Tubular Pi Ceramic Capacitors

Low cost solution for general purpose filtering.

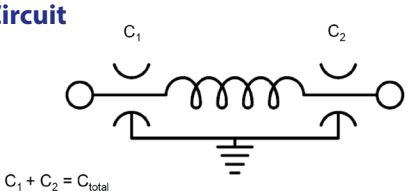
Applications

- Medical implantable devices
- EMI/RF suppression filters
- Commercial and defense applications
- Power supplies
- Converters

Compared to feedthrough tubular capacitors, Pi tubular capacitors have a much more narrow transition between the pass and stop bands. Pi capacitors are effective in stopping high frequency interference without affecting necessary frequencies immediately below the stop band.

Similar to feedthrough tubular capacitors, Pi tubular capacitors can be designed with a solid or multilayered configuration. Solid Pi tubular capacitors are more cost effective, but limited in capacitance values. Multilayered Pi tubular capacitors can cover a wider range of capacitance, while still maintaining the mechanical strength of a solid Pi tubular capacitor in a similar case size.

Pi Circuit



$C_1 + C_2 = C_{total}$

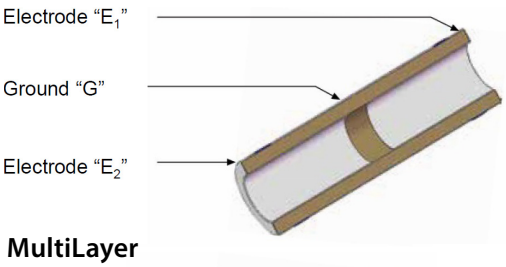
Inductive element not included

Features

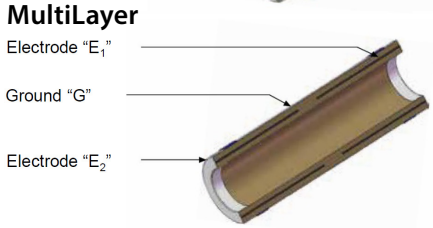
- High ratio of capacitance to volume
- Low inductance, non-polar
- Small, lightweight, reliable, high dielectric strength
- Impervious to moisture and contamination
- Uniform IL over a board frequency range
- -55°C to +125°C operation are achieved with no voltage de-rating
- Outer terminations feature a nickel barrier and final metal layer, typically silver

Feedthrough Construction

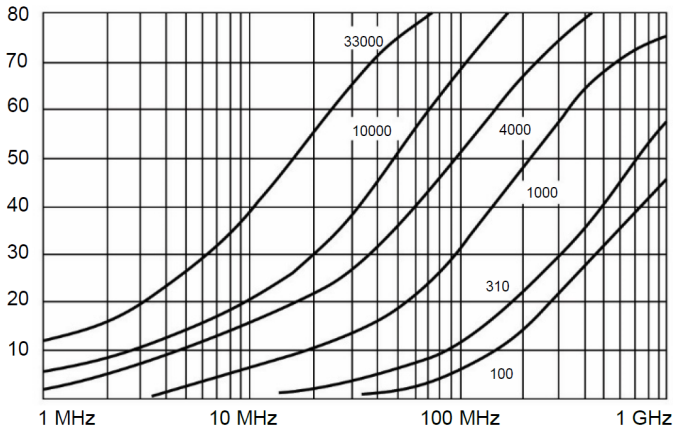
Solid



MultiLayer



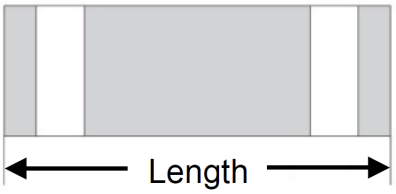
Insertion Loss (dB) Per MIL-STD-220

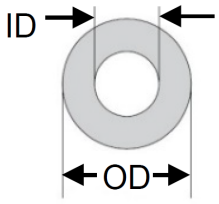


Frequency (MHz)

Banding Dimensions

Center Dimension, min.	0.065″	1.651 mm
Tip Dimension, min.	0.002″	0.051 mm
Bandwidth 200 VDC min.	0.025″	0.635 mm
Bandwidth 100 VDC min.	0.020″	0.508 mm
Bandwidth 50 VDC min.	0.015″	0.381 mm





TCC																									
	OD	(in)	0.081±0.002						0.090±0.003													0.122±0.004		
		(mm)	2.06±0.05						2.29±0.08													3.10±0.10		
	ID	(in)	0.050±0.002						0.060±0.003													0.082±0.004		
		(mm)	1.27±0.05						1.52±0.003													2.08±0.10		
	Length	(in)	0.173±0.10			0.235±0.10			0.173±0.10			0.235±0.10			0.300±0.10			0.315±0.10			0.250±0.10		
		(mm)	4.39±0.25			5.97±0.25			4.39±0.25			5.97±0.25			7.62±0.25			8.00±0.25			6.35±0.25		
	Cap (pF) \ WV (VDC)		200	100	50	200	100	50	200	100	50	200	100	50	200	100	50	200	100	50	200	100	50
NPO	10 Max																							
	12																							
	27																							
	33																							
	39																							
	47																							
	56																							
	68																							
	82																							
	100																							
	120																							
	150																							
	180																							
	220																							
	270																							
X7R	180																							
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	270																							
	330																							
	390																							
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Y5V	1800																							
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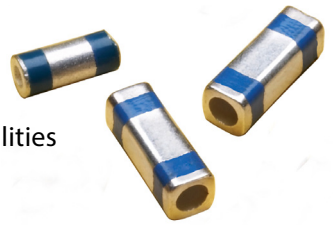
General Ceramic Capacitors Information

Exhibit low parasitic capacitance and superior EMI filtering capabilities.

Specialty Tubular Products



We offer many variations of tubular capacitors to fit your custom application:

- Various OD, ID, thickness, and length configurations
- Square tube for surface mount application
- Lapped feedthrough capabilities
- Custom style capability

Tubular Electrical Testing

Electrical Parameter	Test Method	Temperature Coefficient		
		NPO	X7R	Y5V
Temperature Coefficient	EIA 198	±30 ppm/°C, -55 to 125°C	±15%, -55 to 125°C	+22, -82%, -30 to +85°C
Capacitance Tolerance	EIA Tolerance Code	M, P	N, P, Z	N, P, Z
Capacitance Test @25°C	MIL-STD-202, Method 305	Cap≤100pF; 1 MHz 1 Vrms Cap≥100pF: 1 KHz, 1 Vrms	1 KHZ, 1 Vrms	1 KHZ, 1.0 Vms
Dissipation Factor @25°C	MIL-STD-202, Method 305	0.15% max.	3.5% max.	3.5% max.
Aging Rate (per decade)		No Aging	< 2.0%	< 2.5%
Insulation Resistance @25°C	MIL-STD-202, Method 302	50 K Megohm or 500 Ohm-Farad, whichever is lower	50 K Megohm or 500 Ohm-Farad, whichever is lower	50 K Megohm or 500 Ohm-Farad, whichever is lower
Insulation Resistance @25°C	MIL-STD-202, Method 302	5 K Megohm or 50 Ohm-Farad, whichever is less	5 K Megohm or 50 Ohm-Farad, whichever is less	5 K Megohm or 50 Ohm-Farad, whichever is less
Dielectric Withstanding Voltage	MIL-STD-202, Method 301	250% of rated voltage 5 second hold, 30-50 mA	250% of rated voltage 5 second hold, 30-50 mA	250% of rated voltage 5 second hold, 30-50 mA

Tubular Part Numbering System

After determining the capacitor properties required for a given application, use the part numbering system below to place order. If there are any questions, do no hesitate to contact APITech's customer service team.

The part number shown represents a Pi tubular capacitor with an outer diameter of 0.081" and inner diameter of 0.050". The voltage rating for this part is 200 VDC. The ceramic type will be X7R. The capacitance value is 470 pF with a tolerance of ±20%. The termination will be silver and the parts will receive bulk packaging.

Example: **I8150173X7R471M**

1	81	50	173	X7R	471	M

Voltage Rating
A: FT, 50 VDC
C: FT, 100 VDC
E: FT, 200 VDC
G: FT, 50 VDC
H: FT, 100 VDC
I: FT, 200 VDC

Outter Diameter
Example:
0.081" = 81

Inner Diameter
Example:
0.050" = 50

Length
Example:
0.173" = 173

Ceramic Code
NP0
X7R
Y5V

EIA Cap Code
Example:
470 pF = 471

EIA Cap Tolerance
M: ± 20%
N: ± 30%
P: +100-0%
Z: +80 -20%

Processing & Soldering Notes

General Soldering Recommendations for Leadless Ceramic Capacitors

Soldering Ceramic Capacitors with High Temperature Process

SN10 Solder

Ramp Rate, Heating and Cooling:	Approx. 30°C/min.
Peak Temperature:	Approx. 320°C
Dwell at Peak:	<30 Seconds

Soldering Ceramic Capacitors with Medium Temperature Process

SN96 Solder

Ramp Rate, Heating and Cooling:	Approx. 30°C/min.
Peak Temperature:	Approx. 250°C
Dwell at Peak:	<30 Seconds

Soldering Ceramic Capacitors with Low Temperature wProcess

SN62 Solder

Ramp Rate, Heating and Cooling:	Approx. 30°C/min.
Peak Temperature:	Approx. 220°C
Dwell at Peak:	<30 Seconds

Notes

Care must be taken to minimize the time silver terminations are exposed to molten solder to avoid leaching (amalgamation of the silver into molten solder). APITech recommends the use of a silver (Ag) bearing solder when terminating directly to ceramic ceramic capacitors to reduce the potential for leeching. Gradual heating and cooling of the components are essential to prevent thermal stresses to the ceramic.

Application Note: Soldering Recommendations for Switch Mode Power Supply Capacitors

- SMPS capacitors are highly durable structures designed to provide long service per lifetime, however they require attention to basic considerations during assembly. Like all ceramic components, SMPS capacitors are subject to thermal stresses. For this reason, preheating of the capacitor assemblies is recommended. Preheat components using hot plate to 120 to 150°C, or within 50 to 60°C of the soldering temperature being applied. Avoid over-exposure to high temperatures during assembly and allow for gradual, post-assembly cooling.
- For hand iron soldering, recommended soldering iron tip temperature is 330 to 350°C. Contact the pad adjacent to the pre-tinned lead should be made from below the PCB (opposite of the component side), and the dwell time on the solder joint should be less than five seconds. An aluminum heat sink plate may be placed adjacent to the SMPS lead frame to protect the ceramic body during assembly. Avoid direct contact between soldering iron and ceramic during assembly process. Soldering time is dependant upon heat sinking provided by the chasis and boardmaterial, so a longer preheat cycle may be required.
- Standard solders (Sn60, Sn63, Sn60/38/2) may be used. Please consult the factory for use with RoHS compliant solders.
- Use a controlled temperature profile ramp not exceeding 4°C per second as measured by an attached low mass thermocouple.
- Soldering time and temperatures can vary with component size, board material and layout. Please consult the factory for assistance.