Replacing Feedthrough Capacitors with X2Y® Technology

Summary

Application Note #2003 RF Filtering for Audio Amplifier Circuits and other publications have highlighted the benefits of X2Y® Technology over feedthrough chip capacitors. This application note is a practical guide for design engineers to implement the X2Y® Technology in bypass to replaces two feedthrough capacitors. Additionally, an alternative bypass configuration for the X2Y® Technology is also shown for filtering single traces or when trying to "retro-fit" the X2Y® Technology.

Chip Feedthrough Capacitors

The important subtleties between feedthrough chip capacitors and the X2Y® Technology will be highlighted by showing how both products are implemented in a circuit. Figure 1 presents a schematic, layout, and implementation of a single feedthrough chip capacitor. Notice that the PWR trace is broken. This results in the following two effects: 1) it places the feedthrough capacitor in series with the trace and 2) current is forced "thru" the part adding DC resistance.

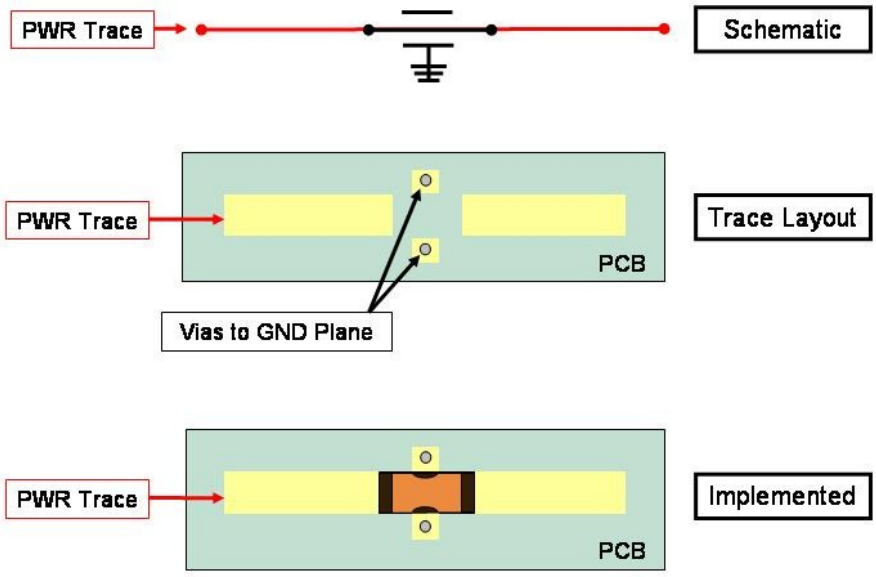

Figure 1. *Schematic, layout, and implementation of a single feedthrough chip capacitor*.

Due to its internal electrode design, individual feedthrough chip capacitors are required for each individual trace, as shown in Figure 2 and Figure 3, which increases layout area, complexity and cost.

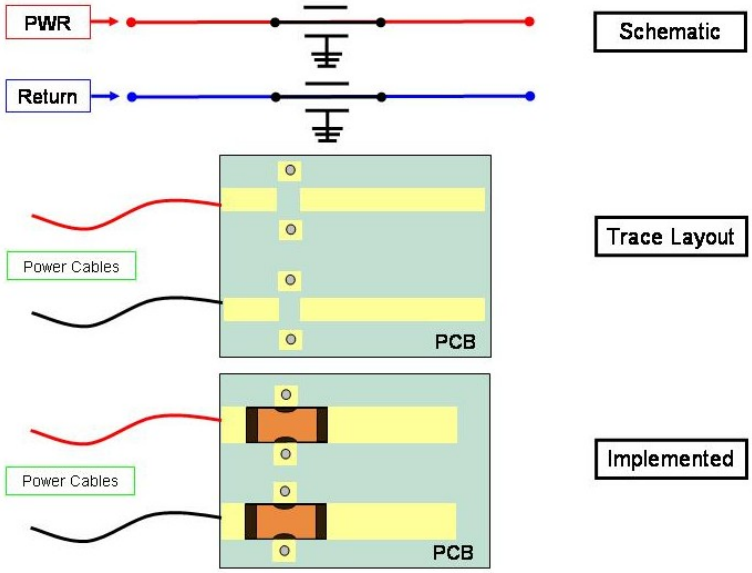

Figure 2. *Schematic, layout, and implementation of two feedthrough chip capacitors between a power and return trace.*

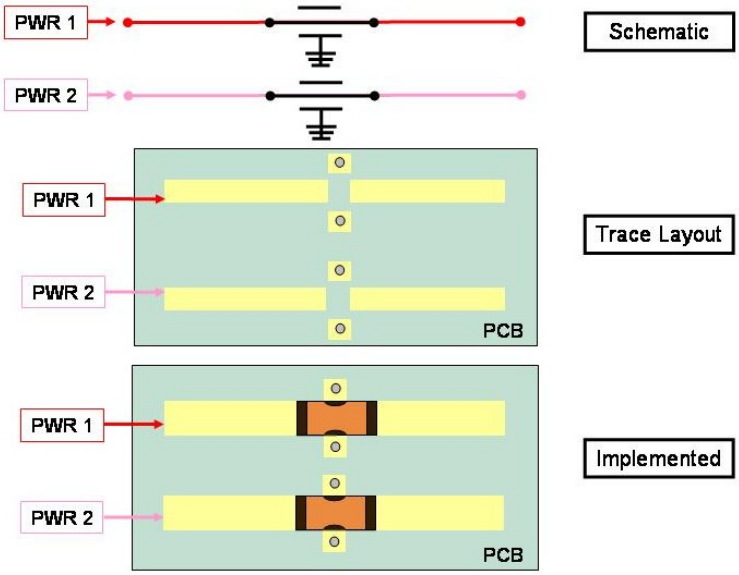

Figure 3. *Schematic, layout, and implementation of two feedthrough chip capacitors between two different power traces.*

When matching capacitive values of 10% or less are required for feedthrough capacitors applications, manufactures have to sort which adds additional cost.

Implementing X2Y® Technology

The preferred X2Y® attachment configuration is Circuit 1 (Figure 4 & Figure 5). Circuit 1 utilizes the X2Y® Technology to replace two feedthrough capacitors with one X2Y® component. To implement X2Y®, a single component is placed between the two traces in bypass. It is important to realize that unlike feedthrough capacitors (series connection); the connection of an X2Y® component to the traces is in parallel.

The unique structure, connected differentially, offers a low-impedance path for noise while maintaining DC current on the traces and providing crosstalk isolation between the traces. The result is no added DC resistance.

The Circuit 1 configuration provides the maximum performance for the X2Y® structure and superior performance over feedthrough capacitors. (For more information on Circuit 1 see Application Note #1002 X2Y® Circuit 1 & Circuit 2 Configurations.)

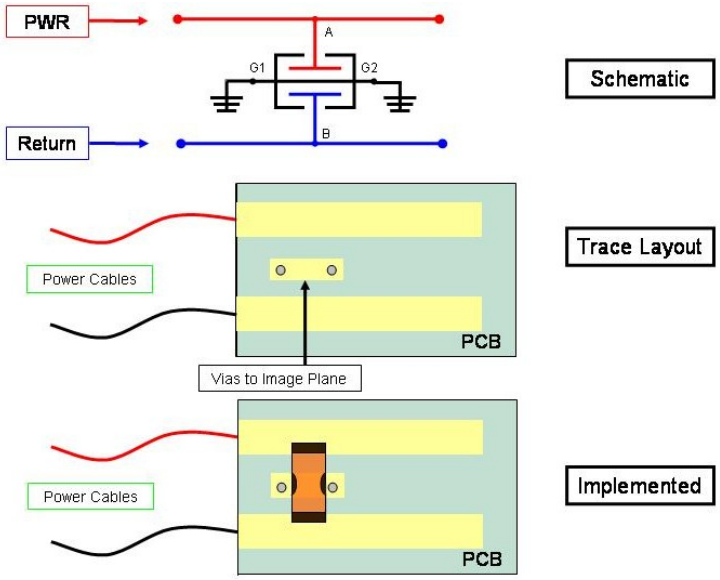

Figure 4. *CIRCUIT 1 – schematic, layout, and implementation of an X2Y® component between a power and return trace.*

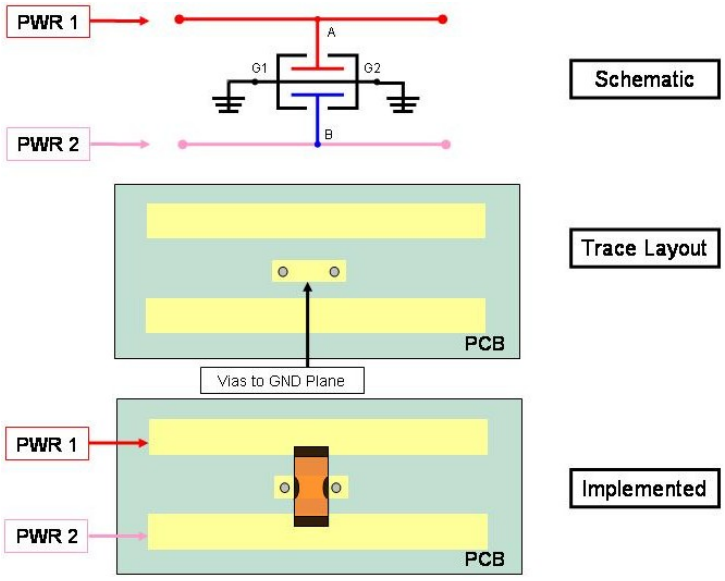

Figure 5. *CIRCUIT 1 – schematic, layout, and implementation of an X2Y® component between two power traces.*

Since the capacitive halves of the X2Y® components are geometrically symmetric and share the same substrate; capacitive values from side-to-side are 1-2% unsorted, which track over temperature and aging.

Alternative Implementation of the X2Y® Technology

An alternative to the Circuit 1 configuration is the Circuit 2 configuration (Figure 6). This configuration is recommended when a single trace requires filtering or when trying to "retro-fit" X2Y® Technology into a previous layout design with minimal changes.

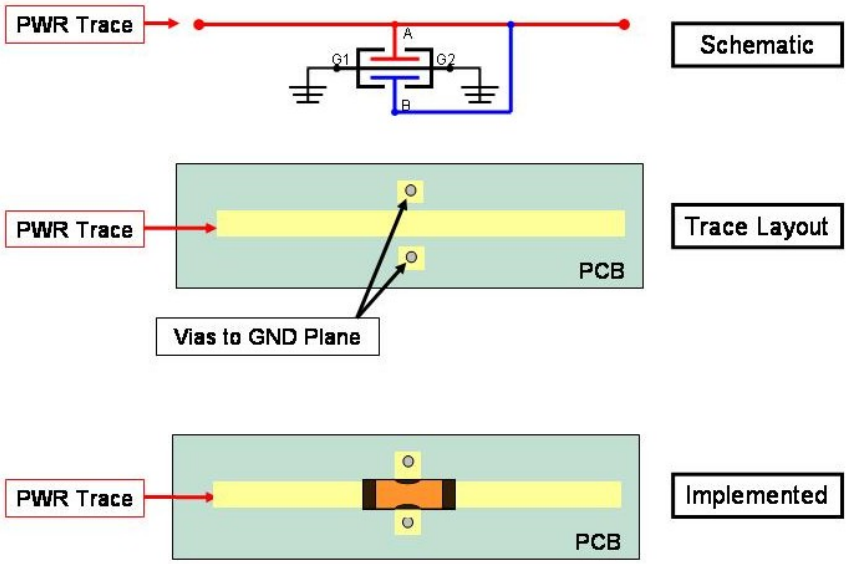

Figure 6. *CIRCUIT 2 – schematic, layout, and implementation of an X2Y® component between a power and ground trace.*

A second alternative is a modified Circuit 2 configuration when the G1/G2 is in parallel with the trace and the A/B terminals are attached to ground (Figure 7).

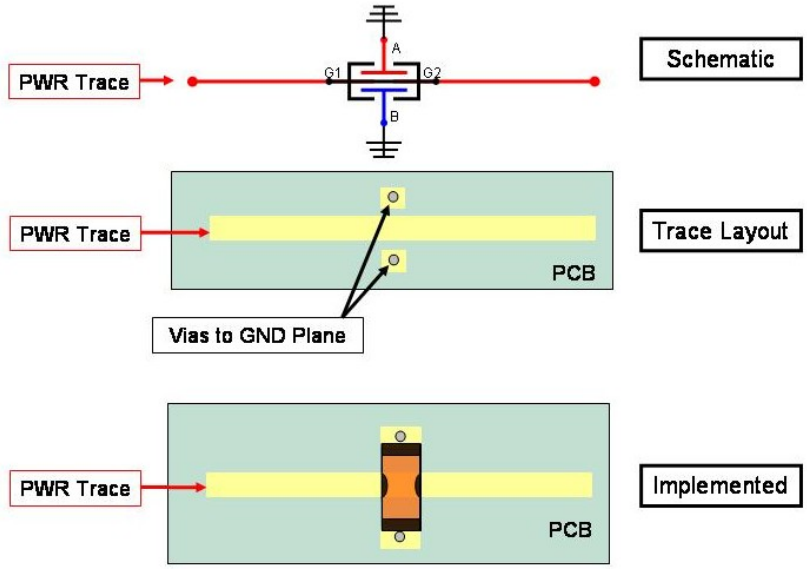

Figure 7. *CIRCUIT 2 (alternative) – schematic, layout, and implementation of an X2Y® component between a power and ground trace.*

The insertion loss measurements (performance) between Figure 6 and Figure 7 are nominal due to the symmetry of the X2Y® structure. (For more information see Application Note #3001 X2Y® Solution for Decoupling Printed Circuit Boards.)

Conclusion

For more information on using the X2Y® Technology to replace chip feedthrough capacitors, other circuit configurations and benefits, go to www.x2y.com, or use the contact information at the end of this application note for questions that are unique to your application.

Note: Performance results reported in this and other application notes can only be achieved with patented X2Y® components sourced from X2Y® licensed manufacturers or their authorized distribution channels.

Contact Information

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