Specialty
Ceramic Capacitors

SPECTRUM CONTROL, INC.
Signal & Power Integrity

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ISO 9001:2000 CERTIFIED

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Custom Applications

Spectrum Control has engineered a complete line of ceramic capacitors designed to provide solutions for a wide range of commercial and military applications. This diverse group of products offer performance and cost alternatives to help you satisfy varied voltage, capacitance, packaging and budgetary requirements.

We are committed to providing an integrated approach to problem solving by offering customers consulting, diagnostic testing and manufacturing services…making Spectrum Control your most reliable and responsive ceramic capacitor supplier.

Spectrum Control's *expertise*

Spectrum Control's comprehensive line of high reliability ceramic products and our complete design services offer you a flexible resource to assist in product development. We combine sophisticated test facilities and equipment with proven expertise in designing and manufacturing ceramic components.

Our commitment to Operational Excellence enables us to provide innovative solutions, which meet our corporate mandate for world class value, quality and delivery. Our facilities have been audited and qualified to MIL-PRF-790 and we are registered to ISO 9001:2000.

Complimenting our technical expertise, our customer service department will provide the needed support to insure timely processing of orders and information requests.

The ceramic capacitors described in this catalog represent only a portion of the total capacitor solutions available. This cross section of product depicts the most widely used items. Many other styles and variations are available to meet virtually any military or commercial application.

For additional information or assistance, contact your local Spectrum Control representative or visit us at www.specemc.com.

Spectrum Control offers:

- **Engineering support –** Our engineering staff, with years of experience in designing capacitors, has developed sophisticated computer models to help us provide rapid and cost effective solutions. Following an evaluation of your needs, we will produce an economical, space saving capacitor that satisfies your performance requirements.
- **Reduced lead times and volume production –** Spectrum Control's unique manufacturing processes enable us to reduce lead times for both prototyping and production orders, ensuring on-time delivery.
- **Custom capacitor designs –** We offer maximum design versatility to meet the needs of any unique application.
- **Full qualification testing –** In addition to our integrated quality assurance process, we offer testing in compliance with MIL-PRF-55681, MIL-PRF-123 and other capacitor specifications.

SPECTRUM CONTROL INC.

Discoidal Capacitors

Ceramic discoidal feed-thru capacitors are the building blocks of the EMI filter industry. Spectrum Control discoidal capacitors provide great versatility in meeting varied voltage, capacitance and dimensional requirements. Our non-polar, multi-layer capacitors are small, reliable and high in dielectric strength. Operational temperatures of –55°C to +125°C are achieved with no voltage de-rating.

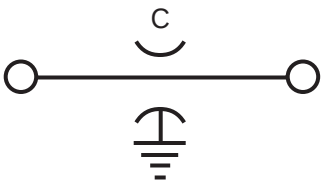
The versatile nature of our discoidals makes them ideally suited for by-pass and filtering applications. Due to their low inductance construction, these capacitors perform extremely well in high frequency applications. The circular geometry of a discoidal feed-thru capacitor offers many paths to ground, resulting in lower impedance and better filtering performance.

The low profile and rugged design of our discoidal capacitors offer an excellent alternative to ceramic tubes.

Features

- Excellent high frequency performance
- Low profile design
- Rugged construction
- Low impedance, many paths to ground
- Low inductance, non-polar
- AC applications up to 240V
- DC applications up to 500V
- -55°C to +125°C operation

Feed-Thru Circuit

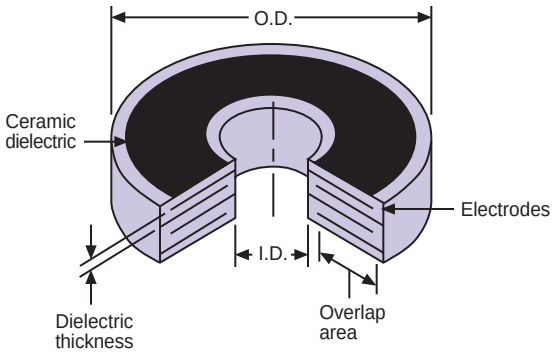


Specialty Ceramic Capacitors

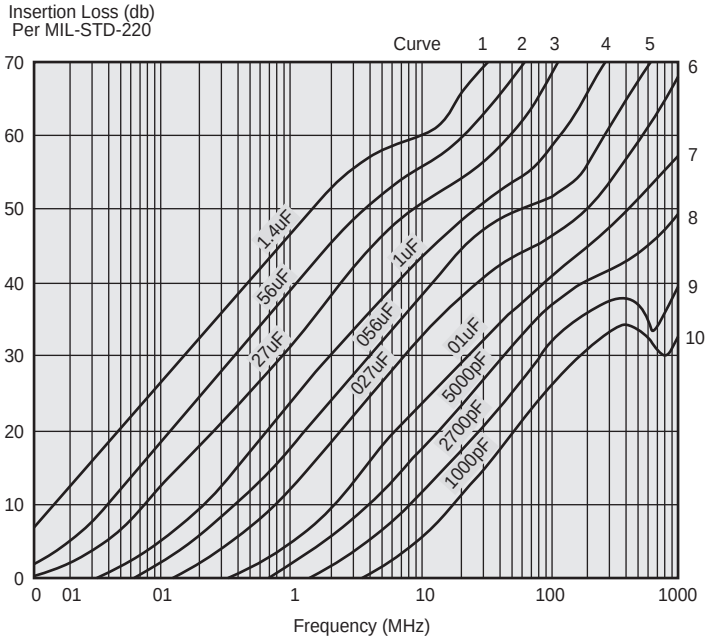
We offer many variations of discoidal and array capacitors to fit your custom application:

- Various OD, ID and thickness configurations
- Pressed discoidals with surface printed terminals
- Multi-hole discoidal designs
- Miniature discoidals down to .080" OD
- Arrays
- Custom style capability
- High voltage designs available
- High temperature designs available

Multilayer Discoidal



Insertion Loss



Metallization

Standard metallization is solderable silver.
Other metallizations are available upon request.

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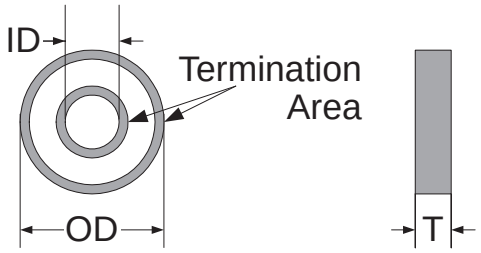
Discoidal NP0



OD	(in)	**0.080** ±0.005				**0.100** ±0.005				**0.135** ±0.005				**0.150** ±0.010				**0.195** ±0.010				**0.340** ±0.010				**0.595** ±0.010			
	(mm)	**2.03** ±0.13				**2.54** ±0.13				**3.43** ±0.13				**3.81** ±0.25				**4.95** ±0.25				**8.64** ±0.25				**15.11** ±0.25			
ID	(in)	**0.030** ±0.005				**0.040** ±0.005				**0.040** ±0.005				**0.045** ±0.005				**0.062** ±0.005				**0.055** ±0.005				**0.095** ±0.005			
	(mm)	**0.76** ±0.13				**1.02** ±0.13				**1.02** ±0.13				**1.14** ±0.13				**1.52** ±0.13				**1.40** ±0.13				**2.41** ±0.13			
T Max	(in)	0.045				0.060				0.060				0.110				0.120				0.120				0.125			
	(mm)	1.14				1.52				1.52				2.79				3.05				3.05				3.18			
Term BW	(in)	0.000 - 0.015				0.000 - 0.020				0.000 - 0.025				0.000 - 0.025				0.002 - 0.025				0.005 - 0.045				0.005 - 0.055			
	(mm)	0.00 - 0.38				0.00 - 0.51				0.00 - 0.64				0.00 - 0.64				0.05 - 0.64				0.13 - 1.14				0.13 - 1.40			
Cap(pF) \ WV(VDC)		500	200	100	50	500	200	100	50	500	200	100	50	500	200	100	50	500	200	100	50	500	200	100	50	500	200	100	50
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Note: AC voltage determined upon request

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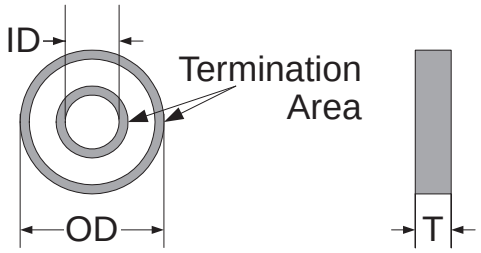
Discoidal X7R



OD	(in)	**0.080** ±0.005				**0.100** ±0.005				**0.135** ±0.005				**0.150** ±0.010				**0.195** ±0.010				**0.340** ±0.010				**0.595** ±0.010			
	(mm)	**2.03** ±0.13				**2.54** ±0.13				**3.43** ±0.13				**3.81** ±0.25				**4.95** ±0.25				**8.64** ±0.25				**15.11** ±0.25			
ID	(in)	**0.030** ±0.005				**0.040** ±0.005				**0.040** ±0.005				**0.045** ±0.005				**0.062** ±0.005				**0.055** ±0.005				**0.095** ±0.005			
	(mm)	**0.76** ±0.13				**1.02** ±0.13				**1.02** ±0.13				**1.14** ±0.13				**1.52** ±0.13				**1.40** ±0.13				**2.41** ±0.13			
T Max	(in)	0.045				0.060				0.060				0.110				0.120				0.120				0.125			
	(mm)	1.14				1.52				1.52				2.79				3.05				3.05				3.18			
Term BW	(in)	0.000 - 0.015				0.000 - 0.020				0.000 - 0.025				0.000 - 0.025				0.002 - 0.025				0.005 - 0.045				0.005 - 0.055			
	(mm)	0.00 - 0.38				0.00 - 0.51				0.00 - 0.64				0.00 - 0.64				0.05 - 0.64				0.13 - 1.14				0.13 - 1.40			
WV(VDC) / Cap(pF)		500	200	100	50	500	200	100	50	500	200	100	50	500	200	100	50	500	200	100	50	500	200	100	50	500	200	100	50
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Note: AC voltage determined upon request

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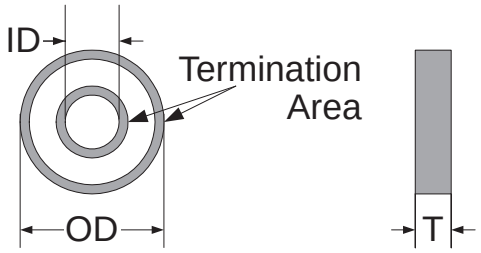
Discoidal Z5U



OD	(in)	**0.080** ±0.005				**0.100** ±0.005				**0.135** ±0.005				**0.150** ±0.010				**0.195** ±0.010				**0.340** ±0.010				**0.595** ±0.010			
	(mm)	**2.03** ±0.13				**2.54** ±0.13				**3.43** ±0.13				**3.81** ±0.25				**4.95** ±0.25				**8.64** ±0.25				**15.11** ±0.25			
ID	(in)	**0.030** ±0.005				**0.040** ±0.005				**0.040** ±0.005				**0.045** ±0.005				**0.062** ±0.005				**0.055** ±0.005				**0.095** ±0.005			
	(mm)	**0.76** ±0.13				**1.02** ±0.13				**1.02** ±0.13				**1.14** ±0.13				**1.52** ±0.13				**1.40** ±0.13				**2.41** ±0.13			
T Max	(in)	0.045				0.060				0.060				0.110				0.120				0.120				0.125			
	(mm)	1.14				1.52				1.52				2.79				3.05				3.05				3.18			
Term BW	(in)	0.000 - 0.015				0.000 - 0.020				0.000 - 0.025				0.000 - 0.025				0.002 - 0.025				0.005 - 0.045				0.005 - 0.055			
	(mm)	0.00 - 0.38				0.00 - 0.51				0.00 - 0.64				0.00 - 0.64				0.05 - 0.64				0.13 - 1.14				0.13 - 1.40			
Cap(pF) \ WV(VDC)		500	200	100	50	500	200	100	50	500	200	100	50	500	200	100	50	500	200	100	50	500	200	100	50	500	200	100	50
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Discoidal Electrical Testing

Electrical Parameter	Test Method	Temperature Coefficient NP0	X7R	Z5U
Temperature Coefficient	EIA 198	±30 ppm/ °C, - 55 to +125°C	±15%, -55 to +125°C	+22, -56%, +10 to +85°C
Capacitance Tolerance	EIA Tolerance Code	K, M, P	K, M, P	M, P, Z
Capacitance Test@ 25°C	MIL-STD-202, Method 305	Cap ≤ 100 pF: 1 MHz, 1 Vrms Cap > 100 pF: 1 KHz,1 Vrms	1 KHz, 1 Vrms	1 KHz, 0.5 Vrms
Dissipation Factor @ 25°C	MIL-STD-202, Method 305	0.15% Max	3.5% Max	3.5% Max
Aging Rate (Per Decade)		0%	<2.0%	<3.5%
Insulation Resistance @ 25°C	MIL-STD-202, Method 302	1000 MΩ · µF or 100 KMΩ, whichever is less	1000 MΩ · µF or 100 KMΩ, whichever is less	1000 MΩ · µF or 100 KMΩ, whichever is less
Insulation Resistance @ 125°C	MIL-STD-202, Method 302	100 MΩ · µF or 10 KMΩ, whichever is less	100 MΩ · µF or 10 KMΩ, whichever is less	100 MΩ · µF or 10 KMΩ, 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

Discoidal Part Numbering System

After determining the capacitor properties required for a given application, use information from pages 4-7 and the part numbering system below to place the order. If there are any questions, do not hesitate to contact Spectrum Control customer service.

Example: **340055AX145P6B0**

The part number shown represents a discoidal with an outer diameter of 0.340" and inner diameter of 0.055". The voltage rating for this part is 50 VDC. The ceramic type will be X7R. The capacitance value is 1,400,000 pF with a tolerance of +100, -0%. The termination will be silver and the parts will receive bulk packaging. Since the last identifier in the part number is “0”, there are no special requirements.

340	055	A	X	145	P	6	B	0
Outer Diameter Example: 0.340" = 340	**Inner Diameter** Example: 0.055" = 055	**Voltage Rating** A: 50 VDC B: 100 VDC C: 200 VDC E: 500 VDC	**Ceramic Code** N: NP0 X: X7R Z: Z5U	**EIA Cap Code** Example: 1,400,000 pF = 145	**EIA Cap Tolerance** K: ±10% M: ±20% P: +100 -0% Z: +80 -20%	**Termination** 6: Silver	**Packaging** B: Bulk	**Special Requirements** 0: None D: Class B G: Custom

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Tubular FT Capacitors

Spectrum Control manufactures a wide variety of tubular feed-thru (FT) ceramic capacitors, which are small in size, lightweight, non-polar and offer high dielectric strength. Operating temperatures of –55°C to +125°C are achieved with no voltage de-rating. All capacitors are fired to produce true monolithic structures, which are impervious to moisture and contamination. Outer terminations feature a nickel barrier and a final metal layer, typically silver.

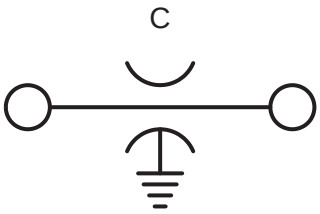
Feed-thru tubular capacitors are ideally suited for by-pass and filtering applications. Due to the cylindrical design, the capacitors will have uniform insertion loss over a broad frequency range. This structure yields a low inductance when compared to conventional wound capacitors.

Solid FT capacitors have no internal electrodes and find their primary usage in low cost applications. Multi-layered FT capacitors have a higher capacitance to volume ratio and are ideally suited for greater filtering at lower frequencies. Multi-layered FT capacitors are also designed for applications where source impedances are high and sharp attenuation rise is critical.

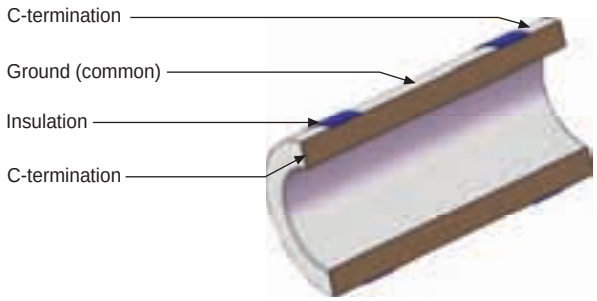
Features

- Low cost solution for general purpose filtering
- Ideal for multi-pin connector applications
- High ratio of capacitance to volume
- Low inductance, non-polar
- Impervious to moisture and contamination
- -55°C to +125°C operation

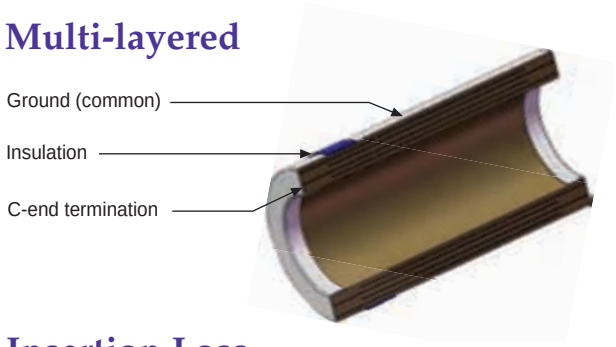
Feed-Thru Circuit



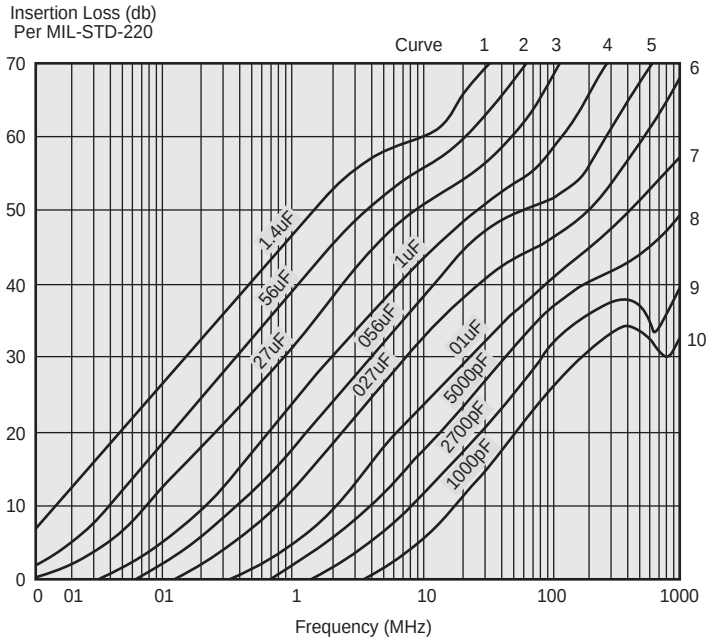
Solid



Multi-layered



Insertion Loss



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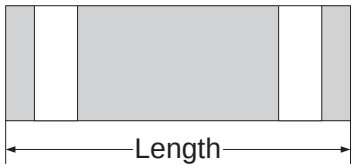
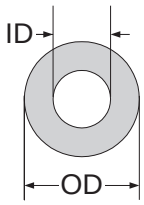
Tubular FT Specifications





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		
	OD (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		
	ID (mm)	**1.27** ±0.05						**1.52** ±0.08													**2.08** ±0.10		
	Length (in)	**0.173** ±0.010			**0.235** ±0.010			**0.173** ±0.010			**0.235** ±0.010			**0.300** ±0.010			**0.315** ±0.010			**0.250** ±0.010		
	Length (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		
	WV(VDC) / Cap(pF)	200	100	50	200	100	50	200	100	50	200	100	50	200	100	50	200	100	50	200	100	50
NP0	10 Max																					
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	27,000																					

KEY: Solid Multi-Layered

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Tubular Pi Capacitors

As with the feed-thru tubular capacitors, the Pi (π) tubular capacitors offered by Spectrum Control are small in size, lightweight, non-polar and offer high dielectric strength. Operating temperatures of –55°C to +125°C are achieved with no voltage de-rating. All capacitors are fired to produce true monolithic structures, which are impervious to moisture and contamination. Outer terminations feature a nickel barrier and a final metal layer, typically silver.

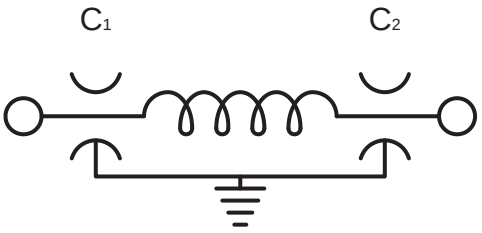
Compared to feed-thru tubular capacitors, Pi tubular capacitors have a much narrower transition between the pass and stop bands. Pi filters are effective in stopping high frequency interference without affecting necessary frequencies immediately below the stop band.

Similar to feed-thru tubular capacitors, Pi tubular capacitors can be designed with a solid or multi-layered configuration. Solid Pi tubular capacitors are more cost effective, but limited in capacitance values. Multi-layered 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.

Features

- Provide filtering of noise content close to signal content
- Ideal for multi-pin connector applications
- High ratio of capacitance to volume
- Low inductance, non-polar
- Impervious to moisture and contamination
- -55°C to +125°C operation

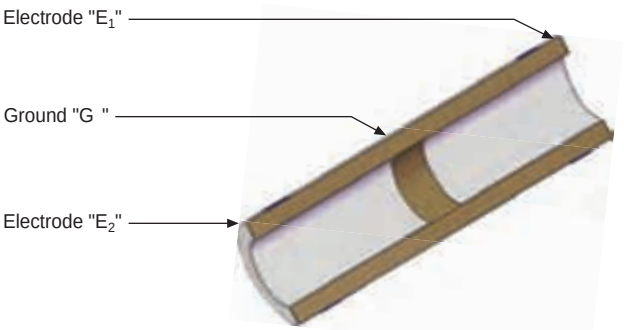
Pi Circuit



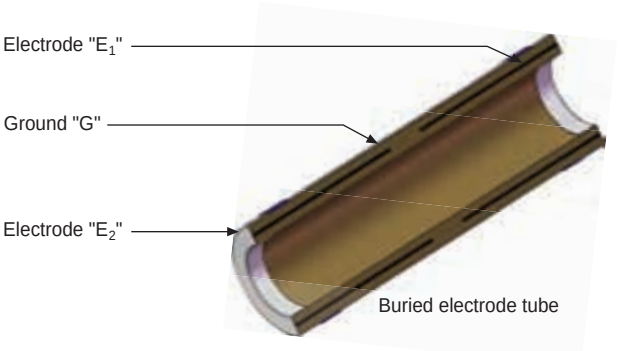
$C_1 + C_2 = C_{Total}$

Inductive Element not included

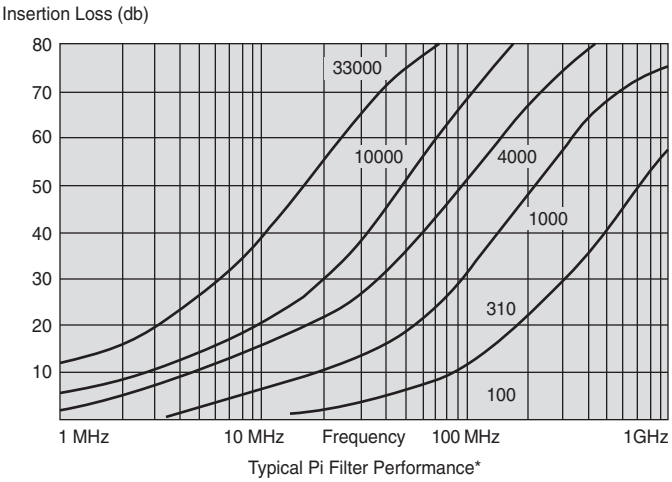
Solid



Multi-layered Tube



Insertion Loss



Typical Pi Filter Performance*

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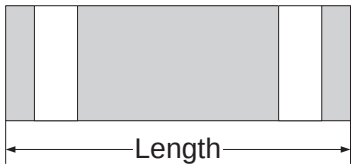
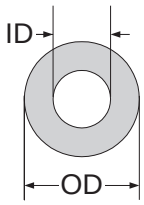
Tubular Pi Specifications





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** ±0.08												**2.08** ±0.10		
	Length	(in)	**0.173** ±0.010			**0.235** ±0.010			**0.173** ±0.010			**0.235** ±0.010			**0.300** ±0.010			**0.315** ±0.010			**0.250** ±0.010		
		(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		
	WV(VDC) / Cap(pF)		200	100	50	200	100	50	200	100	50	200	100	50	200	100	50	200	100	50	200	100	50
NP0	10 Max																						
	12																						
	27																						
	33																						
	39																						
	47																						
	56																						
	68																						
	82																						
	100																						
	120																						
	150																						
	180																						
	220																						
	270																						
	330																						
	390																						
	470																						
X7R	330																						
	390																						
	470																						
	560																						
	680																						
	820																						
	1,000																						
	1,200																						
	1,500																						
	1,800																						
	2,200																						
	2,700																						
	3,300																						
	3,900																						
	4,700																						
	5,600																						
	6,800																						
	8,200																						
	10,000																						
	12,000																						
	15,000																						
	18,000																						
	22,000																						
	27,000																						
Y5V	3,300																						
	3,900																						
	4,700																						
	5,600																						
	6,800																						
	8,200																						
	10,000																						
	12,000																						
	15,000																						
	18,000																						
	22,000																						
	27,000																						

KEY: Solid Multi-layered

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SPECTRUM CONTROL INC.

General Tubular Capacitor Information

Specialty Tubular Products

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

- Various OD, ID and length configurations
- Square tubes for surface mount applications
- Lapped feed-thru capacitors
- Custom style capability

Tubular Electrical Testing

Electrical Parameter	*Test Method*	*Temperature Coefficient*		
		NP0	*X7R*	*Z5U*
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 ≤ 100 pF: 1 MHz, 1 Vrms Cap > 100 pF: 1 KHz, 1 Vrms	1 KHz, 1 Vrms	1 KHz, 0.5 Vrms
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	1000 MΩ · µF or 100 KMΩ, whichever is less	1000 MΩ · µF or 100 KMΩ, whichever is less	1000 MΩ · µF or 100 KMΩ, whichever is less
Insulation Resistance @ 125°C	MIL-STD-202, Method 302	100 MΩ · µF or 10 KMΩ, whichever is less	100 MΩ · µF or 10 KMΩ, whichever is less	100 MΩ · µF or 10 KMΩ, 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 information from pages 9-12 and the part numbering system below to place the order. If there are any questions, do not hesitate to contact Spectrum Control customer service.

Example: **I8150173X7R471M**

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.

I	*81*	*50*	*173*	*X7R*	*471*	*M*
Voltage Rating	**Outer Diameter**	**Inner Diameter**	**Length**	**Ceramic Code**	**EIA Cap Code**	**EIA Cap Tolerance**
A: FT, 50 VDC	Example:	Example:	Example:	NP0	Example:	M: ±20%
C: FT, 100 VDC	0.081" = 81	0.050" = 50	0.173" = 173	X7R	470 pF = 471	N: ±30%
E: FT, 200 VDC				Y5V		P: +100 -0%
G: Pi, 50 VDC						Z: +80 -20%
H: Pi, 100 VDC						
I: Pi, 200 VDC						

SPECTRUM CONTROL INC.

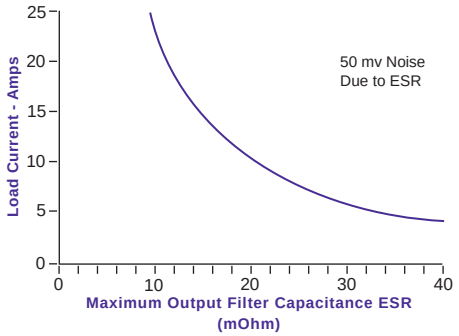
SMPS Capacitors

High speed Switch Mode Power Supply (SMPS) capacitors have the following characteristics when compared to other capacitive elements:

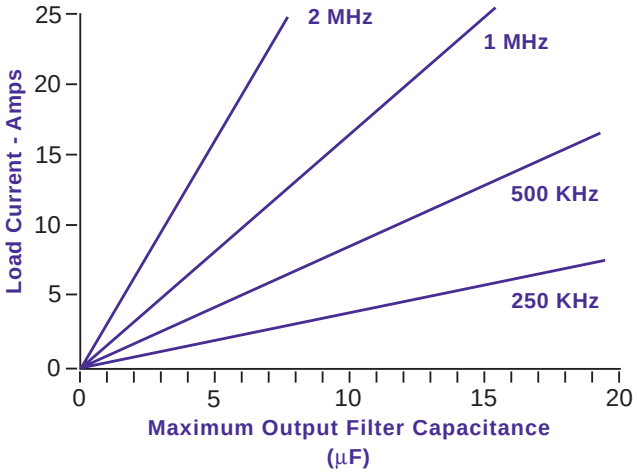
- Lower Equivalent Series Resistance (ESR)
- Lower Equivalent Series Inductance (ESL)
- Lower ripple voltage and less self heating

Style/Size		Dimensions					
		A max	B max	C ±0.025"	D ±0.025"	E max	Leads/ Side
SMP-3	(in)	0.650	0.715	0.450	1.050	0.500	10
	(mm)	16.50	18.16	11.42	26.65	12.69	
SMP-4	(in)	0.650	0.715	0.400	0.400	0.440	4
	(mm)	16.50	18.16	10.15	10.15	11.17	
SMP-5	(in)	0.650	0.715	0.250	0.250	0.300	3
	(mm)	16.50	18.16	6.35	6.35	7.62	

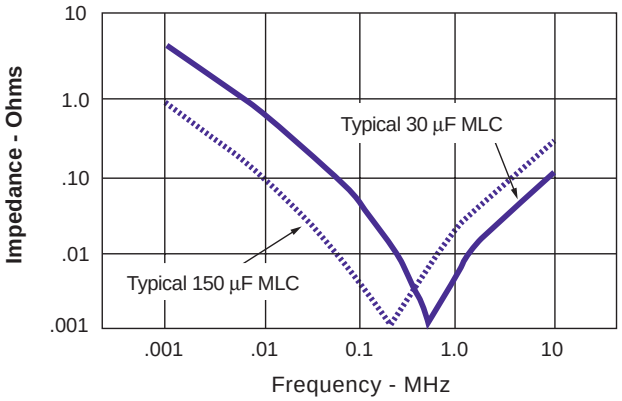
Absolute Maximum Capacitance ESR
Assuming no ESL - Capacitive Induced Ripple



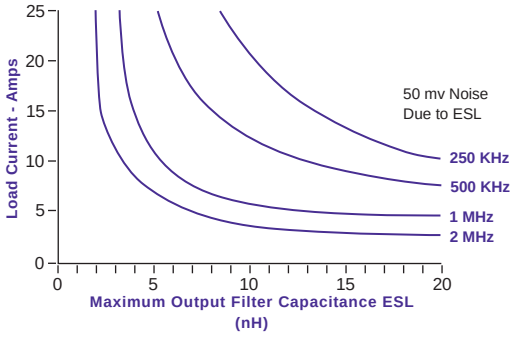
Absolute Maximum Output Capacitance
Assuming no ESL and no ESR



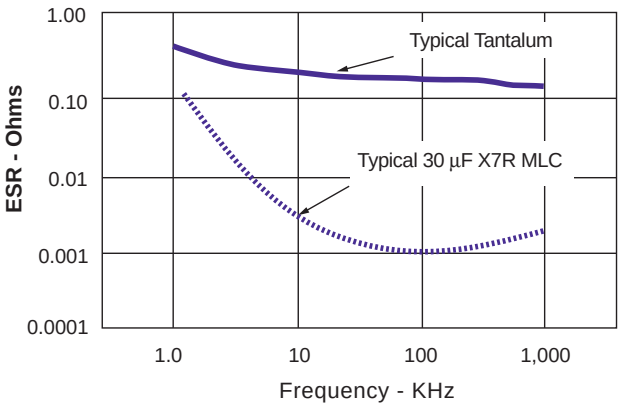
Impedance vs. Frequency



Absolute Maximum Capacitance ESL
Assuming no ESR - Capacitive Induced Ripple



ESR vs. Frequency



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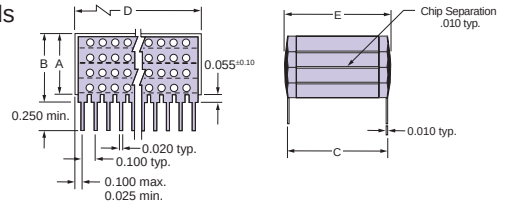
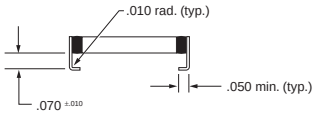
SMPS Specifications

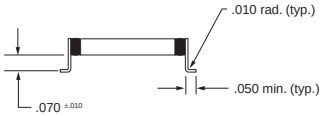
"N" Style Leads



"J" Style Leads



"L" Style Leads



	BP				BX				BR				BQ			
	Working Volts DC				Working Volts DC				Working Volts DC				Working Volts DC			
Cap Value (µF)	500	200	100	50	500	200	100	50	500	200	100	50	500	200	100	50
0.01																
0.012																
0.015																
0.018																
0.022																
0.027																
0.033																
0.039																
0.047																
0.056																
0.068																
0.082																
0.10																
0.12																
0.15																
0.18																
0.22																
0.27																
0.33																
0.39																
0.47																
0.56																
0.68																
0.82																
1																
1.2																
1.5																
1.8																
2.2																
2.7																
3.3																
3.9																
4.7																
5.6																
6.8																
8.2																
10																
12																
15																
18																
22																
27																
33																
39																
47																

KEY: SMP-3 SMP-4 SMP-5

SPECTRUM CONTROL INC.

SMPS Capacitor Electrical Testing

Test Group	Test Order	Test	Test Method	Post Test Requirements	Sampling Procedure
Group A	1	Visual and Mechanical			13 samples 0 failures
	2	Materials, Designs, Construction and Workmanship			
	3	Physical Dimensions and Marking			
	4	Capacitance and Dissipation Factor	MIL-STD-202 Method 305		100%
	5	Dielectric Withstanding Voltage	MIL-STD-202 Method 301, 2.5x DCWV except 500V @ 1.5x		
	6	Insulation Resistance	MIL-STD-202 Method 302 @ DCWV, 25 C	>100,000 megohms or 1,000 megohm-uF, whichever is less	
Group B Sub Grp I	1	Voltage and Temperature Limits			12 samples 1 failure
	2	Resistance to Solvents	MIL-STD-202 Method 215		
	3	Immersion	MIL-STD-202 Method 104 test condition B	No mechanical damage. Dielectric strength, capacitance, df and 25 C IR to original limits	
	4	Terminal Strength	MIL-STD-202 Method 211 test condition A. Case codes 1-4, 6-5 lbs case code 5-4 lbs	No evidence of loosening or rupturing of terminals	
Group B Sub Grp II	1	Resistance to Soldering Heat	MIL-STD-202 Method 210 N lead style test condition B, J and L styles test condition I	No mechanical damage. Dielectric strength, capacitance, df and 25 C IR to original limits	12 samples 1 failure
	2	Moisture Resistance	MIL-STD-202 Method 106, 20 cycles	No mechanical damage. Dielectric strength, capacitance, df and 25 C IR to original limits	
Group B Sub Grp III	1	Life	MIL-STD-202 Method 108, 1000 hrs. 2x DCWV except 1.2x 500 DCWV	No mechanical damage. Dielectric strength, capacitance, df, 125 C IR and 25 C IR to original limits	12 samples 1 failure
Optional		Solderabililty Group A			
		Thermal Shock and Voltage Conditioning			

SMPS Capacitor Part Numbering System

After determining the capacitor properties required for a given application, use information from pages 14-17 and the part numbering system below to place the order. If there are any questions, do not hesitate to contact Spectrum Control customer service.

Example: **SMP3X124KENMB00**

The part number shown represents a size 3 SMPS capacitor. The ceramic type will be BX. The capacitance value is 120,000 pF with a tolerance of ±10%. The voltage rating for this part is 500 VDC. The termination will be "N" style leads and the parts will receive marking/ bulk packaging. There are no special testing requirements for this part.

SMP3	X	124	K	E	N	M	B	00
Case Size	**Ceramic Code**	**EIA Cap Code**	**EIA Cap Tolerance**	**Voltage Rating**	**Termination**	**Marking**	**Packaging**	**Special Requirements**
SMP3	P: BP	Example:	J: ±5%	A: 50 VDC	J: Leads in	M: Marked	B: Bulk	00: Standard
SMP4	Q: BQ	120,000 pF	K: ±10%	B: 100 VDC	L: Leads out	U: Unmarked	T: Tape & Reel	XX: Custom
SMP5	R: BR		M: ±20%	C: 200 VDC	N: Leads straight			HR: Hi-Rel*
	X: BX			E: 500 VDC				

* Hi-Rel is 100% screening to Group A of MIL-PRF-49470 Table VIII, B level

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Dielectric Characteristics

Capacitor Selection

Multilayer capacitors (MLC) and single layer capacitors are categorized by performance with temperature. Component selection is typically determined by dielectric performance; electrical environment and temperature stability. In determining the proper component for a specific application, the following information should be considered.

Dielectric Type

There are three basic dielectric classes (characteristics) available:

DIELECTRIC PROPERTIES

Dielectric Type	Stability Class	Description
NPO (COG)	Ultra Stable Class I	Effects on electrical properties are minimal with temperature, frequency or time. Used in applications which require stable performance.
X7R and BX	Stable Class II	Effects on electrical properties predictably change with temperature, voltage, frequency and time. Selected for applications where blocking, coupling, by-passing and frequency discriminating elements are used. Offers higher capacitance than Class I (COG).
Z5U and Y5V	General Purpose Class II	Exhibits a greater variation of properties with temperature. Dielectric constant is higher than Class I and Class II dielectrics Extremely high capacitance per unit volume and used in general performance applications.

Capacitor Size

The capacitor body size impacts its utility to the design requirements in respect to capacitance value and voltage rating. Typically smaller units are less expensive and provide for greater space savings. Because mass affects the thermal response of the chips, size should be considered when selecting the attachment method to the circuit.

TERMINATION MATERIAL

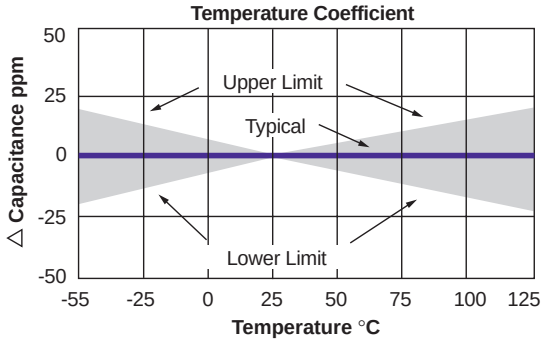
Material Type	Recommended Usage
Silver Palladium	Non-magnetic application requirements. Recommended for conductive epoxy and leaded attachment methods. For soldering applications, use solder reflow below 230°C.
Silver	Most ductile of the available termination methods. Used in applications which will be leaded, to minimize thermal stresses.

Dielectric Characteristics

NPO (COG)

Operating Temperature Range	-55°C to 125°C
Temperature Coefficient	0 ± 30 ppm/°C
Dissipation Factor	.001 (0.1%) max. @ 25°C
Insulation Resistance: 25°C	10^6 Megohms
125°C	10^5 Megohms
Dielectric Withstanding Voltage	50 to 200V, 2.5 x VDCW 201 to 500V, 1.5 x VDCW, or 500V*, >500V, 1.2 VDCW, or 750V*
Aging Rate	0% per decade hour
Test Parameters	1 KHz, 1.0 ± 0.2 VRMS, 25°C 1 MHz for capacitance ≤1,000 pF

** Whichever is greater*

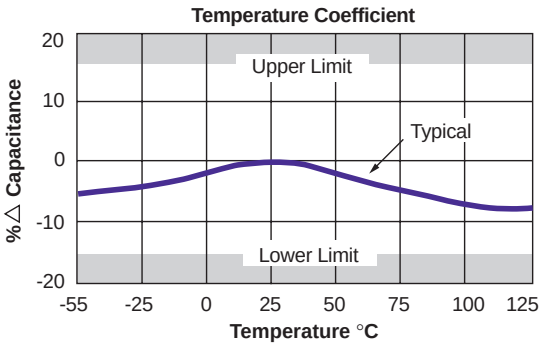


Dielectric Characteristics

Dielectric Characteristics Continued

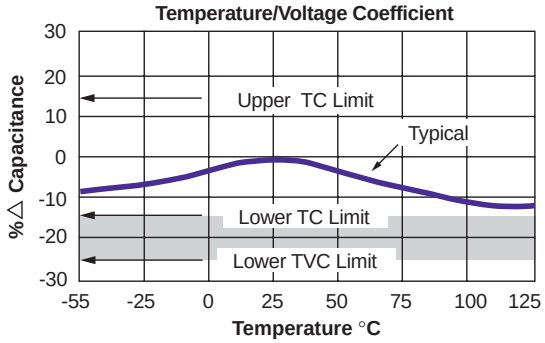
X7R

Operating Temperature Range	-55°C to 125°C
Temperature Coefficient	± 15% △C max.
Dissipation Factor	.025 (2.5%) max. @ 25°C
Insulation Resistance: 25°C	10^6 Megohms
125°C	10^5 Megohms
Dielectric Withstanding Voltage	50 to 200V, 2.5 x VDCW
	201 to 500V, 1.5 x VDCW, or 500V*,
	>500V, 1.2 VDCW, or 750V*
Aging Rate	<2.0% per decade hour
Test Parameters	1 KHz, 1.0 VRMS ± 0.2 VRMS, 25°C



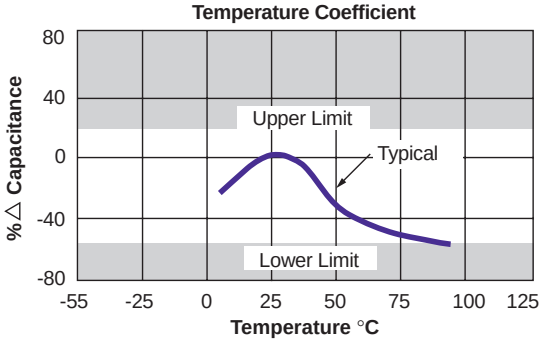
BX

Operating Temperature Range	-55°C to 125°C
Temperature Coefficient	± 15% △C max.
Temperature Voltage Coefficient	+ 15% - 25% △C max.
Dissipation Factor	.025 (2.5%) max. @ 25°C
Insulation Resistance: 25°C	10^6 Megohms
125°C	10^5 Megohms
Dielectric Withstanding Voltage	50 to 200V, 2.5 x VDCW
	201 to 500V, 1.5 x VDCW, or 500V*,
	>500V, 1.2 VDCW, or 750V*
Aging Rate	2.0% per decade hour
Test Parameters	1 KHz, 1.0 VRMS ± 0.2 VRMS, 25°C



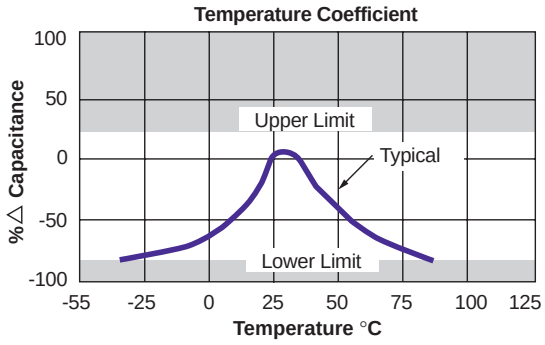
Z5U

Operating Temperature Range	+10°C to 85°C
Temperature Coefficient	+ 22% - 56% △C max.
Dissipation Factor	.030 (3.0%) max. @ 25°C
Insulation Resistance: 25°C	10^5 Megohms
Dielectric Withstanding Voltage	50 to 200V, 2.5 x VDCW
	250V, 1.5 x VDCW
Aging Rate	-2.0% per decade hour
Test Parameters	1 KHz, 0.5 VRMS ± 0.2 VRMS, 25°C



Y5V

Operating Temperature Range	-30°C to 85°C
Temperature Coefficient	+ 22% - 82% △C max.
Dissipation Factor	.050 (5.0%) max. @ 25°C
Insulation Resistance: 25°C	10^5 Megohms
Dielectric Withstanding Voltage	50 to 200V, 2.5 x VDCW
	250V, 1.5 x VDCW
Aging Rate	-2.0% per decade hour
Test Parameters	1 KHz, 0.5 VRMS ± 0.2 VRMS, 25°C



** whichever is greater*

SPECTRUM CONTROL INC.

Processing & Soldering Notes

Soldering Recommendations for Ceramic Capacitors

Soldering Ceramic Capacitors with High Temperature Process

SN10 solder
Ramp rate, heating and cooling . . .approximately 30°C/min
Peak temperature . . . . . .approximately 320°C
Dwell at peak . . . . . .< 30 seconds

An RMA flux may be needed.

Soldering Ceramic Capacitors with Medium Temperature Process

SN96 solder
Ramp rate, heating and cooling....approximately 30°C/min
Peak temperature .....approximately 250°C
Dwell at peak .....< 30 seconds

Soldering Ceramic Capacitors with Low Temperature Process

SN62 solder
Ramp rate, heating and cooling....approximately 30°C/min
Peak temperature .....approximately 220°C
Dwell at peak .....< 30 seconds

Notes

Care must be taken to minimize the time terminations are exposed to molten solder or the silver terminations may amalgamate into the solder (leech). SCI recommends using a silver (Ag) bearing solder alloy when terminating directly to ceramic capacitors to reduce the potential for leeching. A gradual heating and cooling are vital to prevent thermal shock (cracking) of the ceramic.

Soldering Recommendations for Switch Mode Power Supplies

- A controlled temperature profile not exceeding 6°F (3°C) per second is recommended when soldering filters.
- When soldering to terminals of a filter, a heat sink should always be used adjacent to the body of the filter.
- 60-40 solder is recommended for installation of the filter into the chassis as well as soldering to the terminals. If a filter style without an eyelet is being soldered into a chassis, iron processes should be avoided and the recommended solder alloy is 60-38-2.
- Installation hold size for a solder-in filter should be 0.003-0.005" over the maximum tolerance of the minor diameter of the mounting portion of the eyelet with a ±0.002" tolerance.
- Machine/oven soldering 385-415°F (195-210°C) using a dwell and cycle time fast enough to reflow the solder and ramped to maintain less than 6°F/sec rate of change.
- For iron soldering to filter body, preheat components at 250-300°F (120-150°C), solder iron is recommended to be set at 500-550°F (260-290°C). The dwell on the solder joint should be less than 5 seconds. The time is dependent on the heat sinking provided by the chassis so a longer preheat may be required.

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