EE4390 Microprocessors

Lessons 29, 30

Welcome to the Real World!
Welcome to the Real World!
- what keeps paper designs from working -

• Switches/indicators
• Switch debouncing
• Noise
• Input Termination
• Electrical Characteristics
• Interfacing
• Fanout
• Power conditioning
Switches/indicators

- Momentary pushbutton
  - interrupt
- DIP switches
  - configuration
- Keypad
  - data entry
- LEDs
  - status entries
- 7 segment display
  - data display
Tri-state indicator circuit

• Tri-state indicator:
  – Green: logic high
  – Red: logic low
  – None: high impedance
Switch debouncing

• Switches are mechanical devices
• When switch is flipped it makes/breaks contacts multiple times - called bouncing
  – processor fast enough to see each bounce as independent input
  – debounce with hardware, software, or HW/SW techniques
Switch debouncing - techniques -

• Hardware

[Diagram of switch debouncing circuit]

• Software
  – after first transition provide 25-50 ms delay
Noise Sources

- Electrostatic discharge (ESD) - static electricity
- Radio frequency interference (RFI) - undesired RF energy
- Electromagnetic interference (EMI) - varying magnetic fields emanating from electromechanical devices (motors)
- Sag - decrease in input AC
- Surge - sudden increase in input AC
Reducing noise susceptibility

- Printed circuit boards should have well filtered power supply inputs
  - Provide ferrite-bead feed-throughs
  - 50 uF capacitor between power and ground -- mount close to beads
    - low frequency noise
  - 0.1 to 0.01 uF capacitor to bypass mid to upper frequency noise
- Provide bypass capacitors on every IC
  - 0.01 uF capacitor between IC supply and ground pin
- Provide ferrite-bead feed-throughs at signal inputs and output
- Provide separate power feed to each IC row
- Provide short ground return paths with large ground planes
- properly terminate unused IC inputs
- every other conductor in ribbon cable should be grounded
- Enclose system processor in a well-grounded metal box
Power Conditioning
Terminating Unused Inputs

- Input impedance is very high on unused input pins
- If not connected, the input can oscillate or float to midsupply level
- Oscillation can couple noise to power supply
- Terminate unused input pins by pulling up (or down) via a resistor -- 4.7 Kohm
Electrical Characteristics, interfacing, and fanout

EX] pgs 332-334

Revised: Aug 1, 2003