

✓ Pro PCB Design Tips

🔧 Core Principles

Principle	Tip
Component Placement	Try multiple layouts; route a bit, and if it feels off, rip it up and redo. Optimization starts with smart, thoughtful placement.
Schematic First	Your schematic must be clean, readable, and organized —every time, all the time. Schematic is the master design guide.
Group Components	Organize by function and priority: High-Speed, Power, Digital, Analog, RF, Thermal needs, mechanical/enclosure considerations.

📐 Layout & Routing Guidelines

Area	Best Practice
Polarity & Orientation	Keep uniform (e.g., all e-caps polarity aligned). Public restrooms have design languages; your board should be intuitive.
From Symbol to Footprint	All footprints should originate from a symbol in your schematic—maintain traceability.
Clearances & Constraints	Respect minimum clearances, edge constraints, and mechanical outlines.
Trace Widths & Vias	Choose trace width based on current; size vias appropriately for current and thermal demands. Use online calculators.
Planes	Use solid Power and Ground planes for signal integrity and thermal performance.
Thermal Relief	Consider thermal pads, heatsinks, relief spokes, and reflow profiles. Heat is a layout constraint.

Calculators:

<https://www.digikey.com/en/resources/online-conversion-calculators>

Class Examples:

<https://cmu-mfi.github.io/learninglab/courses/pcb.html>

Electronics Parts:

Pro Suppliers: [Digikey.com](https://www.digikey.com) [mouser.com](https://www.mouser.com) [Arrow.com](https://www.arrow.com) [Newark.com](https://www.newark.com)

Hobby Suppliers [Adafruit.com](https://www.adafruit.com) [Sparkfun.com](https://www.sparkfun.com) [Pololu.com](https://www.pololu.com)



Validation & Testing

Step	Tip
Footprint Verification	Print your layout on paper and place parts on it to check fit. Catch issues early.
Silkscreen Essentials	Mark Pin 1 , polarity , reference designators , test points , and all power/GND lines clearly. Label everything circuit critical.
Test Points	Add them liberally—access for probing and troubleshooting is critical. Pl troubleshooting. Footprints are free; design flexibility and troubleshooting your layout stage.
Extra Footprints	Add alternates for key components where possible. Flexibility is free in early prototypes.

Design Smarter

Area	Tip
Differential Pairs	Route them together, equal length, controlled impedance where needed.
BoM Control	Maintain clean documentation—this is part of engineering. All parts should have a <i>reputable</i> vendor source and purchasing part number.
ERC/DRC Rules	Don't ignore them. They catch what you can't see.
Copy Good Ideas	Look at other designs—great layouts are studied and borrowed.
Datasheets	Read them thoroughly. Seriously. All of it. Twice.

Mindset & Process

- You won't get it perfect on the first revision—**focus on progress, not perfection.**
 - **Assemble your own boards:** The best lessons are mistakes.
 - **Design with failure in mind:** Build in alternate circuits & footprints, debug features, test pads, and flexibility.
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EDA (Design and Layout) Software:

KiCAD <https://www.kicad.org/download/>