARKING

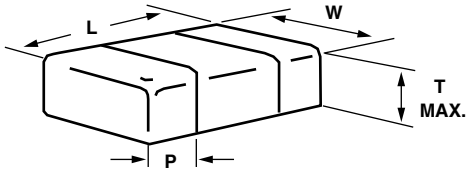
MARKING	1ST DIGIT MANUFACTURER	2ND DIGIT DIELECTRIC AND RATING
VC	V = Vishay	C = C0G (NP0), X1 / Y2 - “X” termination option
VT		T = C0G (NP0), X2 - “X” termination option
VD		D = C0G (NP0), X1 / Y2 - “W” termination option
VU		U = C0G (NP0), X2 - “W” termination option
VA		A = X7R, X1 / Y2 - “X” termination option
VM		M = X7R, X2 - “X” termination option
VB		B = X7R, X1 / Y2 - “W” termination option
VN		N = X7R, X2 - “W” termination option

DIMENSIONS FOR "X" TERMINATION OPTION in inches (millimeters)



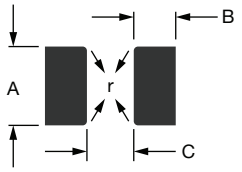
CASE CODE	PART ORDERING NUMBER	LENGTH (L)	WIDTH (W)	MAXIMUM THICKNESS (T)	TERMINATION (P)	
					MINIMUM	MAXIMUM
2008	VJ2008	0.200 ± 0.010 (5.08 ± 0.25)	0.080 ± 0.010 (2.03 ± 0.25)	0.086 (2.18)	0.010 (0.25)	0.030 (0.76)
2220	VJ2220	0.220 ± 0.008 (5.59 ± 0.20)	0.200 ± 0.010 (5.08 ± 0.25)	0.086 (2.18)	0.010 (0.25)	0.030 (0.76)

DIMENSIONS FOR "W" TERMINATION OPTION in inches (millimeters)



CASE CODE	PART ORDERING NUMBER	LENGTH (L)	WIDTH (W)	MAXIMUM THICKNESS (T)	TERMINATION (P)	
					MINIMUM	MAXIMUM
2008	VJ2008	0.200 - 0.010 / + 0.020 (5.08 - 0.25 / + 0.50)	0.080 ± 0.010 (2.03 ± 0.25)	0.086 (2.18)	0.010 (0.25)	0.030 (0.76)
2220 C0G (NP0)	VJ2220A	0.220 - 0.008 / + 0.018 (5.59 - 0.20 / + 0.45)	0.200 ± 0.010 (5.08 ± 0.25)	0.086 (2.18)	0.010 (0.25)	0.030 (0.76)
2220 X7R	VJ2220Y	0.220 - 0.008 / + 0.018 (5.59 - 0.20 / + 0.45)	0.200 ± 0.010 (5.08 ± 0.25)	0.105 (2.65)	0.010 (0.25)	0.030 (0.76)

RECOMMENDED SOLDERING PAD DIMENSIONS in millimeters



CASE CODE	A	B	C	r [1]
2008	2.70	1.50	4.00	0.5
2220	5.80	1.50	4.20	0.5

Note

[1] Radius optional

SELECTION CHART				
DIELECTRIC		C0G (NP0) (X1 / Y2)		C0G (NP0) (X2)
STYLE		VJ2008 [1]	VJ2220 [1]	VJ2008 [1]
CASE CODE		2008	2220	2008
VOLTAGE (V_{AC})		250	250	250
VOLTAGE CODE		U	U	U
CAP. CODE	CAP.			
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			

Note

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

SELECTION CHART						
DIELECTRIC		X7R (X1 / Y2)		X7R (X2)		
STYLE		VJ2008 (1)	VJ2220 (1)	VJ2008 (1)	VJ2220 (1)	
CASE CODE		2008	2220	2008	2220	
VOLTAGE (V_{AC})		250	250	250	250	
VOLTAGE CODE		U	U	U	U	
CAP. CODE	CAP.					
100	10 pF					
220	22 pF					
330	33 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					

Notes

Values available with “W” termination

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

PACKAGING QUANTITIES (1)

CASE CODE	TAPE SIZE	7" REEL QUANTITIES
		PACKAGING CODE "T"
2008	12 mm	2000
2220	12 mm	1000

Note

(1) Reference: EIA standard RS481 - "Taping of Surface Mount Components for Automatic Placement"

APPROVALS FOR C0G (NP0)

VDE approval mark (update 2020-02-20):				
X1 / Y2-capacitor:	40036706	10 pF to 1000 pF	250 V_{AC}	
X2-capacitor:	40036706	10 pF to 470 pF	250 V_{AC}	
DIN EN 60384-14 (VDE 0565-1-1):2014-04; EN 60384-14:2013-08; IEC 60384-14 (ed.4)				
CAN / cCSAus approval mark (update 2020-05-05):				
X1 / Y2-capacitor:	70001064	10 pF to 1000 pF	250 V~	
X2-capacitor:	70001064	10 pF to 470 pF	250 V~	
CAN / CSA-E60384-14:14 and ANSI / UL 60384-14-2017				

APPROVALS FOR X7R

VDE approval mark (*update 2020-02-20), ** update 2021-01-14:				
X1 / Y2-capacitor:	X termination	40037440*	82 pF to 4700 pF	250 V_{AC}
	W termiation	40052169**	100 pF to 4700 pF	
X2-capacitor:	X termination	40037440*	82 pF to 12 000 pF	250 V_{AC}
	W termiation	40052169**	100 pF to 12 000 pF	
DIN EN 60384-14 (VDE 0565-1-1):2014-04; EN 60384-14:2013-08; IEC 60384-14 (ed.4)				
CSA / cCSAus approval mark (update 2020-05-05):				
X1 / Y2-capacitor:		70001064	82 pF to 4700 pF	250 V~
X2-capacitor:		70001064	82 pF to 12 000 pF	250 V~
CAN / CSA-E60384-14:14 and ANSI / UL 60384-14-2017				

GENERAL CERTIFICATES

# Quality management system according to ISO/IATF 16949	Yes
# Quality management system according to ISO 9001	Yes
# Environmental certification according to ISO 14001	Yes
# Health and safety system according to ISO 45001	Yes

STORAGE AND HANDLING CONDITIONS

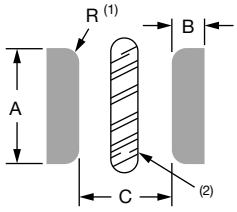
(1) Store the components at 5 °C to 40 °C ambient temperature and ≤ 70 % relative humidity conditions.
(2) The product is recommended to be used within a time-frame of 2 years after shipment.
Check solderability in case extended shelf life beyond the expiry date is needed.

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.

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

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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