

**AVX**

A KYOCERA GROUP COMPANY



AVX  
Multilayer Ceramic Feedthru  
Chip Capacitors And Arrays

# Feedthru 0805/1206 Capacitors



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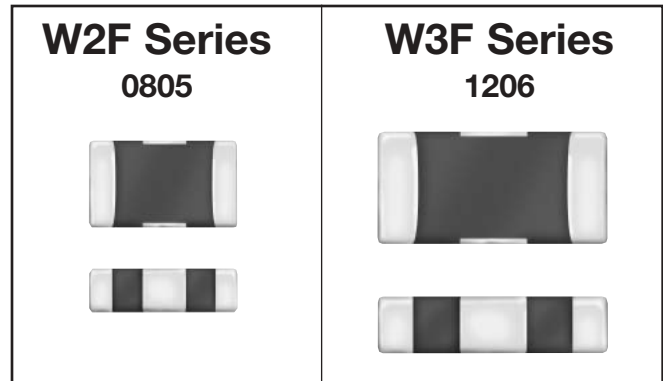
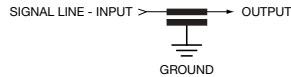
# Feedthru 0805/1206 Capacitors



## W2F/W3F Series

### GENERAL DESCRIPTION

Available in both a standard 0805 and 1206 size, AVX's line of feedthru capacitors are ideal choices for EMI suppression, broadband I/O filtering, or Vcc power line conditioning. The unique construction of a feedthru capacitor provides low parallel inductance and offers excellent decoupling capability for all high di/dt environments and provides significant noise reduction in digital circuits to <5 GHz. A large range of capacitor values are available in either NP0 or X7R ceramic dielectrics.



### CAPACITOR VALUES

Part Number	Size	Voltage	Dielectric	Capacitance
W2F11A 220 8ATxx	0805	100V	NP0	22pF
W2F11A 470 8ATxx	0805	100V	NP0	47pF
W2F11A 101 8ATxx	0805	100V	NP0	100pF
W2F11A 221 8ATxx	0805	100V	NP0	220pF
W2F11A 471 8ATxx	0805	100V	NP0	470pF
W2F15C 102 8ATxx	0805	50V	X7R	1000pF
W2F15C 222 8ATxx	0805	50V	X7R	2200pF
W2F15C 472 8ATxx	0805	50V	X7R	4700pF
W2F15C 103 8ATxx	0805	50V	X7R	10000pF
W2F15C 223 8ATxx	0805	50V	X7R	22000pF
W2F15C 473 8ATxx	0805	50V	X7R	47000pF
W3F11A 220 8ATxx	1206	100V	NP0	22pF
W3F11A 470 8ATxx	1206	100V	NP0	47pF
W3F11A 101 8ATxx	1206	100V	NP0	100pF
W3F11A 221 8ATxx	1206	100V	NP0	220pF
W3F11A 471 8ATxx	1206	100V	NP0	470pF
W3F15C 102 8ATxx	1206	50V	X7R	1000pF
W3F15C 222 8ATxx	1206	50V	X7R	2200pF
W3F15C 472 8ATxx	1206	50V	X7R	4700pF
W3F15C 103 8ATxx	1206	50V	X7R	10000pF
W3F15C 223 8ATxx	1206	50V	X7R	22000pF
W3F15C 473 8ATxx	1206	50V	X7R	47000pF

### PERFORMANCE CHARACTERISTICS

	NP0	X7R
Capacitance Tolerance	+50%, -20%	+50%, -20%
Voltage Rating	100V	50V
Current Rating	300mA	300mA
Insulation Resistance	1000MΩ	1000MΩ
DC Resistance	<0.6Ω	<0.6Ω
Operating Temperature Range	-55 to +125°C	

### HOW TO ORDER

Style	Size	Feedthru of Elements	Number	Voltage*	Dielectric	Capacitance Code	Capacitance Tolerance	Failure Rate	Terminations	Packaging Code (Reel Size)	Quantity Code (Pcs./Reel)
W	3	F	1	5	C	223	8	A	T	3	A
	2=0805 3=1206			1=100v 5=50v	A=NP0 C=X7R		8=+50/-20%	A=Not Applicable	T=Plated	1=7" Reel Embossed Tape 3=13" Reel Embossed Tape	F=1,000 A=2,000, 4,000 or 10,000

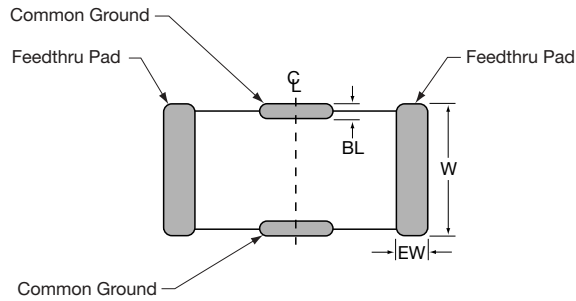
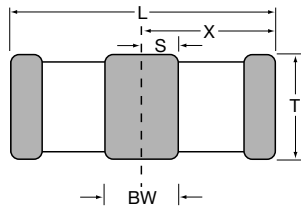
\*Note: NP0 available in 100V only and X7R available in 50V only.



# Feedthru 0805/1206 Capacitors

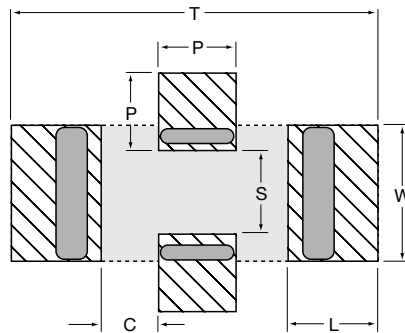


## W2F/W3F Series



### DIMENSIONS

	L	W	T	BW	BL	EW	X	S
<b>0805 MM (in.)</b>	2.01 ± 0.20 (0.079 ± 0.008)	1.25 ± 0.20 (0.049 ± 0.008)	1.14 Max. (0.045 Max.)	0.46 ± 0.10 (0.018 ± 0.004)	0.18 + 0.25 - 0.08 (0.007 + 0.010 - 0.003)	0.25 ± 0.13 (0.010 ± 0.005)	1.02 ± 0.10 (0.040 ± 0.004)	0.23 ± 0.15 (0.009 ± 0.006)
<b>1206 MM (in.)</b>	3.20 ± 0.20 (0.126 ± 0.008)	1.60 ± 0.20 (0.063 ± 0.008)	1.27 Max. (0.050 Max.)	0.89 ± 0.10 (0.035 ± 0.004)	0.18 + 0.25 - 0.08 (0.007 + 0.010 - 0.003)	0.38 ± 0.18 (0.015 ± 0.007)	1.60 ± 0.10 (0.063 ± 0.004)	0.46 ± 0.15 (0.018 ± 0.006)

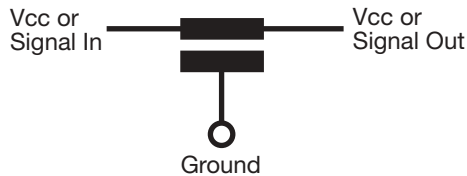


### RECOMMENDED SOLDER PAD LAYOUT (TYPICAL DIMENSIONS)

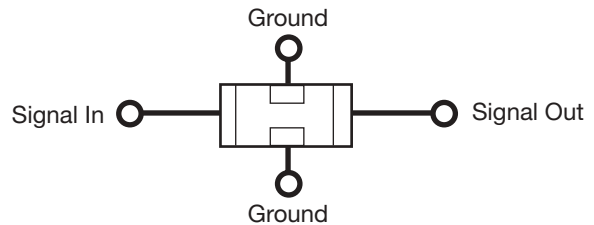
	T	P	S	W	L	C
<b>0805 MM (in.)</b>	3.45 (0.136)	0.51 (0.020)	0.76 (0.030)	1.27 (0.050)	1.02 (0.040)	0.46 (0.018)
<b>1206 MM (in.)</b>	4.54 (0.179)	0.94 (0.037)	1.02 (0.040)	1.65 (0.065)	1.09 (0.043)	0.71 (0.028)

### TYPICAL FEEDTHRU CHIP CAP CONNECTION

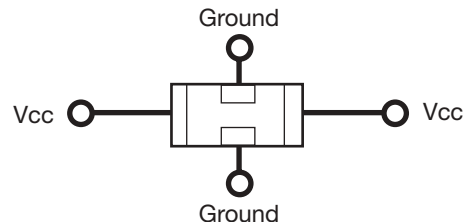
#### Feedthru Chip Component Model



#### Physical Layout - A



#### Physical Layout - B



The terminals are connected internally side to side. Left side and right side are connected and front and back are connected internally. For Decoupling, the chip is usually surrounded by four vias, two for Vcc and two for GND. For Signal Filtering, the in and out lines need to be separated on the circuit board.

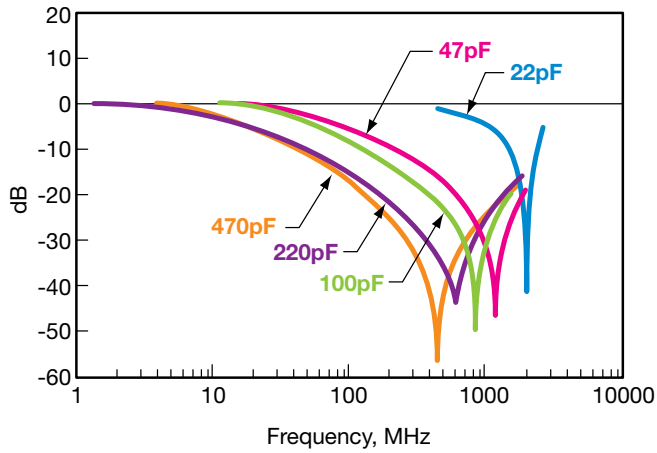
# Feedthru 0805/1206 Capacitors



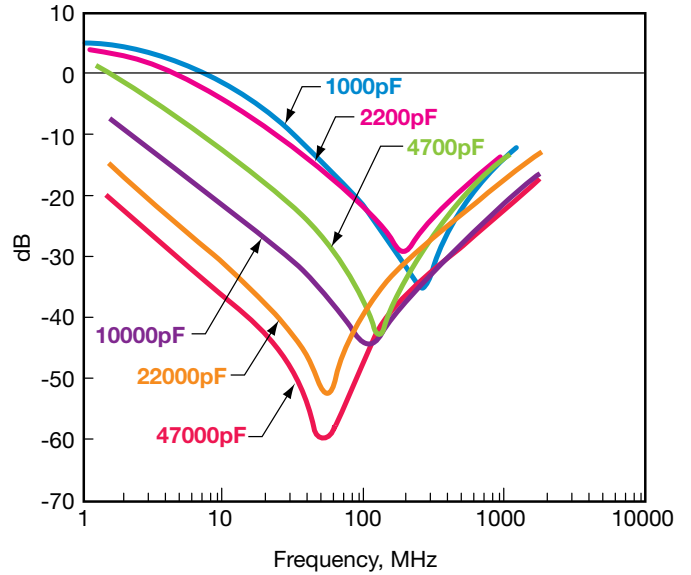
## W2F/W3F Series

### PERFORMANCE CHARACTERISTICS

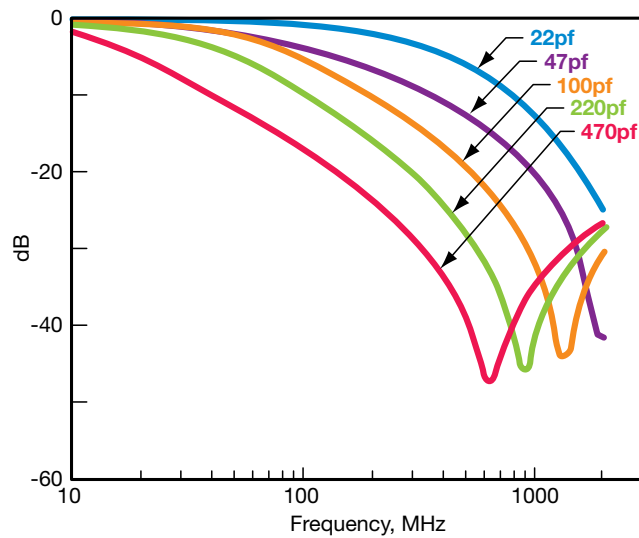
0805 - dB vs. Frequency  
NP0



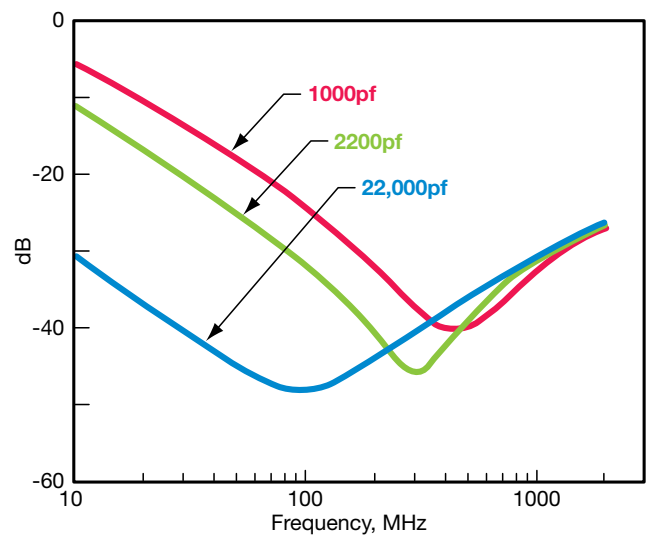
X7R



1206 - dB vs. Frequency  
NP0



X7R



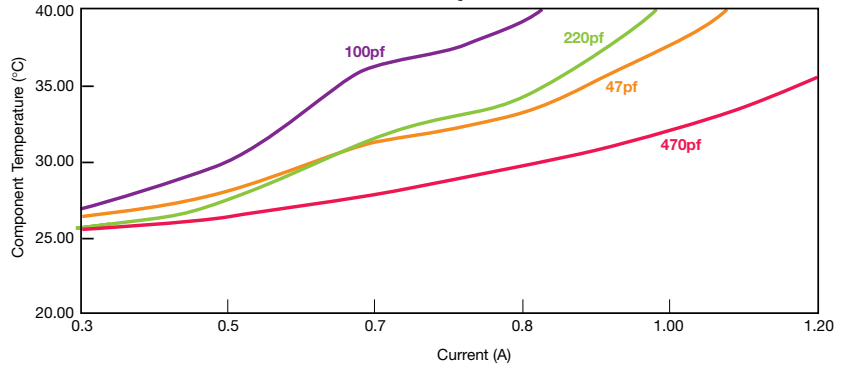
# Feedthru 0805/1206 Capacitors



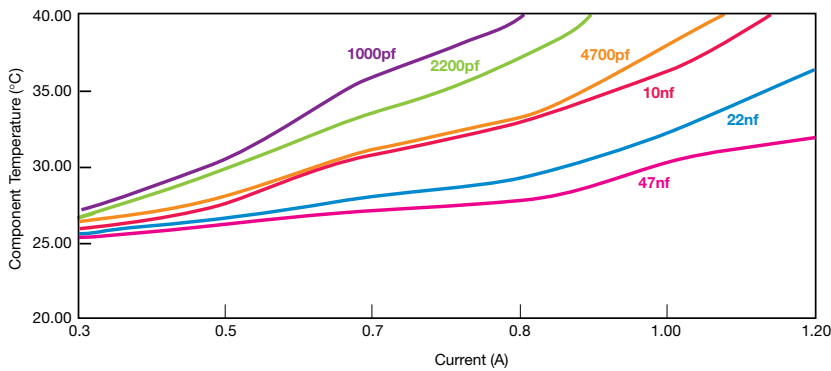
## W2F/W3F Series

### PERFORMANCE CHARACTERISTICS

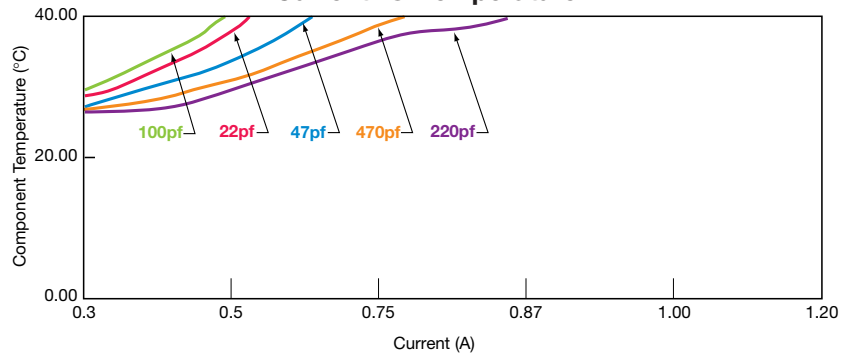
**0805 NPO**  
Current vs. Temperature



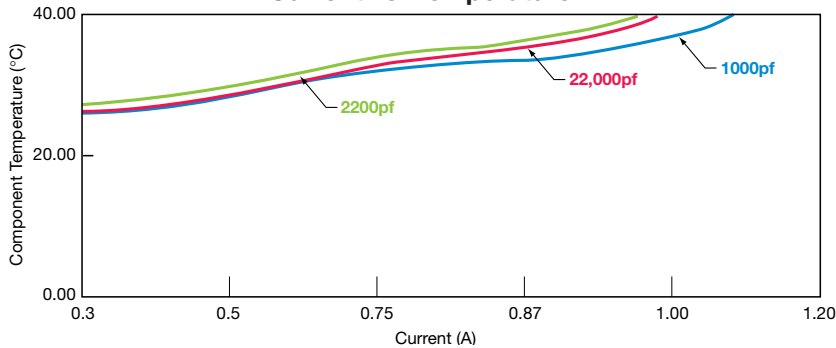
**0805 X7R**  
Current vs. Temperature



**1206 NPO**  
Current vs. Temperature



**1206 X7R**  
Current vs. Temperature



# High Current Feedthru Capacitors



## W2H/W3H Series

### GENERAL DESCRIPTION

High current feedthru capacitors are designed as a broad-band EMI filter that is specially designed to have high current handling capability. These SMT feedthru filters offer an optimized frequency response with high attenuation across a wide RF spectrum due to optimized parallel and series inductances. These W2H/W3H feedthru filters can actually replace discrete L/C filter networks.

### FEATURES

- Low parallel inductance provides significant noise reduction in circuits with operating frequencies up to 5GHz
- Broad frequency response with high attenuation
- High rated current – up to 2A for 0805 and up to 5A for 0612
- Small size – 0805 and 0612 case size
- Reeling in accordance with EIA-481

### MECHANICAL CHARACTERISTICS

- Available in EIA 0805 and 0612 cases
- Plated Tin over Nickel Barrier
- Packaged in Tape & Reel

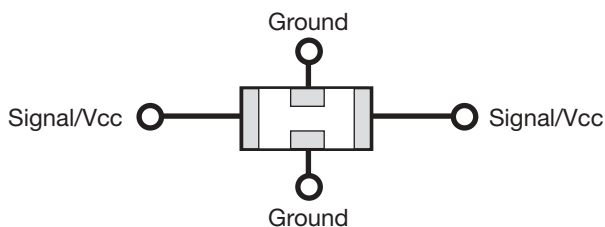
### TYPICAL APPLICATIONS

- High current power (Vcc) lines
- PA decoupling
- DC:DC converters
- Regulators
- Power supervisory circuits

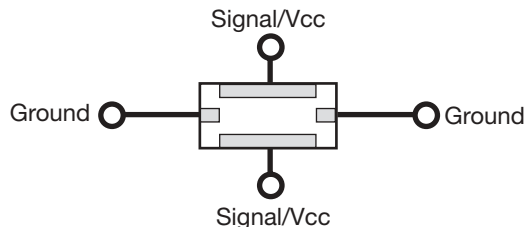
### HOW TO ORDER

<b>W2H1</b>	<b>5</b>	<b>C</b>	<b>473</b>	<b>8</b>	<b>A</b>	<b>T</b>	<b>1A</b>
<b>Size &amp; Style</b> W2H1=0805 W3H1=0612	<b>Voltage</b> 3=25v 5=50v 1=100v	<b>Dielectric</b> A=NP0 C=X7R	<b>Capacitance Code</b>	<b>Capacitance Tolerance</b> 8=+50/-20% M=±20%	<b>Failure Rate</b> A=Not Applicable	<b>Terminations</b> T=Plated Ni And Sn	<b>Packaging</b> 1A=7" Reel 4000 pcs 3A=13" Reel 4000 pcs

### PINOUT CONFIGURATION



W2H1 – 0805 Style



W3H1 – 0612 Style

# High Current Feedthru Capacitors



## W2H/W3H Series

### ELECTRICAL PARAMETERS

Insulation Resistance	1000 mOhms Minimum
DC Resistance	<150 mOhms
Operating Temperature	-55C to +125C

### CAPACITOR VALUES

Part Number	Size	Dielectric	Capacitance	Tolerance	Voltage	Current
W2H13C 104 8AT	0805	X7R	100,000pF	+50%, -20%	25V	2A
W2H15C 473 8AT	0805	X7R	47,000pF	+50%, -20%	50V	2A
W2H15C 223 8AT	0805	X7R	22,000pF	+50%, -20%	50V	1A
W2H15C 103 8AT	0805	X7R	10,000pF	+50%, -20%	50V	1A
W2H15C 102 8AT	0805	X7R	1,000pF	+50%, -20%	50V	1A
W2H11A 471 8AT	0805	NPO	470pF	+50%, -20%	100V	0.5A
W2H11A 221 8AT	0805	NPO	220pF	+50%, -20%	100V	0.5A
W2H11A 101 8AT	0805	NPO	100pF	+50%, -20%	100V	0.5A
W2H11A 470 8AT	0805	NPO	47pF	+50%, -20%	100V	0.5A
W2H11A 220 8AT	0805	NPO	22pF	+50%, -20%	100V	0.5A
W3H13C 104 8AT	0612	X7R	100,000pF	+50%, -20%	25V	up to 5A
W3H15C 473 8AT	0612	X7R	47,000pF	+50%, -20%	50V	up to 5A
W3H15C 223 8AT	0612	X7R	22,000pF	+50%, -20%	50V	up to 4A
W3H15C 103 8AT	0612	X7R	10,000pF	+50%, -20%	50V	up to 3A
W3H11A 471 8AT	0612	NPO	470pF	+50%, -20%	100V	up to 4A
W3H11A 221 8AT	0612	NPO	220pF	+50%, -20%	100V	up to 4A
W3H11A 101 8AT	0612	NPO	100pF	+50%, -20%	100V	up to 4A
W3H11A 470 8AT	0612	NPO	47pF	+50%, -20%	100V	up to 3A
W3H11A 220 8AT	0612	NPO	22pF	+50%, -20%	100V	up to 3A

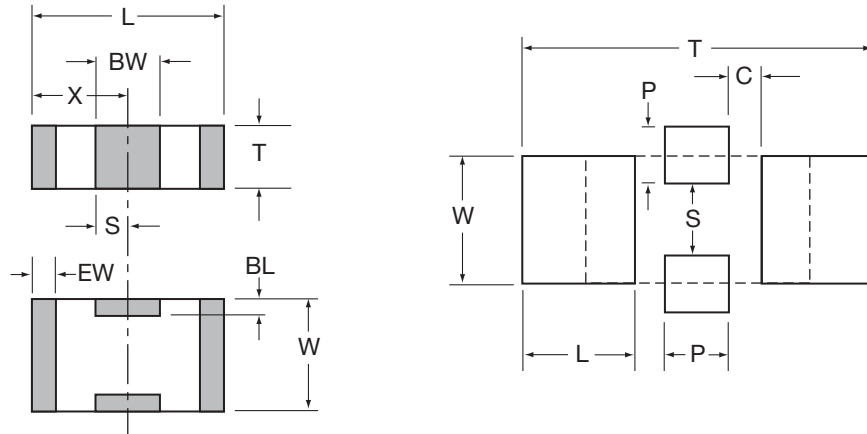


# High Current Feedthru Capacitors

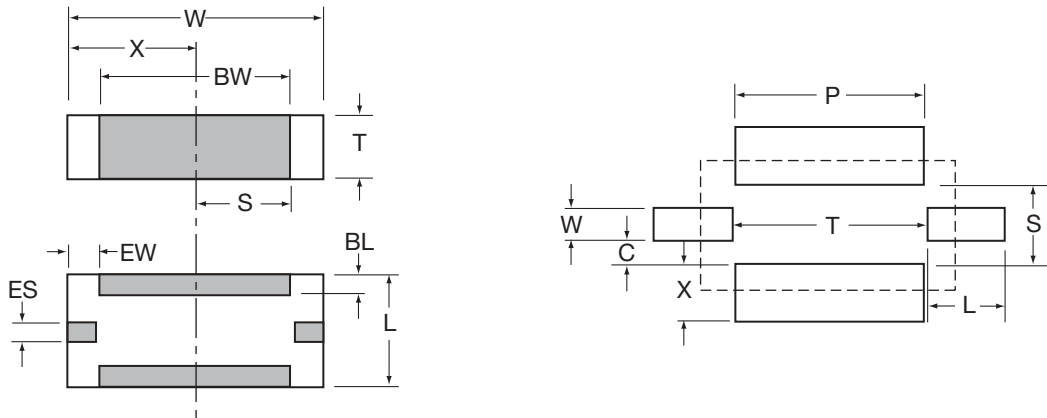


## W2H/W3H Series

### PHYSICAL DIMENSIONS AND PAD LAYOUT



W2H1 – 0805 Style



W3H1 – 0612 Style

### PHYSICAL DIMENSIONS

	L	W	T	BW	BL	ES	EW	X	S
W2H1- 0805 MM (in.)	2.01 ± 0.20 (0.079 ± 0.008)	1.25 ± 0.20 (0.049 ± 0.008)	1.14 Max. (0.045 Max.)	0.46 ± 0.10 (0.018 ± 0.004)	0.18 + 0.25 - 0.08 (0.007 + 0.010 - 0.003)	NA	0.25 ± 0.13 (0.010 ± 0.005)	1.02 ± 0.10 (0.040 ± 0.004)	0.23 ± 0.05 (0.009 ± 0.002)
W3H1- 0612 MM (in.)	1.60 ± 0.20 (0.063 ± 0.008)	3.20 ± 0.20 (0.126 ± 0.008)	1.22 Max. (0.048 Max.)	2.80 ± .127 (0.110 ± 0.005)	0.18 + 0.25 - 0.08 (0.007 + 0.010 - 0.003)	0.41 ± 0.10 (0.016 ± 0.004)	0.41 ± 0.10 (0.016 ± 0.004)	1.60 ± 0.10 (0.063 ± 0.004)	1.40 ± 0.07 (0.055 ± 0.003)

### PAD DIMENSIONS

	T	P	S	W	L	C	X
W2H1- 0805 MM (in.)	3.45 (0.136)	0.51 (0.020)	0.76 (0.030)	1.27 (0.050)	1.02 (0.040)	0.46 (0.018)	NA
W3H1- 0612 MM (in.)	2.54 (0.100)	3.05 (0.120)	1.12 (0.044)	.460 (0.018)	.610 (0.024)	.330 (0.013)	.710 (0.028)

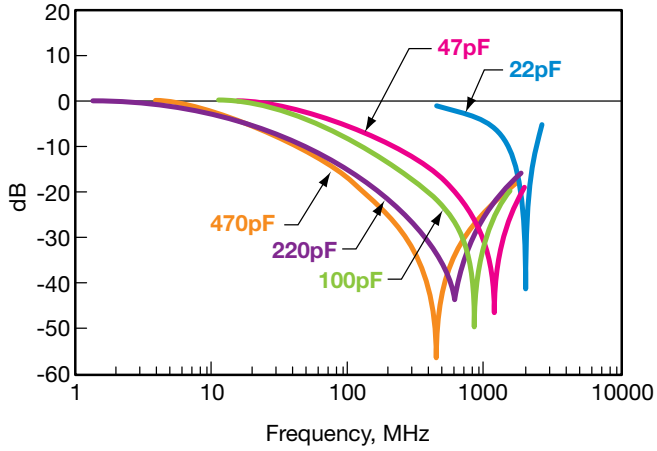
# High Current Feedthru Capacitors



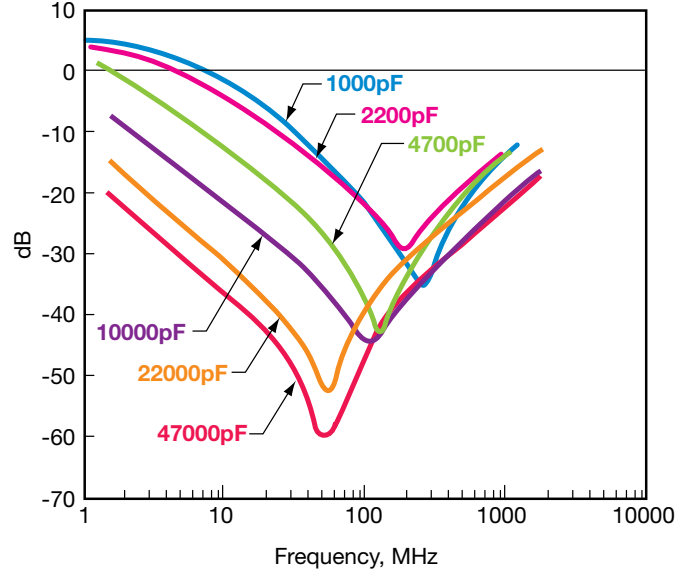
## W2H/W3H Series

### TYPICAL S21 PERFORMANCE

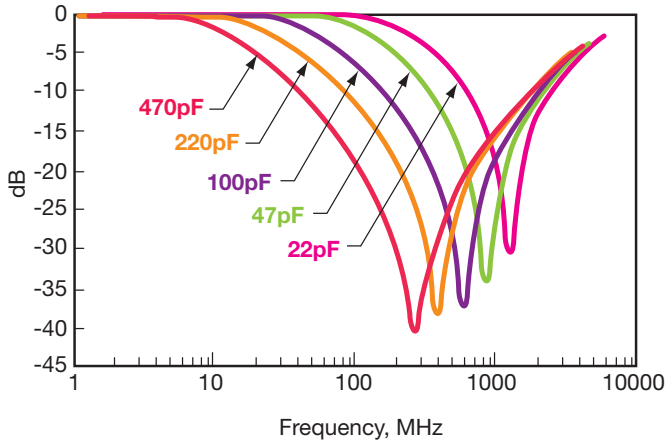
0805 NP0



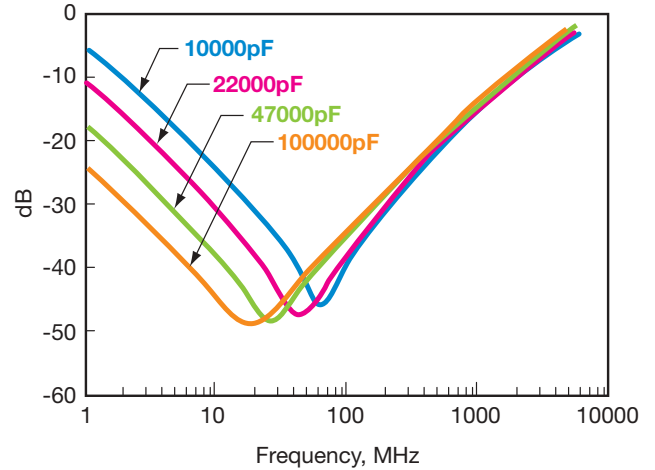
0805 X7R



0612 NP0



0612 X7R



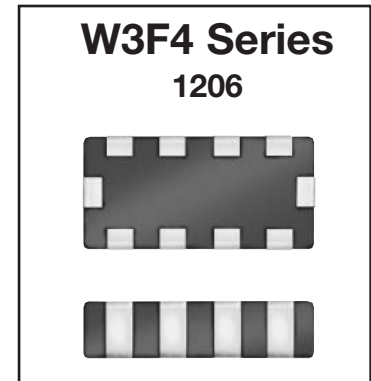
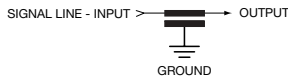
# Feedthru 0805/1206 Capacitors



## W3F4 Series - 4 Element 1206 Feedthru Array

### GENERAL DESCRIPTION

The Feedthru Capacitor Array contains four elements with a common ground connection. This makes them an ideal choice for Multi-line designs needing EMI suppression, broadband I/O filtering or Vcc power line conditioning. Additional benefits are reduced component count and PCB space savings. The unique construction provides low parallel inductance and offers excellent decoupling capability for all high di/dt environments. It provides significant noise reduction in digital circuits to <5 GHz. A number of capacitor values are available in NP0 and X7R ceramic dielectrics.



### CAPACITOR VALUES

Part Number	Size	Voltage	Dielectric	Capacitance
W3F41A 220 8ATxx	1206	100V	NP0	22pF
W3F41A 470 8ATxx	1206	100V	NP0	47pF
W3F41A 101 8ATxx	1206	100V	NP0	100pF
W3F45C 221 8ATxx	1206	50V	X7R	220pF
W3F45C 471 8ATxx	1206	50V	X7R	470pF

### PERFORMANCE CHARACTERISTICS

	NP0	X7R
Capacitance Tolerance	+50%, -20%	+50%, -20%
Voltage Rating	100V	50V
Current Rating	300mA	300mA
Insulation Resistance	1000MΩ	1000MΩ
DC Resistance	<0.6Ω	<0.6Ω
Operating Temperature Range	-55 to +125°C	

### HOW TO ORDER

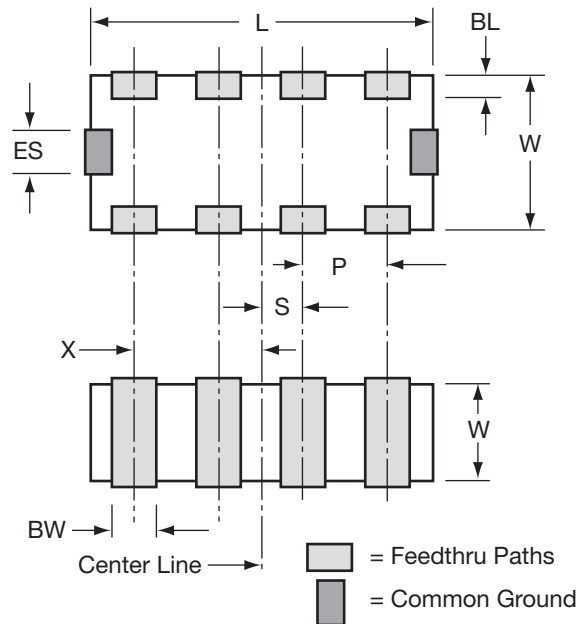
<b>W</b>	<b>3</b>	<b>F</b>	<b>4</b>	<b>5</b>	<b>C</b>	<b>223</b>	<b>8</b>	<b>A</b>	<b>T</b>	<b>3</b>	<b>A</b>
<b>Style</b>	<b>Size</b>	<b>Feedthru</b>	<b>Number of Elements</b>	<b>Voltage*</b>	<b>Dielectric</b>	<b>Capacitance Code</b>	<b>Capacitance Tolerance</b>	<b>Failure Rate</b>	<b>Terminations</b>	<b>Packaging Code (Reel Size)</b>	<b>Quantity Code (Pcs./Reel)</b>
	2=0805 3=1206			1=100v 5=50v	A=NP0 C=X7R		8=+50/-20%	A=Not Applicable	T=Plated	1=7" Reel Embossed Tape 3=13" Reel Embossed Tape	F=1,000 A=2,000, 4,000 or 10,000

\*Note: NP0 available in 100V only and X7R available in 50V only.

# Feedthru 0805/1206 Capacitors



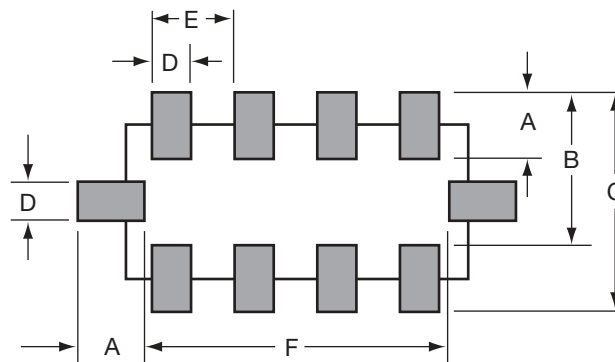
## W3F4 Series - 4 Element 1206 Feedthru Array



### DIMENSIONS

millimeters (inches)

L	W	T	BW	BL	P	X	S	ES
3.25±0.15 (0.128±0.006)	1.60±0.20 (0.063±0.008)	1.22 max (0.048 max)	0.41±0.10 (0.016±0.004)	0.18 <sup>+0.25</sup> <sub>-0.08</sub> (0.007 <sup>+0.010</sup> <sub>-0.003</sub> )	0.76 ref. (0.030 ref.)	1.14±0.10 (0.045±0.004)	0.38±0.10 (0.015±0.004)	0.41±0.10 (0.016±0.004)



### PAD LAYOUT DIMENSIONS

	A	B	C	D	E	F
mm	0.6	1.6	2.2	0.35	0.76	2.6
Inches	(0.024)	(0.064)	(0.088)	(0.014)	(0.030)	(0.104)

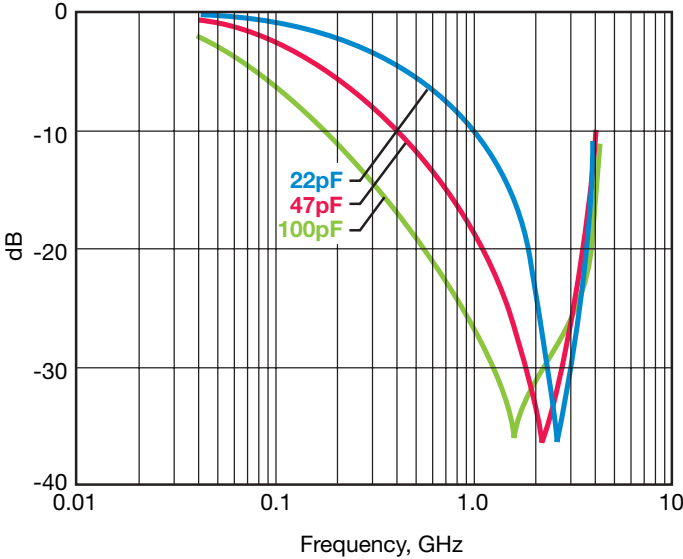
# Feedthru 0805/1206 Capacitors



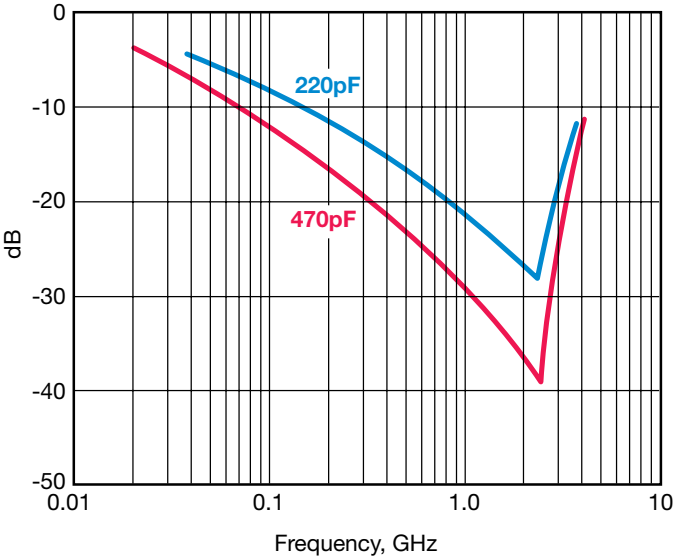
## W3F4 Series - 4 Element 1206 Feedthru Array

### PERFORMANCE CHARACTERISTICS

S21 vs. Frequency  
NP0 4 Element Feedthru



S21 vs. Frequency  
X7R 4 Element Feedthru



# Applications

### APPLICATIONS

EMI Suppression  
Broadband I/O Filtering  
Vcc Line Conditioning

### FEATURES

Standard EIA Sizes  
Broad Frequency Response  
Low ESR  
8 mm Tape and Reel

### MARKET SEGMENTS

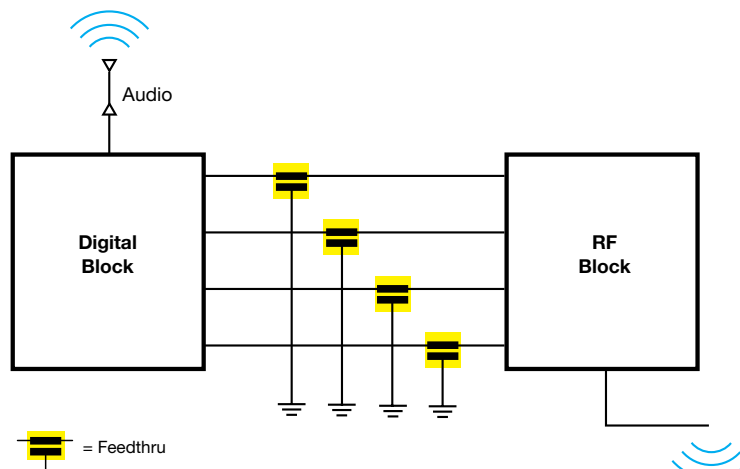
Computers  
Automotive  
Power Supplies  
Multimedia Add-On Cards  
Bar Code Scanners and Remote Terminals  
PCMCIA Cards  
Medical Instrumentation  
Test Equipment  
Transceivers/Cell Phones

# Typical Circuits Requiring EMI Filtering

THE FOLLOWING APPLICATIONS AND SCHEMATIC DIAGRAMS SHOW WHERE FEEDTHRU CAPACITORS MIGHT BE USED FOR EMI SUPPRESSION

- Digital to RF Interface Filtering
- Voltage Conditioning in RF Amplifiers
- Power Decoupling GaAs FET Transistor Preamp
- Vcc Line Filtering on Frequency Control Circuit
- Clock, Data, Control Line High Frequency Decoupling (Frequency Synthesizer)  
(SEE APPLICATION NOTES)

### DIGITAL TO RF INTERFACE FILTERING

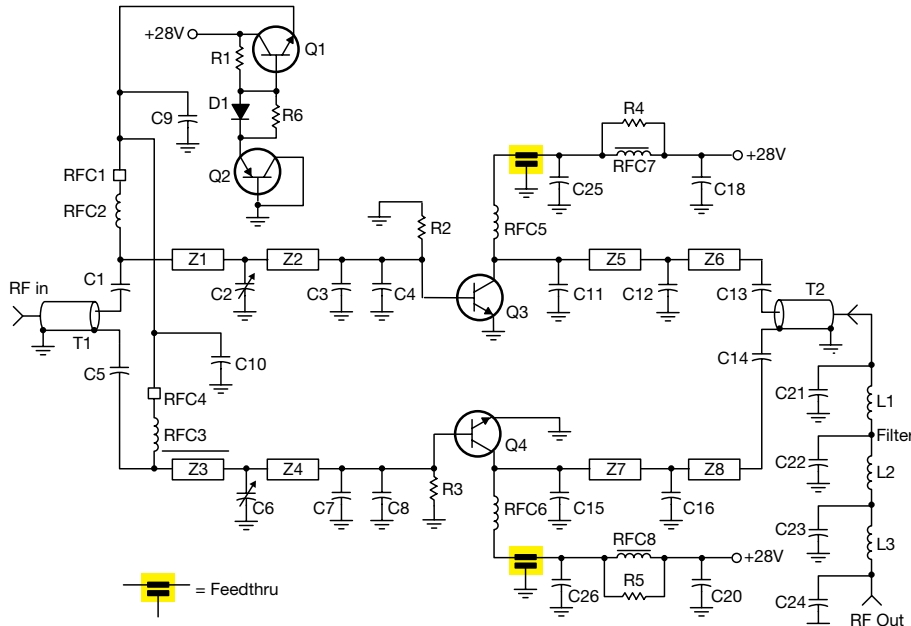


# Feedthru 0805/1206 Capacitors

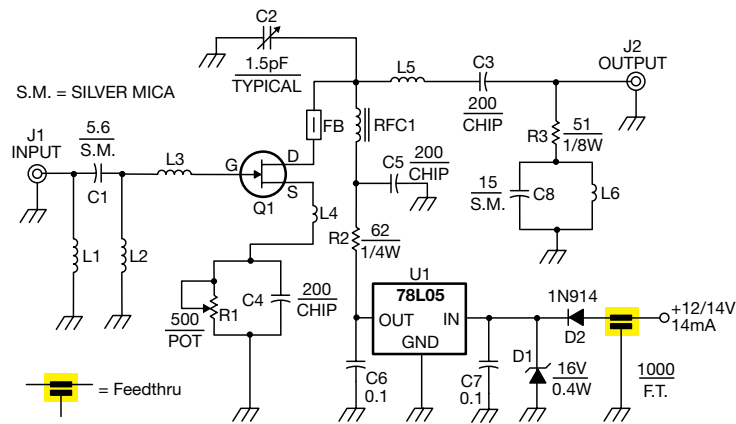


## W2F/W3F Series

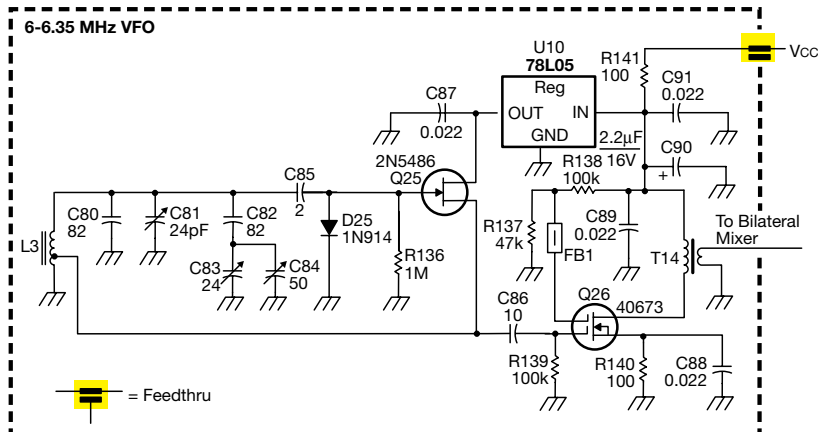
### VOLTAGE CONDITIONING IN RF AMPLIFIERS



### POWER DECOUPLING GaAs FET TRANSISTOR PREAMPLIFIER



### Vcc LINE FILTERING ON FREQUENCY CONTROL CIRCUIT



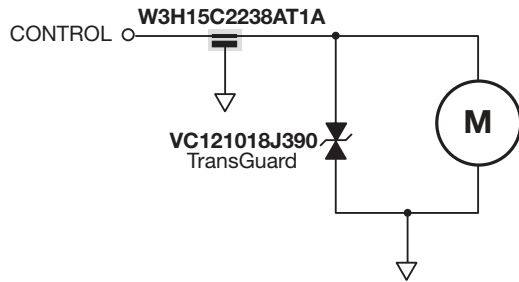
# High Current Feedthru Capacitors



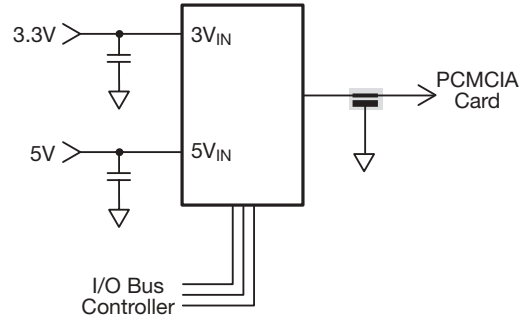
## W2H/W3H Series

### APPLICATIONS

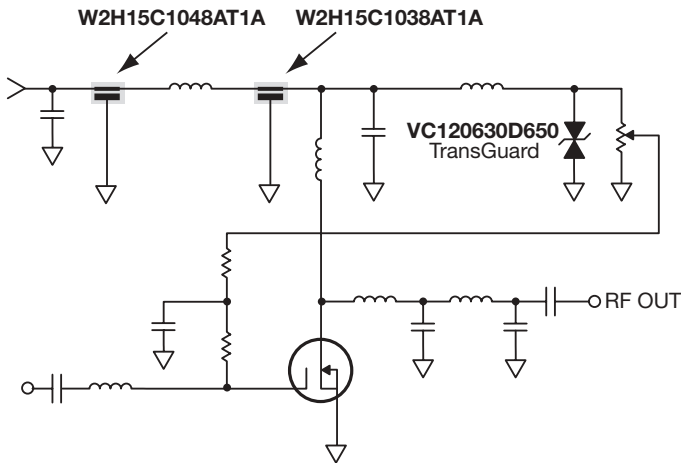
#### Vcc Filtering



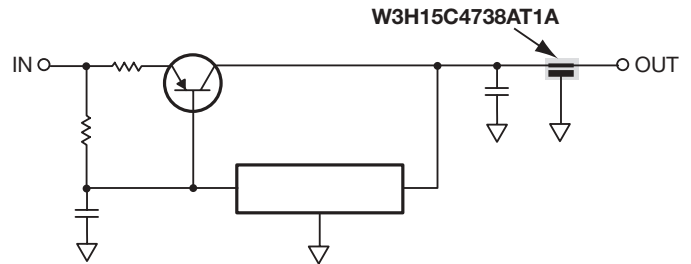
#### Dual Power Switch Filtering



#### PA Filtering



#### Regulator Filtering





# Feedthru 0805/1206 Capacitors



## W2F/W3F/W3F4 Series

### EMI REDUCTION THROUGH THE USE OF SMT FEEDTHRU CAPACITORS

#### ABSTRACT

Today's high speed, miniaturized semiconductors have made EMI issues a key design consideration. This paper briefly defines EMI and illustrates the capability of SMT feedthru capacitors.

#### WHAT IS EMI?

The term EMI stands for Electromagnetic Interference and refers to signals/energy interfering with a circuit or systems functions.

In an electronic system, two classes of energy are generated - wanted and unwanted. Both are potential sources of EMI<sup>(1)</sup>.

Wanted signals such as clocks and bus lines could cause EMI if they were not decoupled, terminated or filtered properly. Unwanted signals (cell phones, police radios, power supply noise, etc.) could be conducted or radiated into the circuit due to poor circuit layout, improper decoupling or a lack of high frequency filtering.

In either type of EMI signal interference, the system could be rendered useless or put into a state which would cause early failure of its semiconductors. Even worse, the unwanted energy could cause an incorrect answer to be generated from a computer by randomly powering a gate up or down.

From all of this we can gather that EMI is a complex problem, usually with no one solution. EMI interference can be a random single shot noise (like a SCR firing) or repetitive in nature (stepper motor or relay noise). The interference can enter into our designs either by being induced by E/B fields, or it can be conducted through control lines or a communication bus. EMI can even be self generated by internal components that generate steep risetime waveforms of voltage or current.

#### HOW CAN EMI BE CONTROLLED?

EMI is most efficiently controlled by realizing it to be a design parameter in the earliest stages of the design. This way, the board layout can be optimized with large power and ground planes which will be low impedance in nature. The use of SMT feedthru filters will yield optimal results.

#### SMT FEEDTHRU CAPACITORS

AVX introduced feedthru capacitors to supply a broadband EMI filter capacitor for source suppression and receiver noise reduction.

SMT feedthru capacitors use the same material systems as standard ceramic capacitors. They exhibit the same reliabili-

ty and can be processed in the same end user production methods as standard capacitors. What feedthru capacitors offer is an optimized frequency response across a wide RF spectrum due to a modified internal electrode design.

An application comparison between an SMT feedthru and a discrete capacitor is shown in Figure 1.

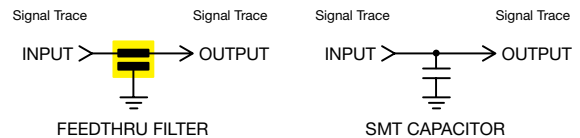


Figure 1. Comparison of Feedthru Capacitors to Discrete Capacitors

The key difference between the two filtering methods is that the feedthru has a much lower inductance between the signal line and ground than the capacitor. The difference in inductances can be in the range of roughly one order magnitude with a feedthru capacitor. This inductance can be shown in an electrical sense through the model for a feedthru and a capacitor (Figure 2).

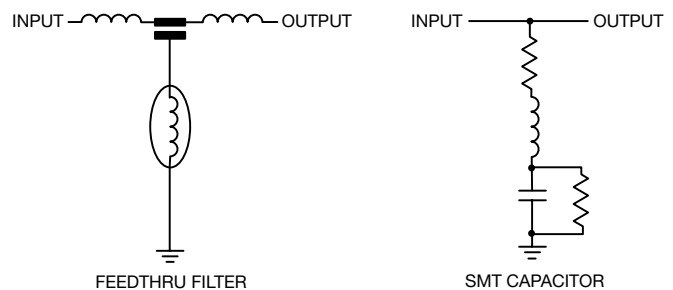


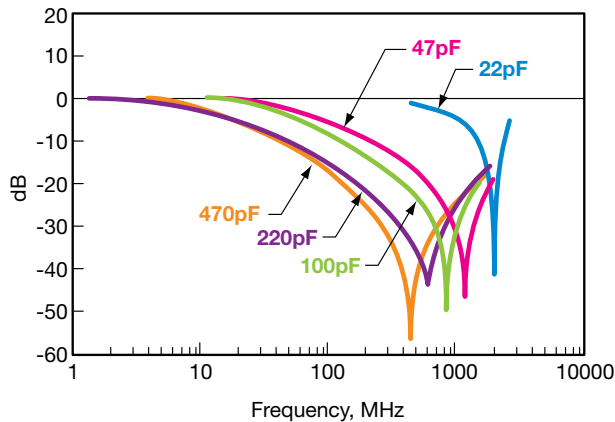
Figure 2. Comparison of Feedthru Capacitors to Discrete Capacitors

The feedthru capacitor has a minimized parallel inductance and an optimal series inductance (which broadens the frequency response curve). Typical attenuation graphs are shown in Figure 3A.

These curves demonstrate feedthru capacitors advantage of a broad frequency response with high attenuation. They also serve as a comparison to the inductance of even lower inductance devices (primarily used in extreme decoupling cases and switch mode power supplies) - see Figure 3B.

(1)Practical Design for Electromagnetic Compatibility edited by Rocco F. Ficchi Hayden Book Company 1978

0805 - dB vs. Frequency  
NP0



1206 - dB vs. Frequency  
X7R

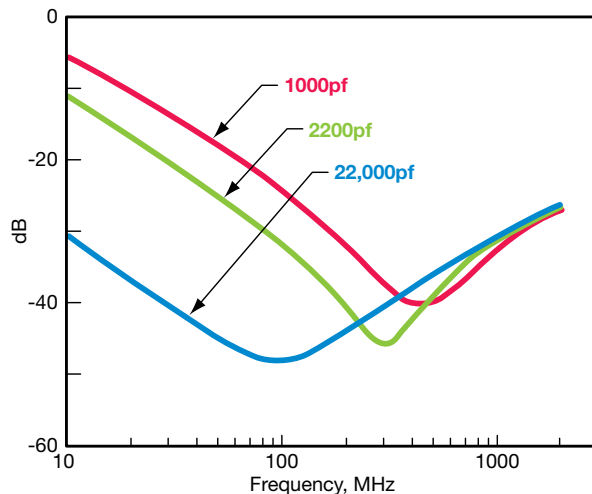


Figure 3A. Feedthru Capacitor Attenuation Graphs  
(Forward Transmission Characteristic - S21)

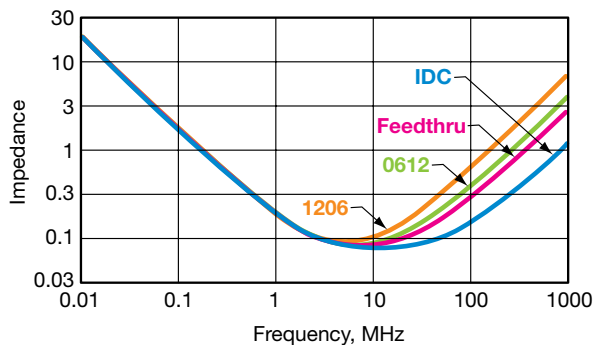


Figure 3B. Comparison of SMT Capacitor  
Frequency Response to Feedthru Filters

## SMT FEEDTHRU CAPACITOR TERMINOLOGY

AVX's feedthru capacitors have additional technical terminologies relative to standard ceramic capacitors. The reason for this is due to the series manner in which the feedthru element is connected to the circuit.

The most important term is DC Resistance. The DC resistance of the feedthru is specified since it causes a minor signal attenuation which designers can calculate by knowing the maximum resistance of the part.

The maximum current capability of the part is also of interest to designers since the feedthru may be placed in series with the voltage line.

## APPLICATION AND SELECTION OF SMT FEEDTHRU CAPACITOR FILTERS

EMI suppression and receiver noise reduction can be achieved most effectively with efficient filtering methods. Attenuations of over 100 dB are achievable depending on the complexity and size of the filters involved.

However, before filtering is discussed, another EMI reduction method is noise limiting, using a series element (inductors or resistors). This method is easy to implement and inexpensive. The problem it poses is that it can only reduce noise by -3 to -10 dB. Because of that, series element EMI reduction is primarily used where there is a poor ground.

SMT feedthru filter capacitors can actually replace discrete L/C filter networks (depending on the frequency response needed). The SMT filter capacitors should first be chosen for its specific frequency response. Then the voltage rating, DCR, and current capability must be evaluated for circuit suitability. If there is not a match on voltage, current and DC resistance ratings, the designer must select the closest available frequency response available on parts that will meet the design's power spec.

The top 5 applications for SMT feedthru filter capacitors are:

1. Digital to RF interface filtering.
2. Control line high frequency decoupling.
3. Data and clock high frequency decoupling.
4. Power line high frequency decoupling.
5. High gain and RF amplifier filtering.

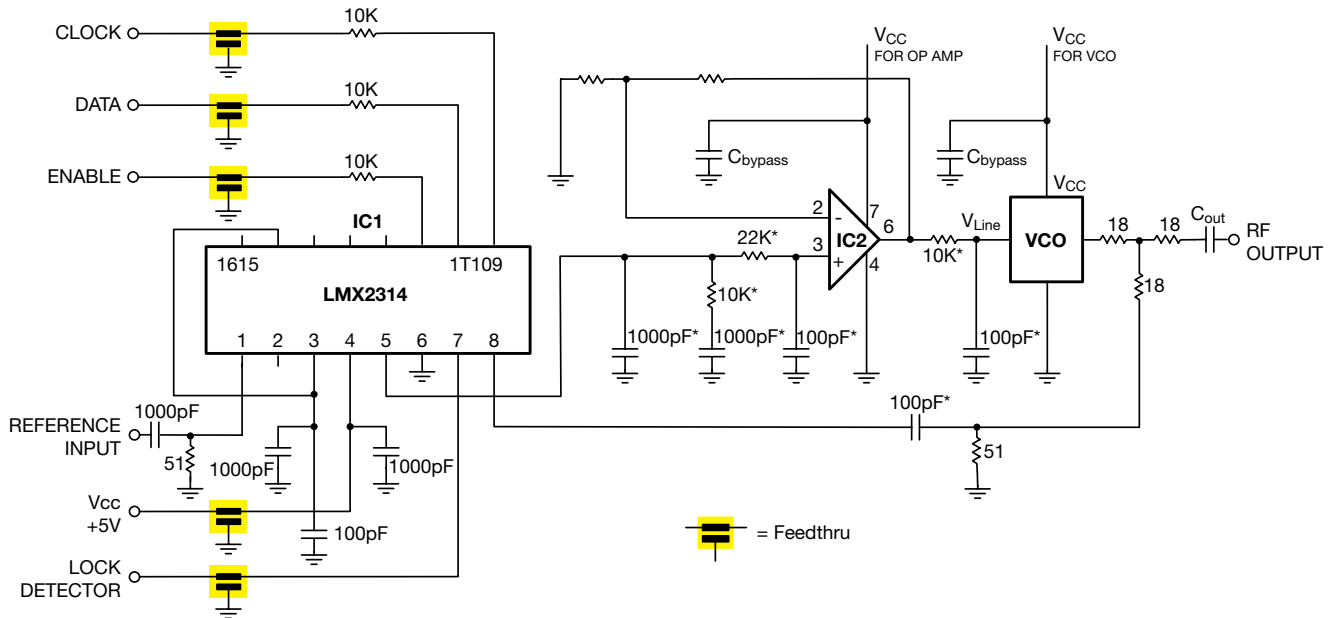
# Feedthru 0805/1206 Capacitors



## W2F/W3F/W3F4 Series

A typical example of data, clock control line and power line filtering is shown below:

### Clock, Data, Control Line High Frequency Decoupling (Frequency Synthesizer)



## CONCLUSION

EMI problems will continue to play a large role in designers priorities. AVX SMT feedthru filters are an easy way to achieve broad band EMI reduction in a small SMT package.

SMT feedthru filters can help reduce cost designs by eliminating some types of L/C filters, increasing system reliability and saving valuable PCB area. SMT feedthru filters are offered in both 0805, 1206 single element packages or in 1206 four element packages.

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