EE2361 - Lecture 37
12/7/16

- HW 5 is due

[ - Low-Power Design Guide
Microchip AN1416 ]

# Low-Power is IMPORTANT

- Because of many reasons, one major reason is portable, battery powered, devices

- Most μC vendors have families of μC designed for low-power operation
  - Microchip XLP (Extreme Low Power) devices
  - TI MSP430 Family

Low-Power Design typically involves trade offs between

Low-Power and performance

# What Caused Power consumption?

- Dynamic Power Consumption
  transistor switching, CPU activity
- Static Power Consumption
  analog circuits, leakage,
  things that must always operate

# Dynamic Power Consumption

⇒ mainly due to switching
(but also capacitive loads)

Quantify this

$$P = V^2 f C$$

- $V$: voltage across the circuit
- $f$: frequency of switching
- $C$: capacitive load

How does the reducing the voltage change things

Example V is changed 3.3 V to 1.8 V

$$\frac{P_{1.8}}{P_{3.3}} = \frac{(1.8)^2 \cancel{fC}}{(3.3)^2 \cancel{fC}} = 0.298$$

What about frequency?

$$\frac{P_{0.5}}{P_{32}} = \frac{V^2(500\,kHz)\,\cancel{C}}{V^2(32\,MHz)\,\cancel{C}}$$

$$= 0.01562\,S$$

What about capacitance?

Most of this is due to how the chip is constructed (rely on Vendor)

Be careful about PC board layout

# Static Power Consumption

- Bias currents for analog devices (such as the A/D)
- Time keeping oscillators
- Leakage currents

Battery powered systems spend most their time "sleeping" so in that case static power can be significant.

- Power consumption Depends on Process technology

- Simple Example of a data logger

  Fig 3 & Fig 4 in AN 14/6

- Average Power

$$\text{Average Current} = \frac{I_{active} \times t_{active} + I_{lowpower} \times t_{lowpower}}{t_{active} + t_{lowpower}}$$

You can measure this system in different modes, etc. to create a power budget

- Average Current
- Peak Current

} These are important in the design

# Critical Aspects of Low-Power Design

- Wake-Up Time
- Clock Speeds
- Instruction Set Architecture (ISA)
- Peripheral Features
- Execute from Flash or RAM

see AN1416 for more detail