Schematic Diagrams: Art and Rules

- **Benefits**
  - A good schematic will save way more time than it takes to produce
  - Even the eventual CAD drawing will go much faster
  - Errors, forgotten pins, omissions jump out at you
  - A schematic is code and comments for the HW designer when coupled with a written description

- **Schematic Diagram Must Include:**
  - All electrical connectivity including decoupling caps
  - On parts: pins, pin numbers, pin function, part number
  - On nets: annotate (name) where helpful
  - On nets: Use off-page connection symbols
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- Fine points
  - No "horseshoe" jumpers
  - Keep all lines straight, use a straight edge
  - Don’t "drag" Vdd and Vss all over
  - Grouping decoupling caps on one page is nice
  - Let designer intent be clear
  - Schematic should aid in visualizing functionality
  - Signal/control flow usually left to right, rarely top to bottom
  - Limit excessive hierarchical blocks, use only when necessary for clarity
  - Hierarchy clearly shown with multiple pages
  - Write on the schematic: comments, measurements, questions, etc.
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- Fine points cont.
  - If you scan/copy your schematic and turn in the copy, make sure its readable.
  - Don’t just print the schematics provided on the course webpage and turn them in. This shows no effort and undermines the benefits for drawing a schematic.
  - You are drawing schematics, not a block diagram. You should not (for example) replace an entire board with an empty block and label
  - When appropriate to combine multiple wires into a *bus*, you may do that
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▶ Tools for making schematics

▶ Make the medium easily extensible, small is not necessarily good
▶ Green engineering paper, scotch tape, pencil, no colors, KISS
▶ Beyond two/three taped pages, split design into separate pages
▶ Prototypes change a lot, make schematic changes easy as well
▶ Expect many changes, sometimes large; use a big eraser
▶ Bottom line: Can an engineer familiar with your design, replicate it without any further explanation? If not, your schematic and documentation is incomplete.
▶ CAD drawing is a necessary last step. During development however, messing with another tool hinders thinking and progress.
▶ Some best schematics are started on napkins!
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3. This part of the vertical amplifier schematic from a Tektronix 454 oscilloscope shows