Prototyping

Help!! I’ve fallen and can’t get up!
Prototyping

- Prototyping allows testing a circuit after initial design and simulation.
- It helps confirm that simulation models were generally correct and that real-world imperfections (grounding, parasitic R,L,C, noise etc.) are mostly accounted for.
- It should allow for easy probing of all points in the circuit.
- It should be constructed so that rapid changes can be made.
- It should be organized such that confusion/mistakes are minimized.
- It should be a rough approximation of the final circuit configuration.
- It should NOT necessarily be "pretty", but should be neat.
- It should be electrically and mechanically sound without "flying" leads dangling parts, etc.
- It's usually not a PCB except where SMT parts are used.
Prototyping

▶ Helps and Hindrances
  ▶ For digital circuits or uCs, a "break-out" board is very helpful. These work with "white bricks" dead bug style or one-sided protoboards (pads only).
  ▶ Jumper wires with 0.1" headers are too easy to make mistakes with. They also pull out easily. They you put them back in the wrong place!
  ▶ If your eyesight is non-optimal, consider an eye loupe or Optivisor plus good lighting.
  ▶ Small soldering iron tip, liquid flux and solderwick is nice for SMT parts. Use standard soldering iron tips for simple dead bug prototypes.
Prototyping

There are many types of possibilities for prototype platforms.

- Bare (unclad) veroboard, protoboard
  - Rapid changes difficult
  - probing and tracing are difficult
  - takes extra time to build well
  - poor power/ground distribution

(a) Audio filter  (b) What’s hooked to what? Uh...
Prototyping

- White brick (plug-in) protoboards
  - Rapid changes easy but "off by one" errors easy to make
  - Easy to short out long wires
  - Easy to probe except when probe pulls out leads!
  - Mechanically "iffy" and prone to damage
  - Banned in some professional labs due to degraded contacts, coupling between adjacent rows/columns and poor power/ground connectivity

Could anything short out? You bet!
Prototyping

- PCBs
  - Changes are difficult and are likely to damage board
  - Probing is fairly easy, tracing difficult
  - Minimum 1wk to first article and it will have mistakes
  - Very sound mechanically
  - Substantial learning curve for PCB process
  - Very inflexible to changes
Prototyping

- "Ugly", "Dead bug"
  - Rapid changes easy
  - Easy to probe
  - Excellent ground/power distribution
  - Three-dimensional wiring, hard to beat, better than PCBs!
  - Mechanically sound, and flexible to additions
  - Has a small learning curve

Audio Power Amp - mV in, 0.25W out
Prototyping

- Audio Amp DIP IC closeup:

Audio Power Amp - mV in, 0.25W out
Prototyping

Audio Amp Voltage Regulator closeup:
Prototyping

- Consulting Project, mixed analog and digital
Prototyping

- Direct Digital Synthesizer using breakout boards
Prototyping

- "Oscillator in a Box" - PCB material makes great boxes
Prototyping

- Miniature Tube Oscillator - PCB front panel with tuning control
- Uses "MePads" to make connections
Prototyping

- First Tekbots Mega128 programmer (ATMega48)
- All digital. Note the "Old School" USB connector
Prototyping

- Double-decker quadrature detector with dead-bug ICs
- Design combines uV RF with mV audio amplifiers
- Note standoffs made with connector pins
Prototyping

- Some ugly projects make it into magazines!