

## AN200701-01A

# On the DC resistance of printed circuit board ground plane.

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### Introduction

This application note, compares DC resistance in a trace and a ground plane and provides justification to use the latest in PCB 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 topology or a chain topology. These methods are used in the single or double layer PCB.

There are various requirements for the ground;

An ideal ground has the following characteristics:

- Zero DC resistance.
- Zero inductance.

Referring to upper part of Figure 1 and assuming a current flow of 1A in a 1 once (35 $\mu$ m) copper trace of 10cm long and 0.1cm wide; the voltage drop will be about 50mV.

If you compare 50mV to operational amplifier's  $V_{os}$  of about 1mV or even in microvolt range, 50mV can be disastrous.

If you need precision using ADC, be careful, the last LSB are possibly only millivolts. A drop of 50mV is once again disastrous.

In these cases, the Ground did not provide a precise reference.

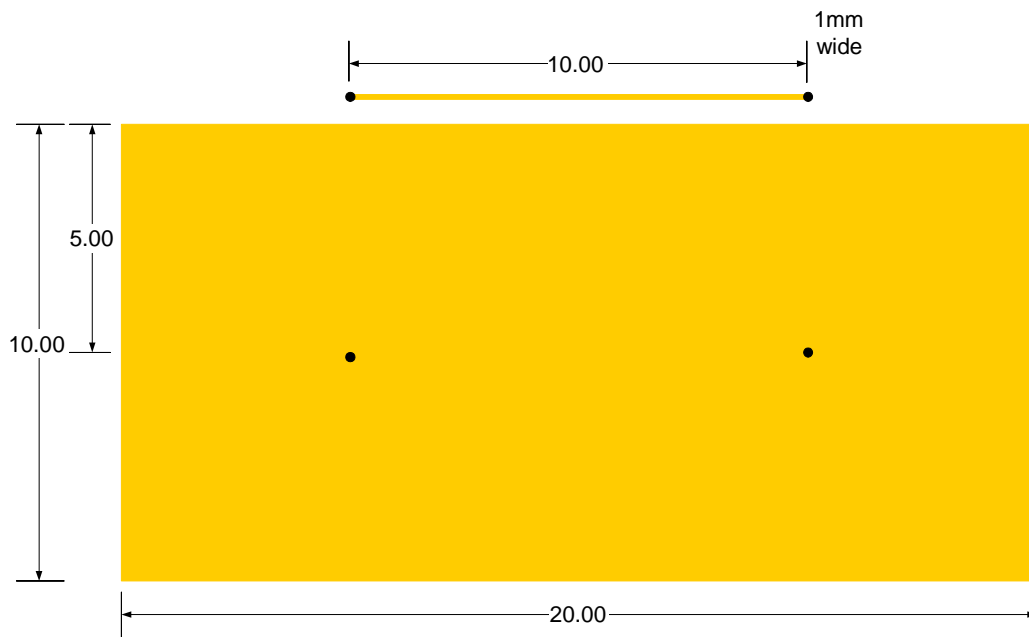
### Ground Plane is a must

Now refer to lower part of Figure 1 showing a PCB all covered with copper acting as a ground plane. The voltage drop for 1A is about 1mV between two points separated by 10 cm (the same distance as before). We may conclude the DC resistance is 50 times lower!

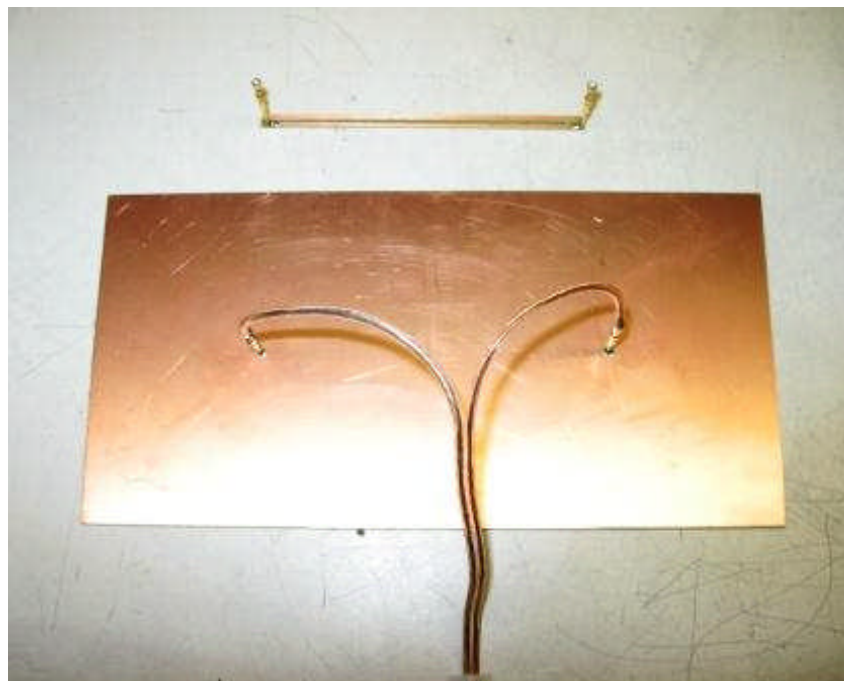
Our test setup is shown in Figure 2. To make the measurement, we have injected a current of 1A and measured the voltage drop. We measured the voltage near the injection points to avoid any error caused by the wire's DC resistance.

### Conclusion

Whenever you can use a ground plane it will really help improve your circuit's performance. At high frequencies, ground planes are even more important.



**Figure 1, Trace resistance versus ground plane resistance**



**Figure 2, Test board picture**