

DC Resistance of PCB Ground Plane

Why using a ground plane in PCB layouts is best

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This application note compares DC resistance of a trace and of a ground plane and provides justification to use the latest in Printed Circuit Board's layouts.

Ground Main Function

All electronic circuits need to have a voltage reference called ground. A PCB may have the ground provided by traces all connected together in a star or a chain topology. These methods are used in both single- and double-layer PCBs. There are various requirements for the ground. However, an ideal ground has the following characteristics: Zero DC resistance, and Zero inductance.

Referring to the upper part of Figure 1 hereafter, and assuming a current flow of 1 A in a 1 ounce (35 μm) copper trace of 10 cm long and 0.1 cm wide, the voltage drop will be approximately 50 mV. When comparing 50 mV to the operational amplifier's V_{os} of about 1 mV, or even in a microvolt range, 50 mV can be disastrous.

If precision is required when using an analog-to-digital convertor (ADC), great consideration should be given as the last LSBs are possibly

a fraction of millivolts, and a drop of 50 mV would once again prove to be detrimental. In these cases, the ground would not provide a precise reference.

Ground Plane Is a Must

A PCB covered with copper acting as a ground plane is featured in the lower part of Figure 1. The voltage drop for 1 A is about 1 mV between two points separated by 10 cm, which is the same distance as before. We may conclude the DC resistance is 50 times lower.

Figure 2 features the test setup. To make the measurement, we injected a current of 1 A and measured the voltage drop. The voltage was measured near the injection points to avoid any error caused by the wire's DC resistance.

Conclusion

The use of ground planes would be recommended as it tends to greatly improve the performance of a circuit. Further, at high frequencies, the use of ground planes would appear to be even more important.

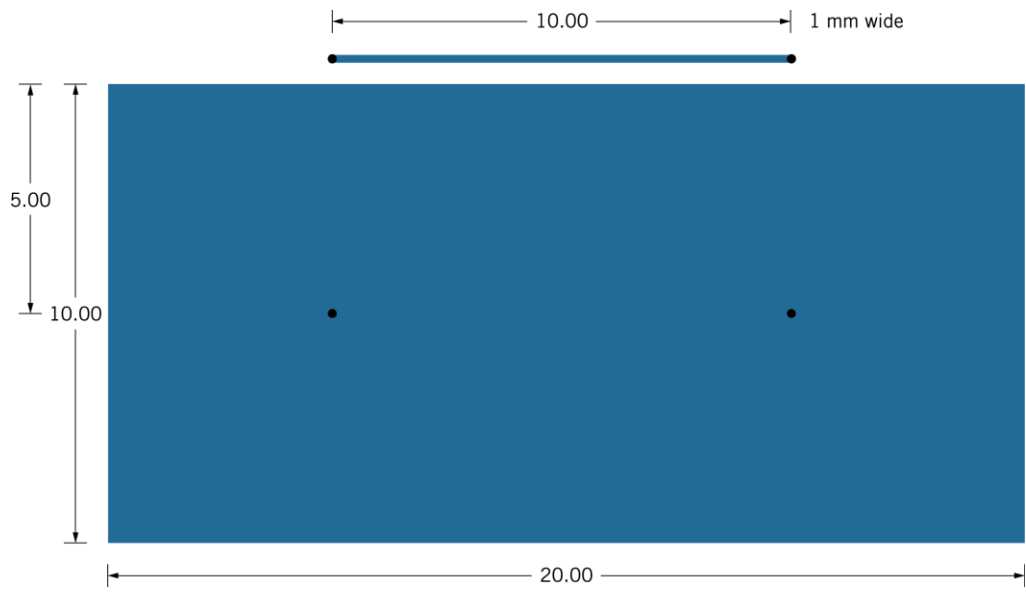


Figure 1 - Trace resistance versus ground plane resistance

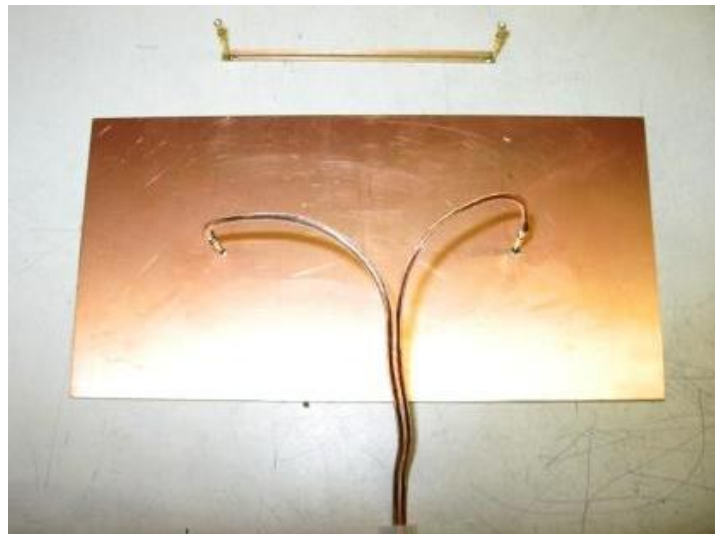


Figure 2 - Test board