AVX Multilayer Ceramic SMD Feedthru Capacitors
Commercial, Automotive, High Current, RoHS & SnPb Termination

Version 17.5
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W2F/W3F Series, High Current W2H Series
Commercial, Automotive, High Current, RoHS & SnPb

**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. AVX FeedThru filters are AEC Q200 qualified. High reliability screening options, and SnPb termination are available for spacecraft designs.

**ELECTRICAL PARAMETERS**

<table>
<thead>
<tr>
<th>Type</th>
<th>Case Size (EIA)</th>
<th>AVX Part Number</th>
<th>Capacitance (pF)</th>
<th>Capacitance Tolerance</th>
<th>Rated DC Voltage (V)</th>
<th>Rated Current (Amps)</th>
<th>Dielectric</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Current</td>
<td>0805</td>
<td>W2H11A2208ATxx</td>
<td>L2H11A2208ABxx</td>
<td>22</td>
<td>+50%, -20%</td>
<td>100V</td>
<td>0.5</td>
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<tr>
<td></td>
<td>0805</td>
<td>W2H11A4708ATxx</td>
<td>L2H11A4708ABxx</td>
<td>47</td>
<td>+50%, -20%</td>
<td>100V</td>
<td>0.5</td>
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<td></td>
<td>0805</td>
<td>W2H11A1018ATxx</td>
<td>L2H11A1018ABxx</td>
<td>100</td>
<td>+50%, -20%</td>
<td>100V</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>0805</td>
<td>W2H11A2218ATxx</td>
<td>L2H11A2218ABxx</td>
<td>220</td>
<td>+50%, -20%</td>
<td>100V</td>
<td>0.5</td>
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<tr>
<td></td>
<td>0805</td>
<td>W2H11A4718ATxx</td>
<td>L2H11A4718ABxx</td>
<td>470</td>
<td>+50%, -20%</td>
<td>100V</td>
<td>0.5</td>
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<tr>
<td></td>
<td>0805</td>
<td>W2H15C1028ATxx</td>
<td>L2H15C1028ABxx</td>
<td>1000</td>
<td>+50%, -20%</td>
<td>50V</td>
<td>1.0</td>
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<tr>
<td></td>
<td>0805</td>
<td>W2H15C1038ATxx</td>
<td>L2H15C1038ABxx</td>
<td>1000</td>
<td>+50%, -20%</td>
<td>50V</td>
<td>1.0</td>
</tr>
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<td></td>
<td>0805</td>
<td>W2H15C2238ATxx</td>
<td>L2H15C2238ABxx</td>
<td>2200</td>
<td>+50%, -20%</td>
<td>50V</td>
<td>1.0</td>
</tr>
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<td></td>
<td>0805</td>
<td>W2H15C4738ATxx</td>
<td>L2H15C4738ABxx</td>
<td>47000</td>
<td>+50%, -20%</td>
<td>50V</td>
<td>2.0</td>
</tr>
</tbody>
</table>

**HOW TO ORDER**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>High Current</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation Resistance (Min.)</td>
<td>1000 MΩ</td>
<td>1000 MΩ</td>
</tr>
<tr>
<td>DC Resistance</td>
<td>&lt;0.15 Ω</td>
<td>&lt;0.60 Ω</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-55°C to +125°C</td>
<td></td>
</tr>
</tbody>
</table>

032619
**Feedthru 0805/1206 Capacitors**

*W2F/W3F Series, High Current W2H Series*

*Commercial, Automotive, High Current, RoHS & SnPb*

**DIMENSIONS**

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

**RECOMMENDED SOLDER PAD LAYOUT (TYPICAL DIMENSIONS)**

<table>
<thead>
<tr>
<th></th>
<th>T (in.)</th>
<th>P (in.)</th>
<th>S (in.)</th>
<th>W (in.)</th>
<th>L (in.)</th>
<th>C (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0805 MM</td>
<td>3.45 (0.136)</td>
<td>0.51 (0.020)</td>
<td>0.76 (0.030)</td>
<td>1.27 (0.050)</td>
<td>1.02 (0.040)</td>
<td>0.46 (0.016)</td>
</tr>
<tr>
<td>1206 MM</td>
<td>4.54 (0.179)</td>
<td>0.94 (0.037)</td>
<td>1.02 (0.040)</td>
<td>1.65 (0.065)</td>
<td>1.09 (0.043)</td>
<td>0.71 (0.028)</td>
</tr>
</tbody>
</table>

**TYPICAL FEEDTHRU CHIP CAP CONNECTION**

**Physical Layout - A**

Feedthru Chip Component Model

Vcc or Signal In

Vcc or Signal Out

Ground

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, High Current W2H Series
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PERFORMANCE CHARACTERISTICS

**S21 0805 – 100V**

![Graph of S21 0805 – 100V](image)

**IMPEDEANCE 0805 – 100V**

![Graph of Impedance 0805 – 100V](image)

**S21 1206 – 100V**

![Graph of S21 1206 – 100V](image)

**IMPEDEANCE 1206 – 100V**

![Graph of Impedance 1206 – 100V](image)

**S21 1206 – 50V**

![Graph of S21 1206 – 50V](image)

**IMPEDEANCE 1206 – 50V**

![Graph of Impedance 1206 – 50V](image)

Feedthru 0805/1206 Capacitors
W2F/W3F Series, High Current W2H Series
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PERFORMANCE CHARACTERISTICS

0805 NP0
Current vs. Temperature

0805 X7R
Current vs. Temperature

1206 NP0
Current vs. Temperature

1206 X7R
Current vs. Temperature

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Feedthru 0805/1206 Capacitors
W2F/W3F Series

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 Preamplifier
- Vcc Line Filtering on Frequency Control Circuit
- Clock, Data, Control Line High Frequency Decoupling (Frequency Synthesizer)
(SEE APPLICATION NOTES)

DIGITAL TO RF INTERFACE FILTERING

[Diagram of digital to RF interface filtering circuit]

= Feedthru
Applications:

**Dual Power Switch Filtering**

3.3V

5V

I/O Bus Controller

\[ 3\text{V}_{\text{IN}} \rightarrow \text{PCMCIA Card} \]

**PA Filtering**

W2H15C1048AT1A  W2H15C1038AT1A  VC120630D650

TransGuard

RF OUT
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(1). 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 reliability 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.

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).

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
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.