Agenda

Wednesday’s reading
   Sections 3.8.8, 6.2.1, 7.14.1, 7.14.2, 10.1.3

Today’s topic:
   Displays
Practical aspects of digital design — so far

Debouncing pushbutton switches

Keypad encoding

Synchronizing asynchronous inputs

Bypass capacitors on each chip

Power-on reset

Clocks

Power and clock distribution

Keypad encoding — corrected description

Q goes low when key is pressed.

Use Q to latch the counter state.
18. Displays

Keypad encoder on a chip — 74C922

- DATA AVAILABLE signal is HIGH while key is pressed.
- 3-state output control.
- Row-column of last key pressed is held in output register until next key is pressed.

Rollerover: If two keys pressed “simultaneously”, first key is held in output register until released. DATA AVAILABLE goes low, then after debounce period, goes high again to indicate availability of second key in the register.

Source: Fairchild Semiconductor

Tuesday, April 22, 2004

Display technology

- Single LED (light-emitting diode)
- Seven-segment and alphanumeric LED displays
- Multiplexed seven-segment and alphanumeric LED displays
- LED matrix displays
- LCD (liquid crystal) — difficult to use with Engs 31 technology (need a microprocessor, Engs 62).

Source: Fairchild Semiconductor

Tuesday, April 22, 2004
Review — driving a light-emitting diode

Low-side drive:
Sink current through cathode

High-side drive:
Source current into anode

Driving a seven-segment display

Common-anode display
Common-cathode display

- For large displays, lots of wiring, high chip count.
- High-side drive may not provide sufficient current for desired brightness — use extra driver transistors.
- LS47 and LS48 chips are obsolete — but other devices still exist (e.g., MC14511B)
Multiplexed 7-segment display — principle

- One digit is active at a time.
- Digits are rapidly cycled to overcome flicker and give illusion of a continuous display.
- Instantaneous current to LEDs is high, but average power (= average heating) is within limits.

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Multiplexed 7-segment display — implementation

One-chip solution: ICM7218C

Source: Intersil
Multiplexed 7-segment display — implementation

7218C/D timing — looks like a memory chip, digits can be independently altered.

Address bits determine which digit is being written to.

Data bits must satisfy setup and hold requirements.

Data bits are stored in the internal memory by the rising edge of the WRITE signal.

Source: Intersil

Alphanumeric display

14 or 16 segments instead of 7.

One-chip multiplexed drivers available, e.g., ICM7243

Source: LITE-ON
5x7 multiplexed LED array

- Reminiscent of keypad and ROM — to light an LED, source current onto row, sink through column.
- Additional driver transistors used to switch current through LEDs, because logic chips have insufficient current source/sink capacity.

Multiplexed LED array display