Radial Through Hole Multilayer Ceramic Capacitors

Radial, Molded, C0G Dielectric, 50 – 200 VDC (Commercial Grade)

Overview

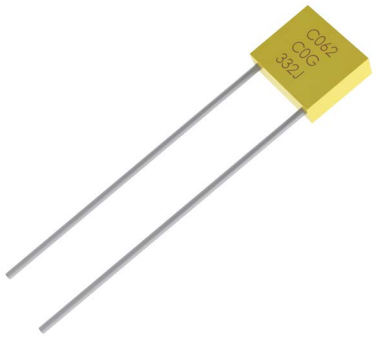
KEMET's epoxy molded radial through-hole ceramic capacitors in C0G dielectric feature a 125°C maximum operating temperature. The Electronics Industries Alliance (EIA) characterizes C0G dielectric as a Class I "stable" material. Components of this classification are temperature compensating and are suited for resonant circuit applications or those where Q and stability of capacitance characteristics are required. C0G exhibits no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to ±30 ppm/°C from −55°C to +125°C. These devices meet the flame test requirements outlined in UL Standard 94 V–0.

Applications

Typical applications include critical timing, tuning, circuits requiring low loss, circuits with pulse, high current, decoupling, bypass, filtering, transient voltage suppression, blocking and energy storage.

Benefits

- Radial through-hole form factor
- Molded case
- −55°C to +125°C operating temperature range
- DC voltage ratings of 50 V, 100 V and 200 V
- Capacitance offerings ranging from 1.0 pF up to 0.18 µF
- Available capacitance tolerances of ±0.5 pF, ±1%, ±2%, ±5%, and ±10%
- No piezoelectric noise
- Extremely low ESR and ESL
- High thermal stability
- High ripple current capability
- No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature from −55°C to +125°C
- No capacitance decay with time
- Non-polar device, minimizing installation concerns
- SnPb-plated lead finish (60/40)
- 100% pure matte tin-plated lead finish option available upon request (RoHS)
- Encapsulation meets flammability standard UL 94 V–0



Ordering Information

C	052	C	272	F	2	G	5	T	A	7303
Ceramic	Style/ Size	Specification/ Series	Capacitance Code (pF)	Capacitance Tolerance[1]	Rated Voltage (VDC)	Dielectric	Design	Lead Finish[2]	Failure Rate	Packaging/ Grade (C-Spec)[3]
	052 062 512 522	C = Standard	Two significant digits and number of zeros Use 9 for 1.0 – 9.9 pF Use 8 for 0.5 – .99 pF ex. 2.2 pF = 229 ex. 0.5 pF = 508	D = ±0.5 pF F = ±1% G = ±2% J = ±5% K = ±10%	1 = 100 2 = 200	G = C0G	5 = Multilayer	T = 100% Matte Sn C = SnPb (60/40)	A = N/A	Blank = Bulk 7301 = 12" Reel 7303 = 12" Reel 7293 = Ammo Pack

[1] *Additional capacitance tolerance offerings may be available. Contact KEMET for details.*

[2] *Lead materials and finishes:*

Standard: 60% tin (Sn)/40% lead (Pb) finish with 100% copper core ("C" designation).

Optional (C052 and C062 only): 100% matte tin (Sn) with nickel (Ni) underplate and steel core ("T" designation).

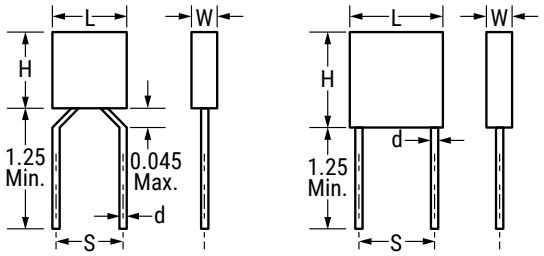
Alternative lead materials and finishes may be available. Contact KEMET for details.

[3] *Reeling options:*

C-Spec 7301: Recommended for straight lead configuration part types.

C-Spec 7301: Recommended for formed (bent) lead configuration part types.

Dimensions – Inches (Millimeters)



Series	Style/ Size	S Lead Spacing	L Length	H Height	T Thickness	LD Lead Diameter	LL Lead Length Minimum
C05X	052/ 056	0.20±0.015 (5.08±0.38)	0.19±0.01 (4.83±0.25)	0.19±0.01 (4.83±0.25)	0.09±0.01 (2.29±0.25)	0.025+0.004/−0.002 (0.635+0.102/−0.051)	1.25 (31.75)
C06X	062/ 066		0.29±0.01 (7.37±0.25)	0.29±0.01 (7.37±0.25)	0.09±0.01 (2.29±0.25)		
C5XX	512	0.40±0.02 (10.16±0.51)	0.48±0.02 (12.19±0.51)	0.48±0.02 (12.19±0.51)	0.14±0.01 (3.56±0.25)		
	522		0.48±0.02 (12.19±0 .51)	0.48±0.02 (12.19±0.51)	0.24±0.01 (6.10±0.25)		

Application Notes

These devices are not recommended for use in overmold applications and/or processes

Qualification/Certification

Commercial Grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 2, Performance & Reliability.

Environmental Compliance

Devices with standard lead finish option of 60% tin (Sn)/40% lead (Pb) do not meet RoHS criteria.
Devices with 100% matte tin (Sn) lead finish option are RoHS Compliant (C052 & C062 only).

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)	±30 ppm/°C
Aging Rate (Maximum % Cap Loss/Decade Hour)	0%
Dielectric Withstanding Voltage	250% of rated voltage (5±1 seconds and charge/discharge not exceeding 50 mA)
Dissipation Factor (DF) Maximum Limit at 25°C	0.1%
Insulation Resistance (IR) Limit at 25°C	1,000 megohm microfarads or 100 GΩ (Rated voltage applied for 120±5 seconds at 25°C)

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 MHz ±100 kHz and 1.0 V_{rms} ±0.2 V if capacitance ≤ 1,000 pF

1 kHz ±50 Hz and 1.0 V_{rms} ±0.2 V if capacitance > 1,000 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	DF (%)	Capacitance Shift
C0G	All	All	0.5	0.3% or ±0.25 pF

Table 1A – C052 Style/Size (0.20" Lead Spacing), Capacitance Range Waterfall

C052 Style/Size (0.20" Lead Spacing)				
Rated Voltage (VDC)		**50**	**100**	**200**
Voltage Code		**5**	**1**	**2**
Capacitance	**Capacitance Tolerance**	**Capacitance Code (Available Capacitance)**		
1pF	D = ±0.5 pF	109	109	109
1.5pF		159	159	159
2.2pF		229	229	229
2.7pF		279	279	279
3.3pF		339	339	339
3.9pF		399	399	399
4.7pF		479	479	479
5.6pF		569	569	569
6.8pF		689	689	689
8.2pF		829	829	829
10pF	J = ±5% K = ±10%	100	100	100
12pF		120	120	120
15pF		150	150	150
18pF		180	180	180
22pF		220	220	220
27pF	G = ±2% J = ±5% K = ±10%	270	270	270
33pF		330	330	330
39pF		390	390	390
47pF		470	470	470
56pF	F = ±1% G = ±2% J = ±5% K = ±10%	560	560	560
68pF		680	680	680
82pF		820	820	820
100pF		101	101	101
120pF		121	121	121
150pF		151	151	151
180pF		181	181	181
220pF		221	221	221
270pF		271	271	271
330pF		331	331	331
390pF		391	391	391
470pF		471	471	471
560pF		561	561	561
680pF		681	681	681
820pF		821	821	821
1000pF		102	102	102
1200pF		122	122	122
1500pF		152	152	152
1800pF		182	182	182
2200pF		222	222	222
2700pF		272	272	272
3300pF		332	332	
2700pF		272	272	
3300pF		332	332	
3900pF		392	392	
4700pF		472	472	
Rated Voltage (VDC)		**50**	**100**	**200**
Voltage Code		**5**	**1**	**2**

Table 1B – C062 Style/Size (0.20" Lead Spacing), Capacitance Range Waterfall

C062 Style/Size (0.20" Lead Spacing)				
Rated Voltage (VDC)		**50**	**100**	**200**
Voltage Code		**5**	**1**	**2**
Capacitance	**Capacitance Tolerance**	**Capacitance Code (Available Capacitance)**		
3300pF	F = ±1% G = ±2% J = ±5% K = ±10%	332	332	332
3900pF		392	392	392
4700pF		472	472	472
5600pF		562	562	562
6800pF		682	682	682
8200pF		822	822	822
0.01µF		103	103	103
0.012µF		123	123	
0.015µF		153	153	
0.018µF		183	183	
0.022µF		223	223	
Rated Voltage (VDC)		**50**	**100**	**200**
Voltage Code		**5**	**1**	**2**

Table 1C – C512 Style/Size (0.40" Lead Spacing), Capacitance Range Waterfall

C512 Style/Size (0.40" Lead Spacing)				
Rated Voltage (VDC)		**50**	**100**	**200**
Voltage Code		**5**	**1**	**2**
Capacitance	**Capacitance Tolerance**	**Capacitance Code (Available Capacitance)**		
0.012µF	F = ±1% G = ±2% J = ±5% K = ±10%	123	123	123
0.015µF		153	153	153
0.018µF		183	183	183
0.022µF		223	223	223
0.027µF		273	273	273
0.033µF		333	333	333
0.039µF		393	393	393
0.047µF		473	473	473
0.056µF		563	563	563
0.068µF		683	683	683
0.082µF		823	823	
0.1µF		104	104	
Rated Voltage (VDC)		**50**	**100**	**200**
Voltage Code		**5**	**1**	**2**

Table 1D – C522 Style/Size (0.40" Lead Spacing), Capacitance Range Waterfall

C522 Style/Size (0.40" Lead Spacing)				
Rated Voltage (VDC)		**50**	**100**	**200**
Voltage Code		**5**	**1**	**2**
Capacitance	**Capacitance Tolerance**	**Capacitance Code (Available Capacitance)**		
0.082µF	F = ±1% G = ±2% J = ±5% K = ±10%	823	823	823
0.1µF		104	104	104
0.12µF		124	124	
0.15µF		154	154	
0.18µF		184	184	
Rated Voltage (VDC)		**50**	**100**	**200**
Voltage Code		**5**	**1**	**2**

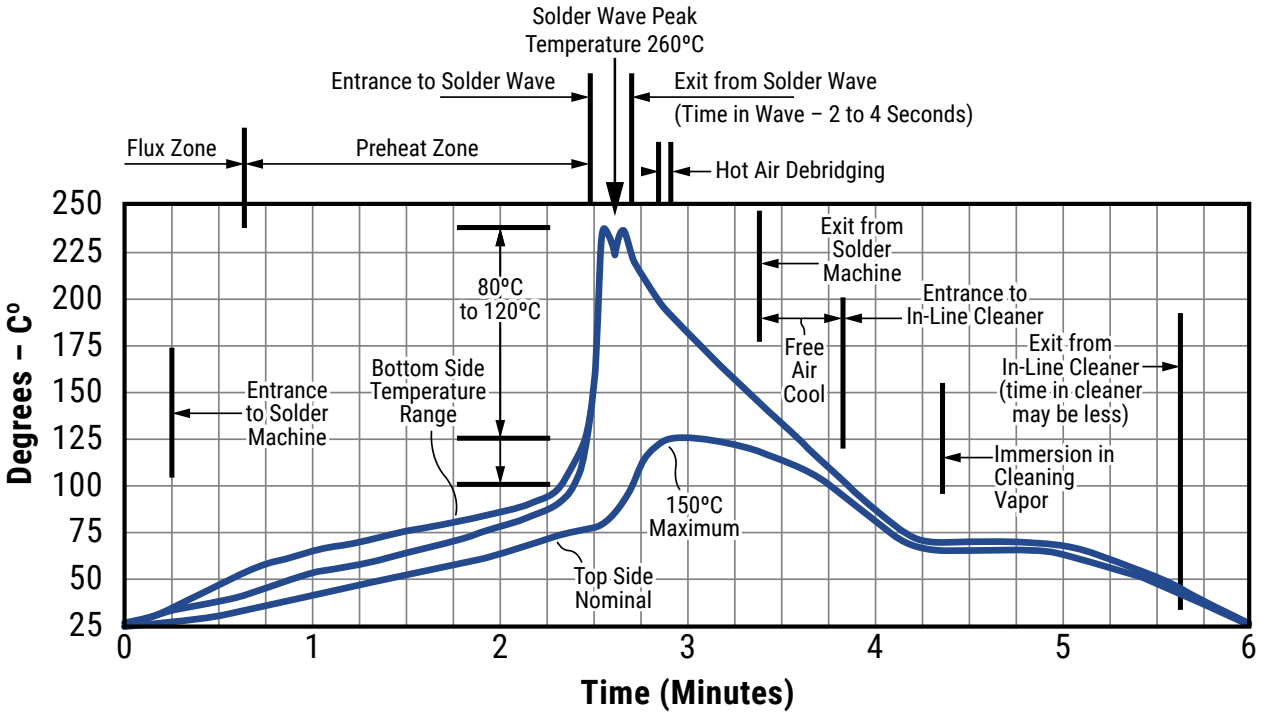
Soldering Process

Recommended Soldering Technique:

- Solder Wave
- Hand Soldering (Manual)

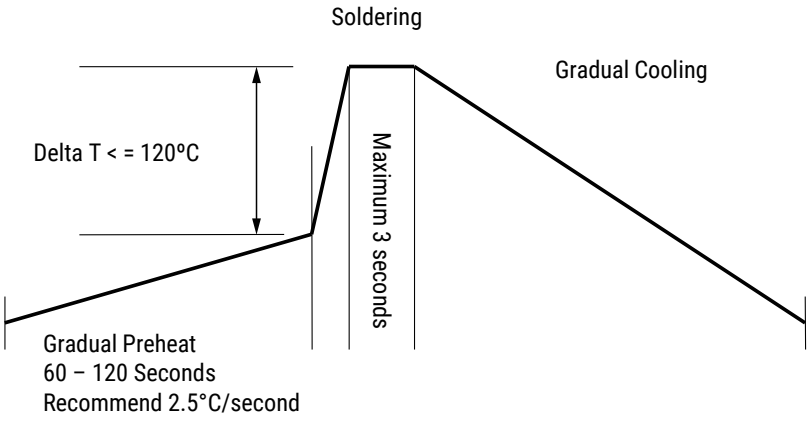
Recommended Soldering Profile:

- Optimum Wave Solder Profile



- Hand Soldering (Manual)

Manual Solder Profile with Pre-heating



KEMET recommends following the guidelines and techniques outlined in technical bulletins F2103 and F9207.

Table 2 – Performance & Reliability: Test Methods and Conditions

Stress	Reference	Test or Inspection Method
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
Temperature Cycling	JESD22 Method JA–104	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 Rated Voltage. 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.
Moisture Resistance	MIL–STD–202 Method 106	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. 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 2 X 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 .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 pre-heat 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 & 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.

Packaging Details

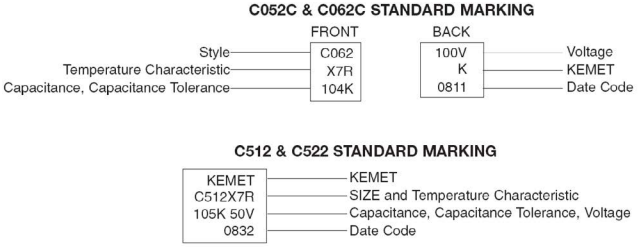
Lead Spacing	Component Pitch (P1)
0.100 (2.54)	5.08
0.200 (5.08)	3.81
0.400 (10.16)	7.62
0.170 (4.32)	
0.220 (5.59)	
0.275 (6.98)	
0.300 (7.62)	
0.375 (9.52)	
0.475 (12.06)	
0.575 (14.60)	
0.675 (17.14)	

Packaging Quantities

Style/ Size	Standard Bulk Quantity	Ammo Pack Quantity Maximum	Reel Quantity Maximum (12" Reel)
052	100/Bag	2000	2000
062	100/Bag	1500	1500
512	See Note[1]	N/A	N/A
522			

[1] *Quantity varies. For further details, please contact KEMET.*

Marking



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