DC Motor Design with X2Y® Example A

Summary

This application note is the second in a series that deal with DC motor design. The first application note (Application Note #4001 - DC Motor Design with X2Y®) provided 4 principles to follow when designing for EMC compliance. The purpose of this second application note is to show how to specifically apply those 4 principles to a design to improve EMI suppression.

For DC motors, the brush card is located around the aperture and usually holds all components needed for EMI filtering (Figure 1). The following example looks at a brush card and critiques the design from an EMC point-of-view highlighting both positive and negative features. The brush card is then mocked-up to demonstrate the results possible if all the principles are applied from Application Note #4001 - DC Motor Design with X2Y®.

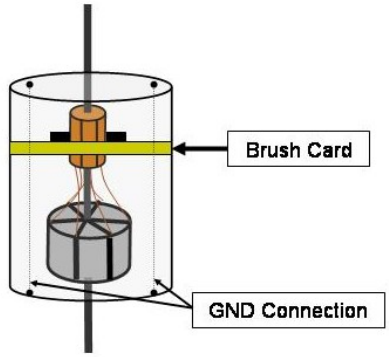

Figure 1. *General diagram of a DC motor*.

Note: All comments in this application note are referenced to Application Note #4001 - DC Motor Design with X2Y®.

Initial Brush Card

Figure 2 is the top-side of a prototype brush card assembly that has been laid out to implement an X2Y® component. The following is a highlight of positive design aspects that were used for maximum EMI suppression:

1. The power leads are located next to each other (Principle #2.E.).
2. The power leads come “thru” the board (Principle #3.B.iii.).
3. A solid trace exists to solder G1 and G2 to the board (Principle #3.B.i.).

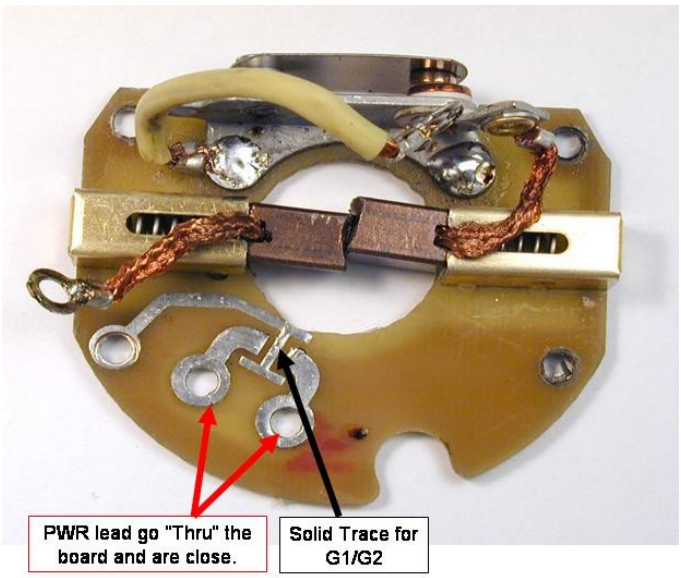

Figure 2. *Positive aspects of the design that help EMI suppression*.

Figure 3 highlights some negative aspects of the design that hinder EMI suppression. Addressing the following problems can improve EMI suppression dramatically:

1. The trace lengths should be short and wide to reduce inductance (Principle #3.B.ii.).
2. A parallel ground hierarchy should exist from the X2Y® component to the motor housing to reduce ground inductance (Principle #4). Figure 3 show that the ground trace terminates at a single point.

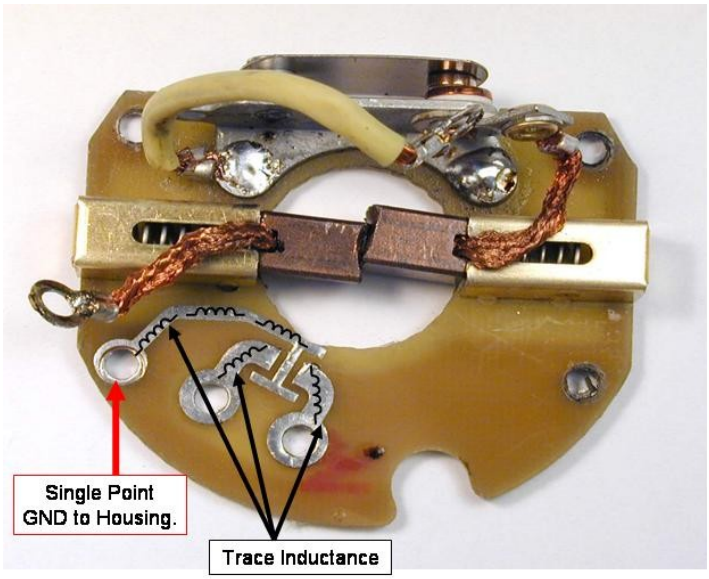

Figure 3. *Negative aspects of the design that hinder EMI suppression.*

Modified Brush Card

Figure 4 is the bottom-side of the brush card. To demonstrate maximum EMI suppression possible when all four design principles are utilized, the bottom-side was mocked-up to correct for the trace inductance and single-point ground.

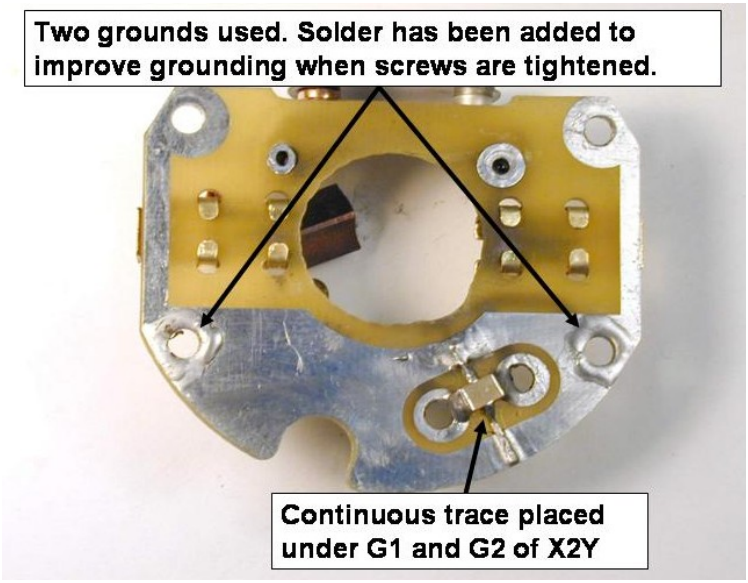

Figure 4. *Mock-up to fix design issues*.

Emission Results and Conclusion

Figure 5 is the radiated emissions results of the brush card tested in the motor. Four measurements were taken:

1. Ambient Noise.
2. The brush card with NO filtering device.
3. The brush card with an X2Y® component (single-point ground).
4. The brush card mock-up with correction for dual-point ground and trace inductance minimized.

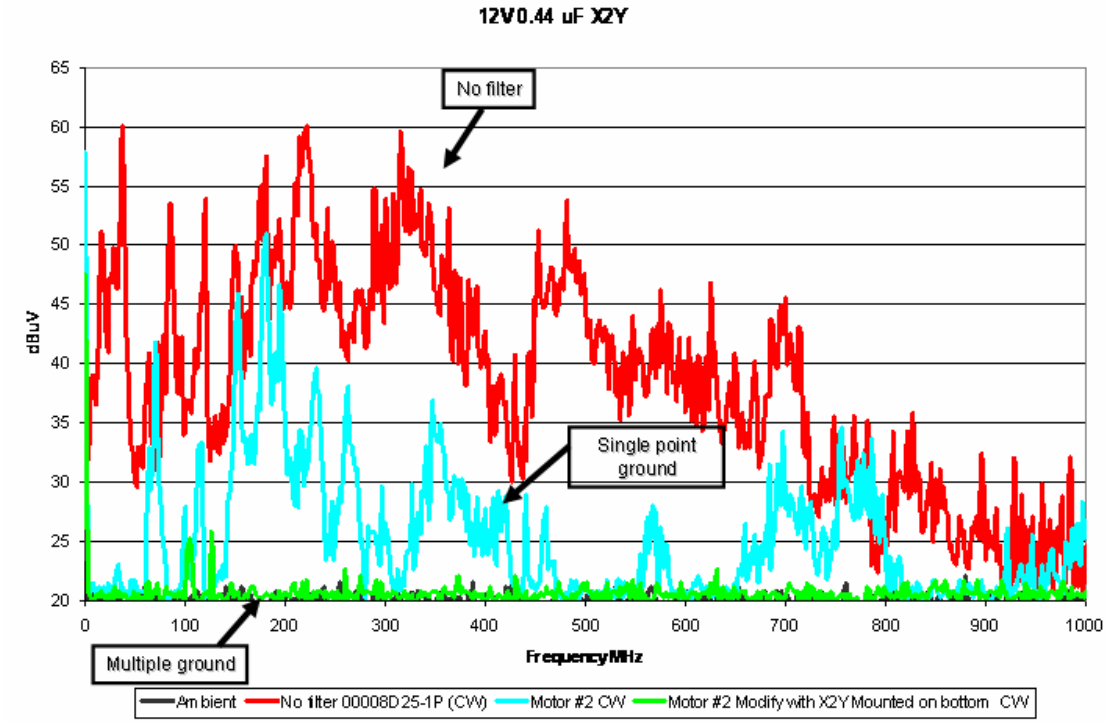

Figure 5. *Radiated emissions test results.*

The original brush card with a single-point ground was not able to filter the entire frequency spectrum. The dual-point ground provided suppression across the spectrum with results close to ambient noise.

Conclusion

When properly applied, X2Y® Technology can significantly reduce radiated emissions on DC motors. For more information on filtering DC motors and other applications go to www.x2y.com.

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

Direct inquiries and questions about this application note or X2Y® products to x2y@x2y.com or telephone:

X2Y Attenuators, LLC
2730B West 21st Street
Erie, PA 16506-2972

Phone: 814.835.8180
Fax: 814.835.9047

To visit us on the web, go to http://www.x2y.com.