

# EE4390 Microprocessors

Lessons 29, 30

Welcome to the Real World!

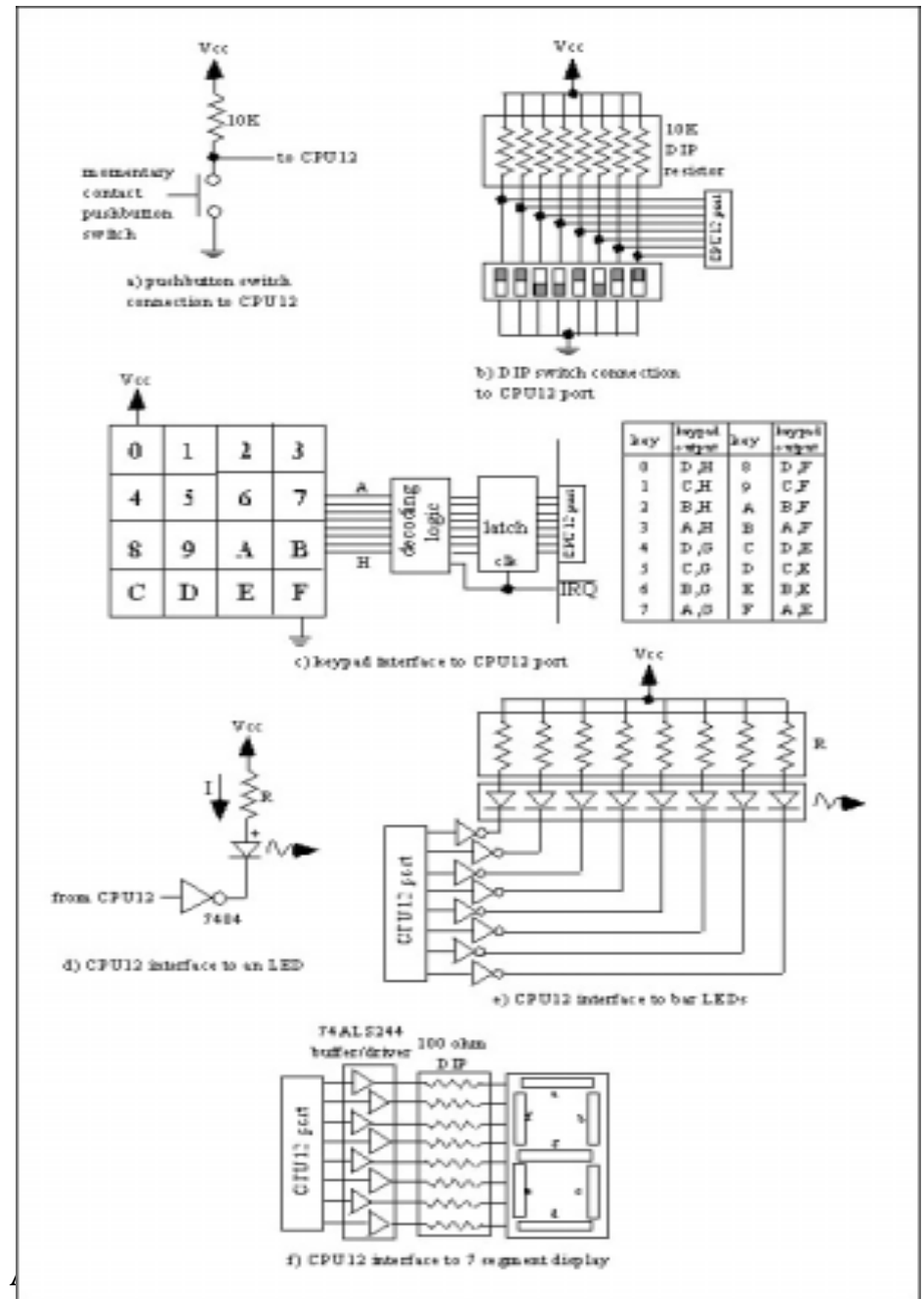
# Welcome to the Real World!

- what keeps paper designs from working -

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

# Switches/indicators

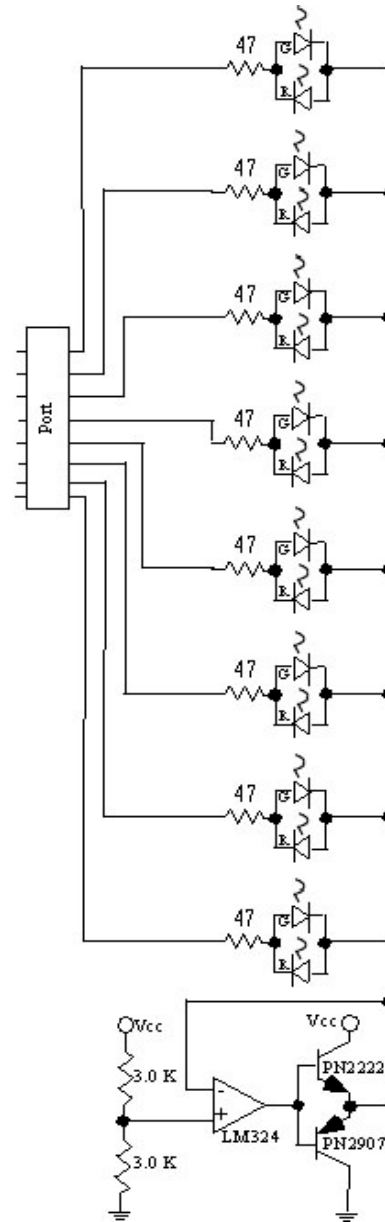
- Momentary pushbutton
  - interrupt
- DIP switches
  - configuration
- Keypad
  - data entry
- LEDs
  - status entries
- 7 segment display
  - data display



Revised: 2

# Tri-state indicator circuit

- Tri-state indicator:
  - Green: logic high
  - Red: logic low
  - None: high impedance



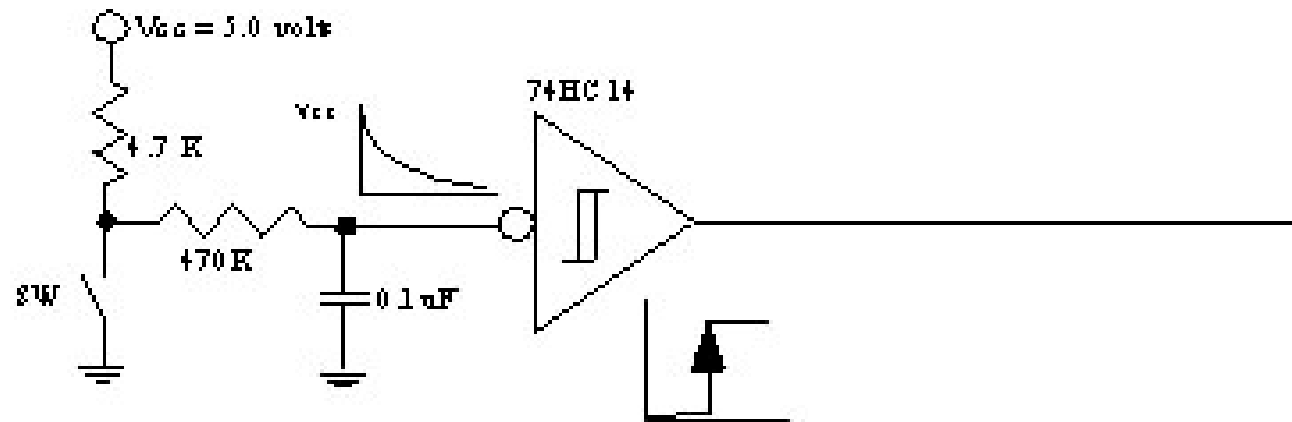
Revised: Aug 1, 2003

# 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



- Software

- after first transition provide 25-50 ms delay

# Noise Sources

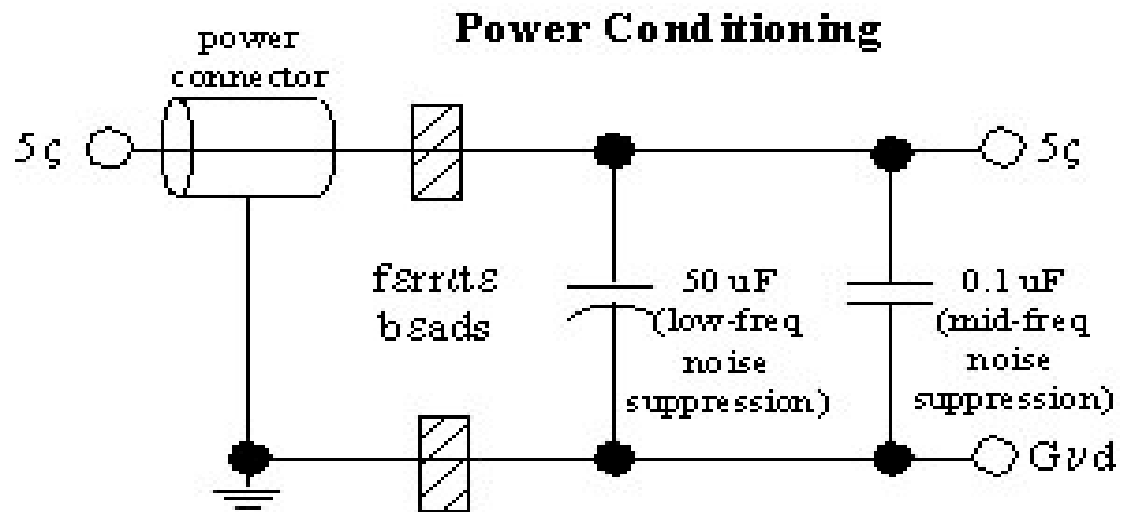
- Electrostatic discharge (ESD) - static electricity
- Radio frequency interference (RFI) - undesired RF energy
- Electromagnetic interference (EMI) - varying magnetic fields emanating from electromechanical devices (motors)
- Sag - decrease in input AC
- Surge - sudden increase in input AC

# 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

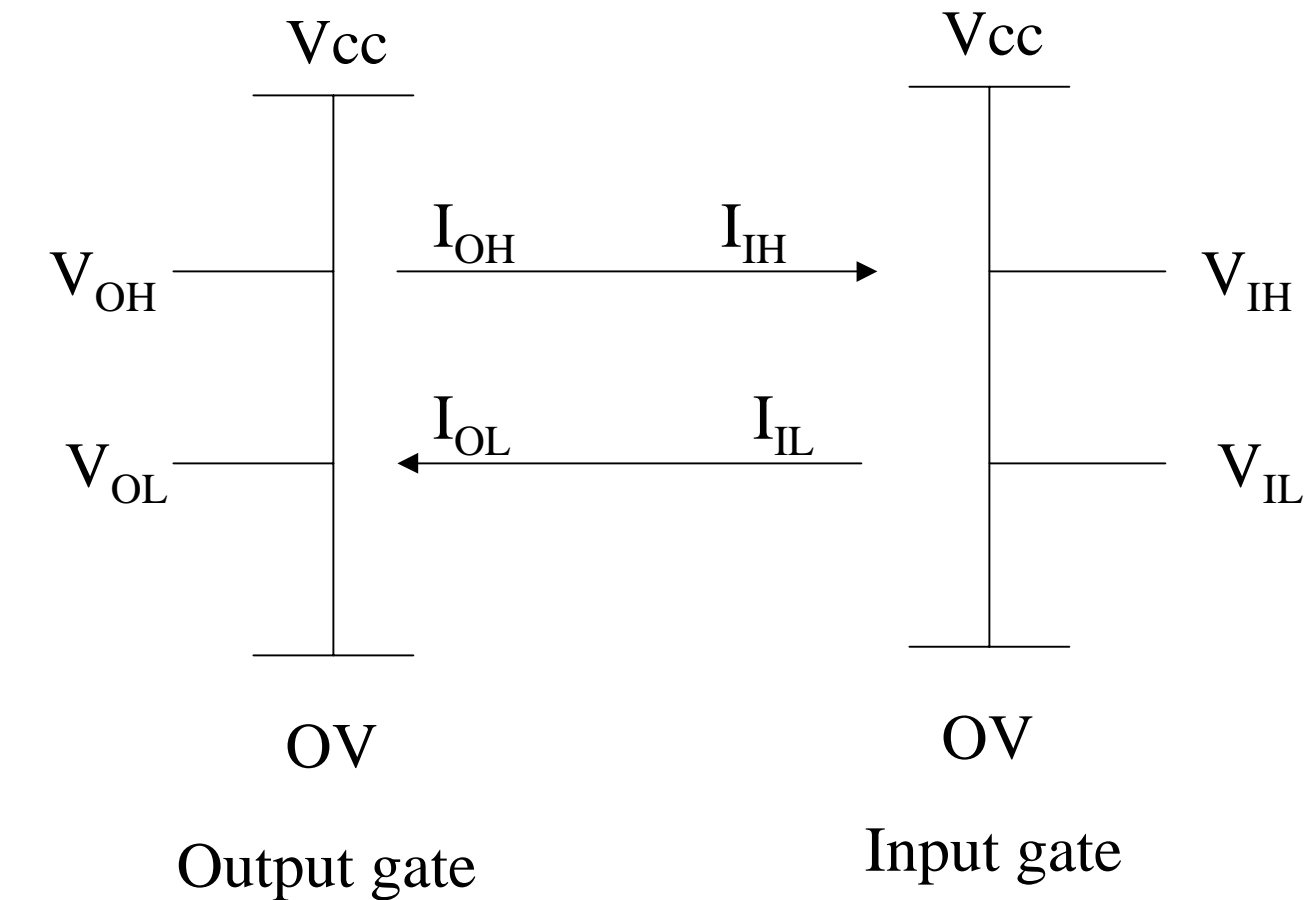


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# Terminating Unused Inputs

- 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

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