Lab 11 and 12:
Trace Resistance and Capacity

Elior Bilow
2025-12-01
ECEN5730 – CU Boulder

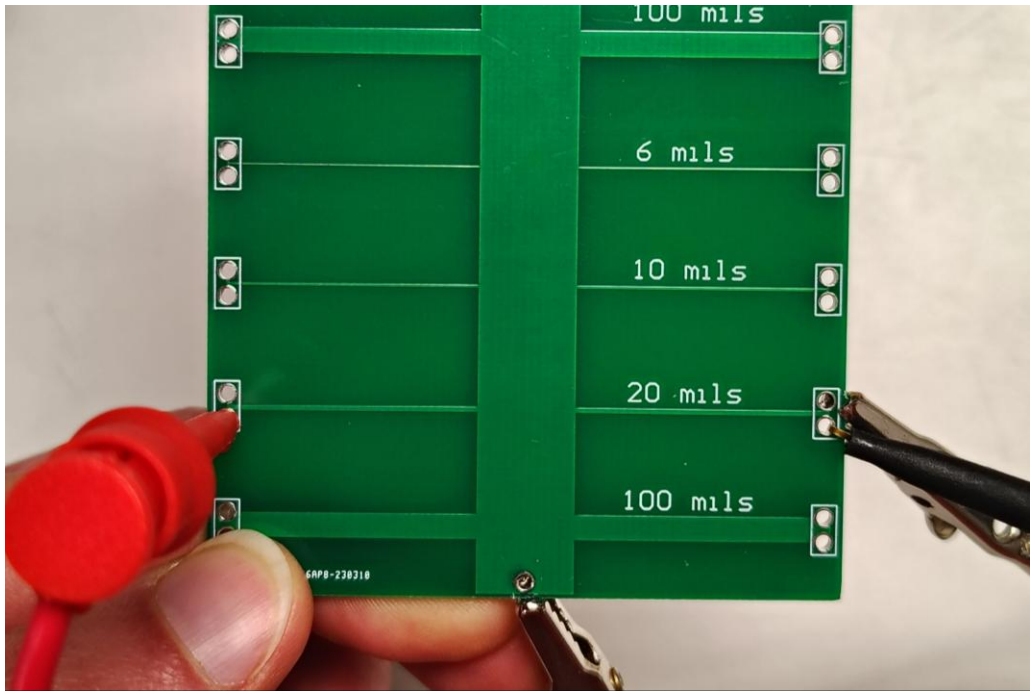

Figure 1: Test setup for 4-wire trace resistance measurement. Test setup for trace capacity was identical but on the traces on the top half of the board

Trace Resistance

- Tested with 2-wire and 4-wire methods
- 4-wire method was most accurate, though 2-wire null method is my recommendation for any resistances above 100Ω since the error was <20Ω and it is easier to set up.
- Notably, in the 2-wire null method, the null resistance varied between 55-70Ω. To get a more consistent null resistance, I pushed the probes together hard when setting the null resistance to avoid any changes due to contact resistance.

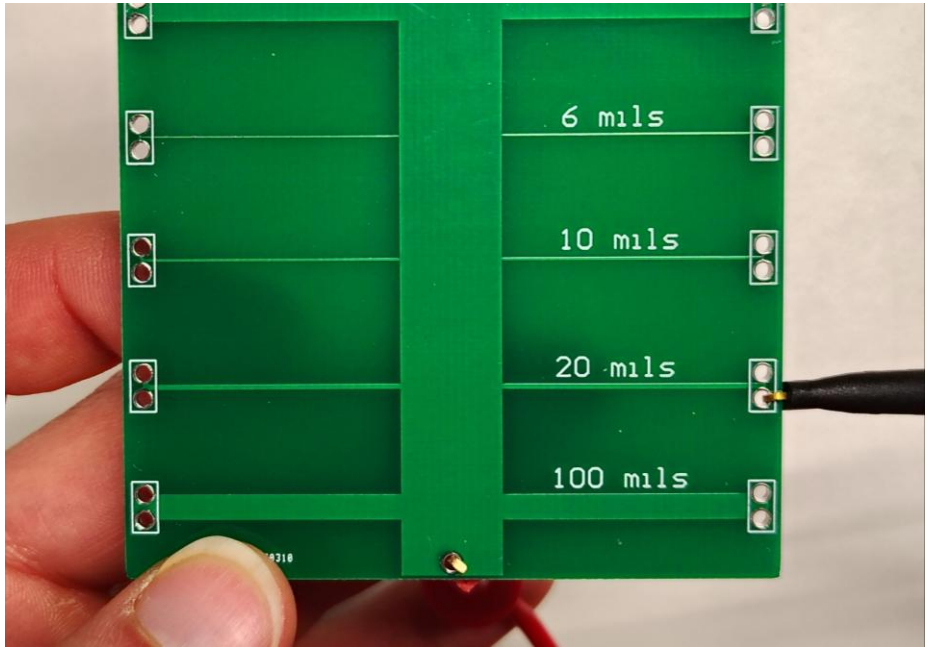

Figure 2: Test setup for 2-wire method

Line Width (mils)	Estimate (mΩ)	2-wire (mΩ)	2-wire null (mΩ)	4-wire (mΩ)
6	83.33333	138	69	75
10	50	107	31	40
20	25	75	9	20
100	5	58	-9	3

Table 1: Trace resistance results (null resistance = 60Ω)

Trace Capacity

- Saturn PCB underestimated the current capacity, likely due to the low temperature increase I entered (20°C).
- The current to get warm was approximately 0.29A/mil of line width, 0.41A/mil to get hot, and 0.63A/mil to burn the trace.
- I recommend staying below 0.29A/mil because higher temperature swings decrease reliability, though a 0.41A/mil emergency current would be acceptable.
- Back-calculating using Saturn PCB, the trace temperature was ~123°C when warm, and over 222°C when hot.

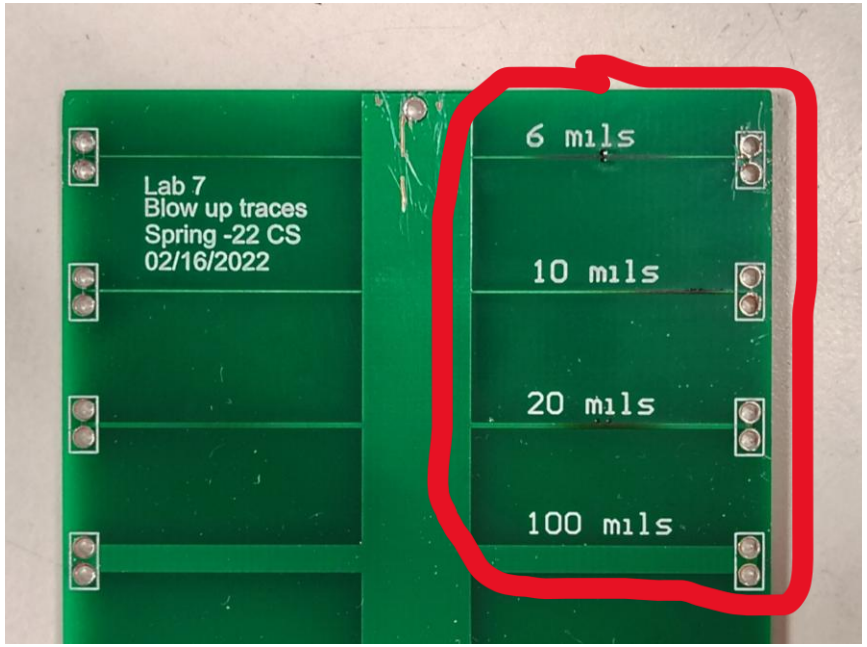

Figure 3: Burnt traces

Line Width (mils)	Max current, Saturn (A)	Current to get warm (A)	Voltage when warm (mV)	Current to hot (A)	Voltage when hot (mV)	Current to smoke (A)	Voltage when smoking (mV)
6	1.1162	2.2	193	3	321	4.6	482
10	1.6045	2.4	110	3.8	207	6	525
20		5.2	120	7.2	195	10.2	450
per mil (avg)		0.29		0.41		0.63	

Table 2: Trace capacity results