

Lab Report 7 - Sam Freed

This lab helped us become more familiar with the restrictions that physical traces can place on circuits when in a PCB, first by showing the amount of resistance they provide and then by testing their current limits. Then, during the second lab session, we were given the opportunity to practice soldering.

Part 1 - Trace Resistance & 4-Wire Measurements

$$R = \frac{\rho}{t} * \frac{l}{w} = \text{sheet resistance } R_{\square} * \text{number of squares}$$

DMM Used - BK Precision 5491B @ Bench 39 - resistance in wires 1.17Ω-1.3Ω (1.25Ω)

Trace Width	Estimate	2-wire Measurement	4-wire Measurement
6mil	0.5m * 166.66 = 0.083Ω	1.28Ω	80.9 mV / 1A = 80.9mΩ
8mil	0.5m * 125 = 0.0625Ω	1.44Ω	58.84 mV / 1A = 58.84mΩ
10mil	0.5m * 100 = 0.05Ω	1.41Ω	45.42 mV / 1A = 45.42mΩ
20mil	0.5m * 50 = 0.025Ω	1.33Ω	22.09 mV / 1A = 22.09mΩ
100mil	0.5m * 10 = 0.005Ω	1.3Ω	4.56 mV / 1A = 4.56mΩ
100mil w/ 13mil vias	N/A	1.39Ω	7.88 mV / 1A = 7.88mΩ

4-wire measurements were necessary for this lab because the resistance in the traces was so small, and the 4-wire method separates the current path from the voltage measurement path. This allows for a much higher degree of accuracy and for resistance in wires to become less impactful.

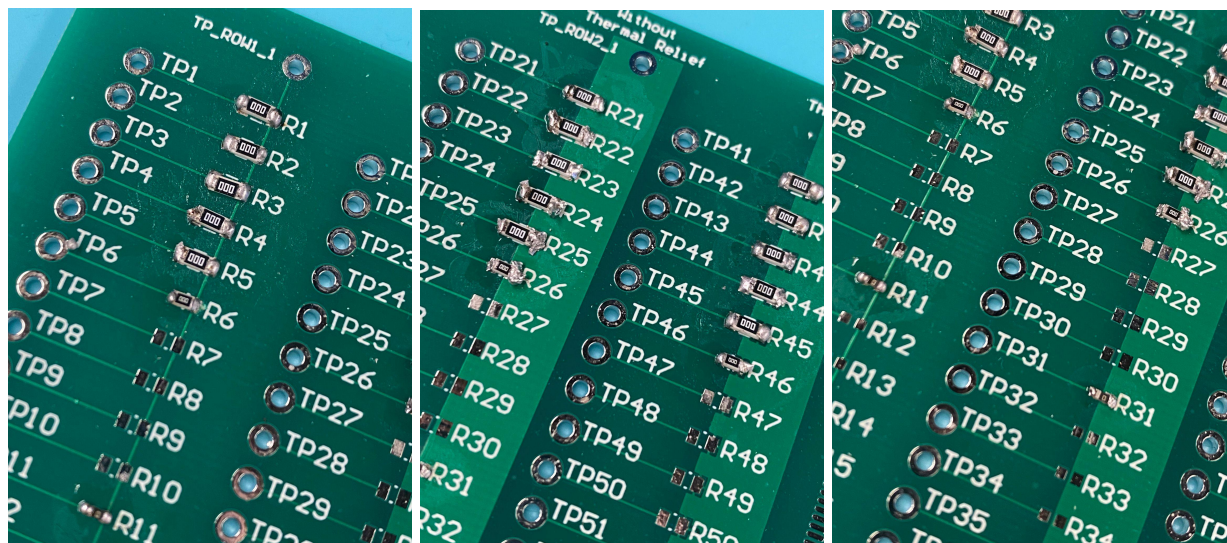
Since the actual resistance values and estimations are magnitudes smaller than the 2-wire measurements, my initial measurements did not match expected values due to the resistance inside the supply cables used.

Part 2 - Trace Heat Dispersion

Trace Width	Estimate	Warm	Hot	Smoking
6mil	1.0016 A	~1.2 A	~2.7 A	(4.5 A)
20mil	2.3032 A	2.5 A	Max 4.2 A	N/A

Due to high resistance in the power supply cables used, I was unable to get the 6mil traces to smoke or the 20mil traces to become truly hot to the touch. Others around me were able to get the 6mil traces to smoke at approximately 4.5A, but I did not see anyone who was able to get the 20mil traces to smoke. Accordingly, I would feel comfortable passing 1A through the 6mil traces and 2A through the 20mil traces.

Part 3 - Soldering



The images above show the progress I made as I practiced soldering more. I started with the non-plane 1206 pads (R1-R5), then the planed 1206 pads with thermal reliefs (R41-R45), and finally the planed 1206 pads without thermal reliefs (R21-R25). I also attempted some 0804 (R6, R26) and 0603 (R11, R31) resistors, and not pictured is a failed attempt at a 0402 solder. Without a doubt, the non-relieved pads are the hardest due to heat dissipation into the return plane. Liberal use of flux was essential to creating better-shaped joins - without it, the solder was less easy to handle.