

# Surface Mount Multilayer Ceramic Chip Capacitors

## DSCC Qualified Type 03028



### FEATURES

- US defense supply center approved
- Federal stock control number, CAGE CODE 2770A
- Small case size (0603)
- Stable BP, BR and BX dielectrics
- Excellent aging characteristics
- Lead (Pb)-free termination code “M”
- Tin / lead termination code “Z” and “U”
- Wet build process
- Reliable Noble Metal Electrode (NME) system
- Made with a combination of design, materials and tight process control to achieve very high field reliability
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### Note

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

### APPLICATIONS

- Broadband wireless communication
- Satellite communication
- WiFi (802.11) and WiMax (802.16)
- Subscriber based wireless devices
- Microwave systems

### ELECTRICAL SPECIFICATIONS

#### Note

- Electrical characteristics at +25 °C unless otherwise specified

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

#### Capacitance Range:

BP: 1.0 pF to 1.0 nF

BR: 100 pF to 100 nF

BX: 100 pF to 100 nF

**Voltage Range:** 6.3 V<sub>DC</sub> to 100 V<sub>DC</sub>

#### Temperature Coefficient of Capacitance (TCC):

BP: 0 ppm/°C ± 30 ppm/°C from -55 °C to +125 °C with zero (0) V<sub>DC</sub> applied

BP: 0 ppm/°C ± 30 ppm/°C from -55 °C to +125 °C with 100 % rated V<sub>DC</sub> applied

BR: ± 15 % from -55 °C to +125 °C with zero (0) V<sub>DC</sub> applied

BR: +15 %, -40 % from -55 °C to +125 °C with 100 % rated V<sub>DC</sub> applied

BX: ± 15 % from -55 °C to +125 °C with zero (0) V<sub>DC</sub> applied

BX: +15 %, -25 % from -55 °C to +125 °C with 100 % rated V<sub>DC</sub> applied

#### Dissipation Factor (DF):

BP:

0.15 % max. at 1.0 V<sub>RMS</sub> and 1 MHz for values ≤ 1000 pF

0.15 % max. at 1.0 V<sub>RMS</sub> and 1 kHz for values > 1000 pF

BR, BX:

≤ 25 V: ± 3.5 % max. at 1.0 V<sub>RMS</sub> and 1 kHz

≥ 50 V: ± 2.5 % max. at 1.0 V<sub>RMS</sub> and 1 kHz

#### Aging Rate:

BP: 0 % maximum per decade

BR, BX: 1 % maximum per decade

#### Insulation Resistance (IR):

at +25 °C and rated voltage 100 000 MΩ minimum or 1000 ΩF, whichever is less

at +125 °C and rated voltage 10 000 MΩ minimum or 100 ΩF, whichever is less

#### Dielectric Strength Test:

performed per method 103 of EIA-198-2-E.

Applied test voltages

≤ 200 V<sub>DC</sub>-rated: 250 % of rated voltage

QUICK REFERENCE DATA				
DIELECTRIC	CASE	MAXIMUM VOLTAGE (V)	CAPACITANCE	
			MINIMUM	MAXIMUM
BP	0603	100	1.0 pF	1.0 nF
BR	0603	100	100 pF	100 nF
BX	0603	100	100 pF	100 nF

**Note**

- Detail ratings see "Selection Chart"

ORDERING INFORMATION							
03028- DSCC NUMBER	BX DIELECTRIC	102 CAPACITANCE NOMINAL CODE	B DC VOLTAGE RATING (1)	J CAPACITANCE TOLERANCE	Z TERMINATION	- GROUP C TESTING OPTION (2)	T PACKAGING
Case code 0603	BP BR BX	Expressed in picofarads (pF). The first two digits are significant, the third is a multiplier. An "R" indicates a decimal point. Examples: 1R8 = 1.8 pF 101 = 100 pF	W = 6.3 V X = 10 V Y = 16 V Z = 25 V A = 50 V B = 100 V	C = ± 0.25 pF D = ± 0.5 pF F = ± 1 % G = ± 2 % J = ± 5 % K = ± 10 % M = ± 20 % <b>Note:</b> C, D < 10 pF (BP) F, G, J, K, M ≥ 10 pF (BP) J, K, M (BR, BX)	M = silver palladium Z = Ni barrier with tin / lead plate min. 4 % lead U = Ni barrier, solder coated (min. of 4 % lead)	C = full group C L = 2000 h life test only M = 1000 h life test only H = low voltage humidity test only - = no group C testing	T = 7" reel / plastic tape C = 7" reel / paper tape O = 7" reel / flamed paper tape J = 7" reel (low quantity) R = 11 1/4" / 13" reel / plastic tape P = 11 1/4" / 13" reel / paper tape I = 11 1/4" / 13" reel / flamed paper tape B = bulk <b>Note:</b> "I" and "O" are used for "M" termination code

**Notes**

- DC voltage rating should not be exceeded in application. Other application factors may affect the MLCC performance. Consult for questions: [mlcc@vishay.com](mailto:mlcc@vishay.com)
- To receive data package, add "P" to the end of the part number. For example, 03028-BX102BJZCTP. Group C will be completed and data included with shipment.

DIMENSIONS in inches (millimeters)					
PART ORDERING NUMBER	LENGTH (L)	WIDTH (W)	MAXIMUM THICKNESS (T)	TERMINATION PAD (P)	
				MINIMUM	MAXIMUM
03028-	0.063 ± 0.006 (1.60 ± 0.15)	0.032 ± 0.006 (0.81 ± 0.15)	0.036 (0.91)	0.008 (0.20)	0.020 (0.51)

**Note**

- Metric equivalents are given for general information only



SELECTION CHART																			
DIELECTRIC		BP						BR						BX					
STYLE		03028																	
CASE CODE		0603																	
VOLTAGE (V <sub>DC</sub> )		6.3	10	16	25	50	100	6.3	10	16	25	50	100	6.3	10	16	25	50	100
VOLTAGE CODE		W	X	Y	Z	A	B	W	X	Y	Z	A	B	W	X	Y	Z	A	B
CAP. CODE	CAP.																		
1R0	1.0 pF	•	•	•	•	•	•												
1R2	1.2 pF	•	•	•	•	•	•												
1R5	1.5 pF	•	•	•	•	•	•												
1R8	1.8 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	•	•	•	•	•	•												
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	•	•	•	•	•	•												

Notes

- RoHS-compliant except when supplied with lead (Pb)-containing termination, code "Z"
- Not RoHS-compliant



SELECTION CHART																			
DIELECTRIC		BP					BR					BX							
STYLE		03028																	
CASE CODE		0603																	
VOLTAGE (V <sub>DC</sub> )		6.3	10	16	25	50	100	6.3	10	16	25	50	100	6.3	10	16	25	50	100
VOLTAGE CODE		W	X	Y	Z	A	B	W	X	Y	Z	A	B	W	X	Y	Z	A	B
CAP. CODE	CAP.																		
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							•	•	•	•	•		•	•	•	•		
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																		

Notes

- RoHS-compliant except when supplied with lead (Pb)-containing termination, code "Z"
- Not RoHS-compliant



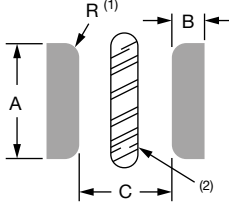
DSCC PACKAGING QUANTITIES <sup>(1)</sup>					
CASE CODE	TAPE SIZE	7" REEL QUANTITIES		11 1/4" AND 13" REEL QUANTITIES	BULK
		PACKAGING CODE		PACKAGING CODE	VIAL PACKAGING CODE
		"C" / "O" / "T"	"J"	"P" / "I" / "R"	"B"
0603	8 mm	4000	1000	10 000	100

**Note**

(1) Reference: EIA standard RS 481 - "Taping of Surface Mount Components for Automatic Placement"

STORAGE AND HANDLING CONDITIONS
<p>(1) Store the components at 5 °C to +40 °C ambient temperature and ≤ 70 % relative humidity conditions.</p> <p>(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.</p> <p>Precautions:</p> <ul style="list-style-type: none"> <li>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.</li> <li>b. Store products on the shelf and avoid exposure to moisture or dust.</li> <li>c. Do not expose products to excessive shock, vibration, direct sunlight and so on.</li> </ul>

## 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 <sup>(3)</sup>
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 <sup>(4)</sup>	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<sub>DC</sub> 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.



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.