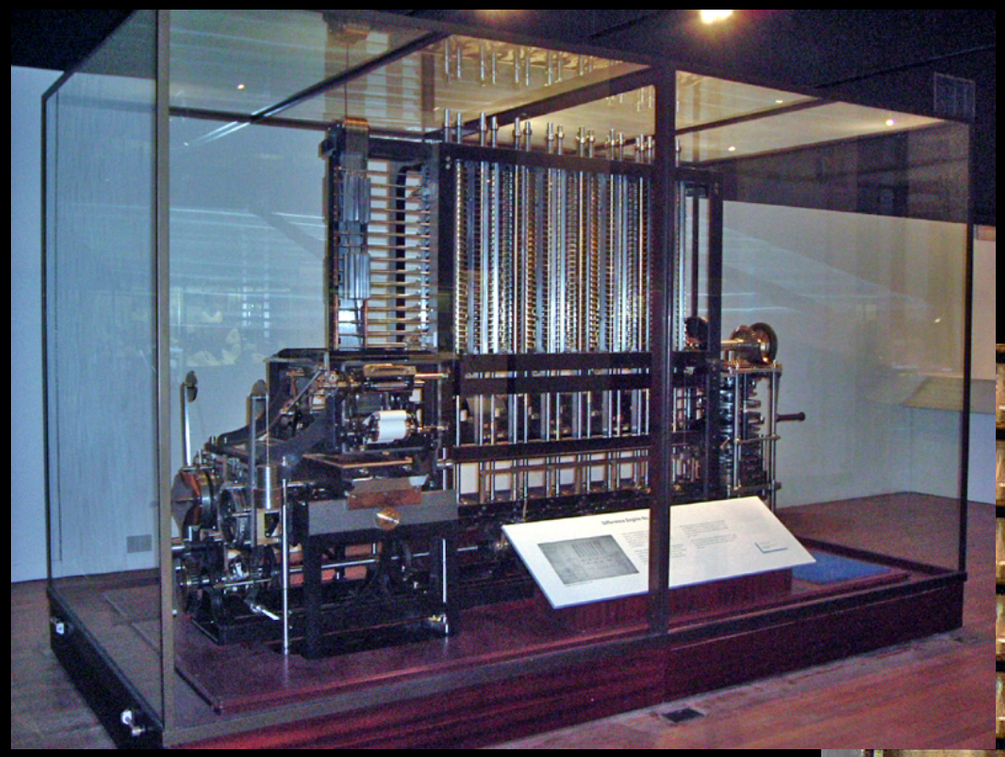
Interrupts & Using ICs

Press Play: Interactive Device Design | July 26, 2011

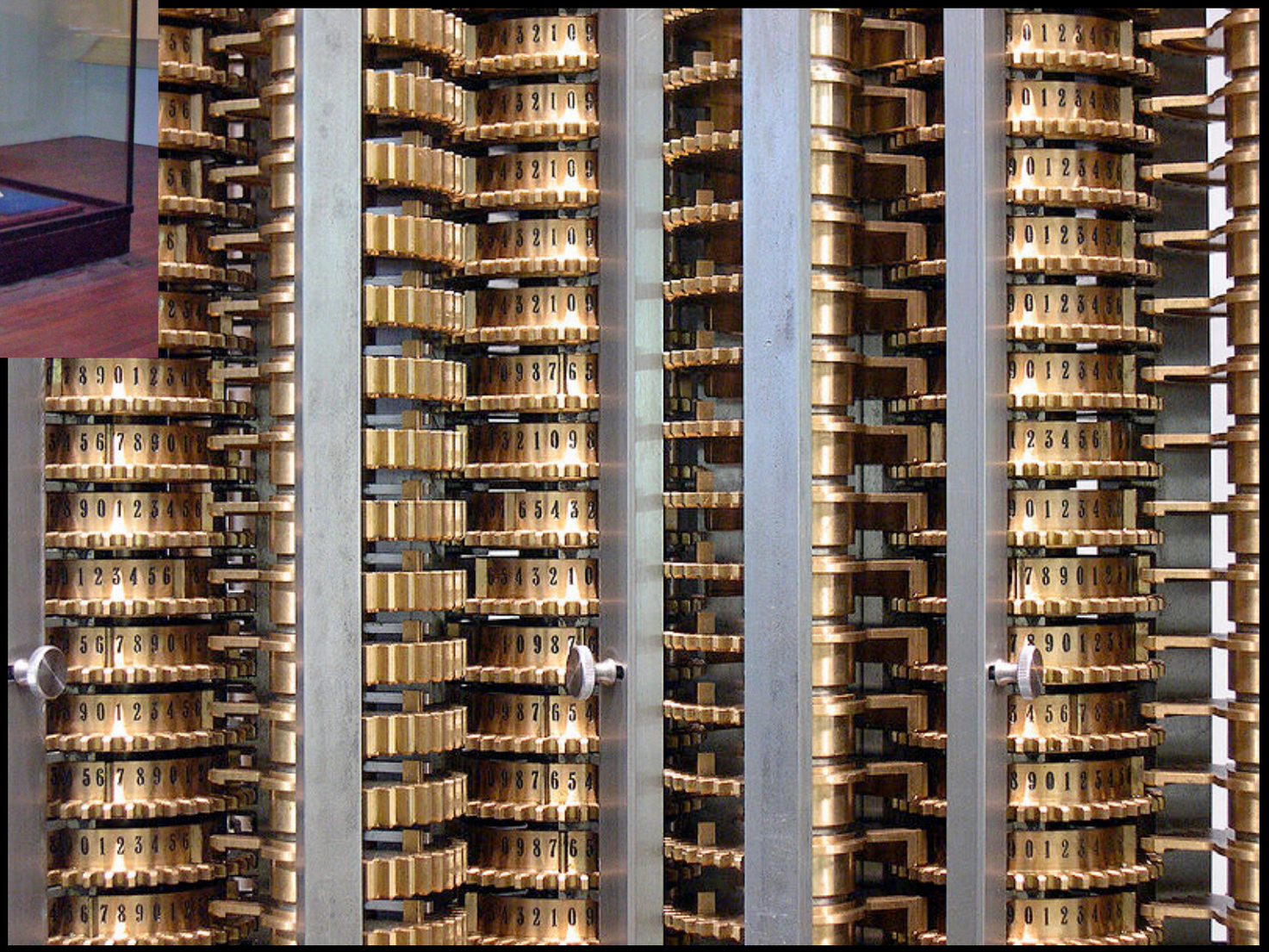
Before Integrated Circuits

Mechanical Computing



Wikimedia, by Joe D in January 2005.

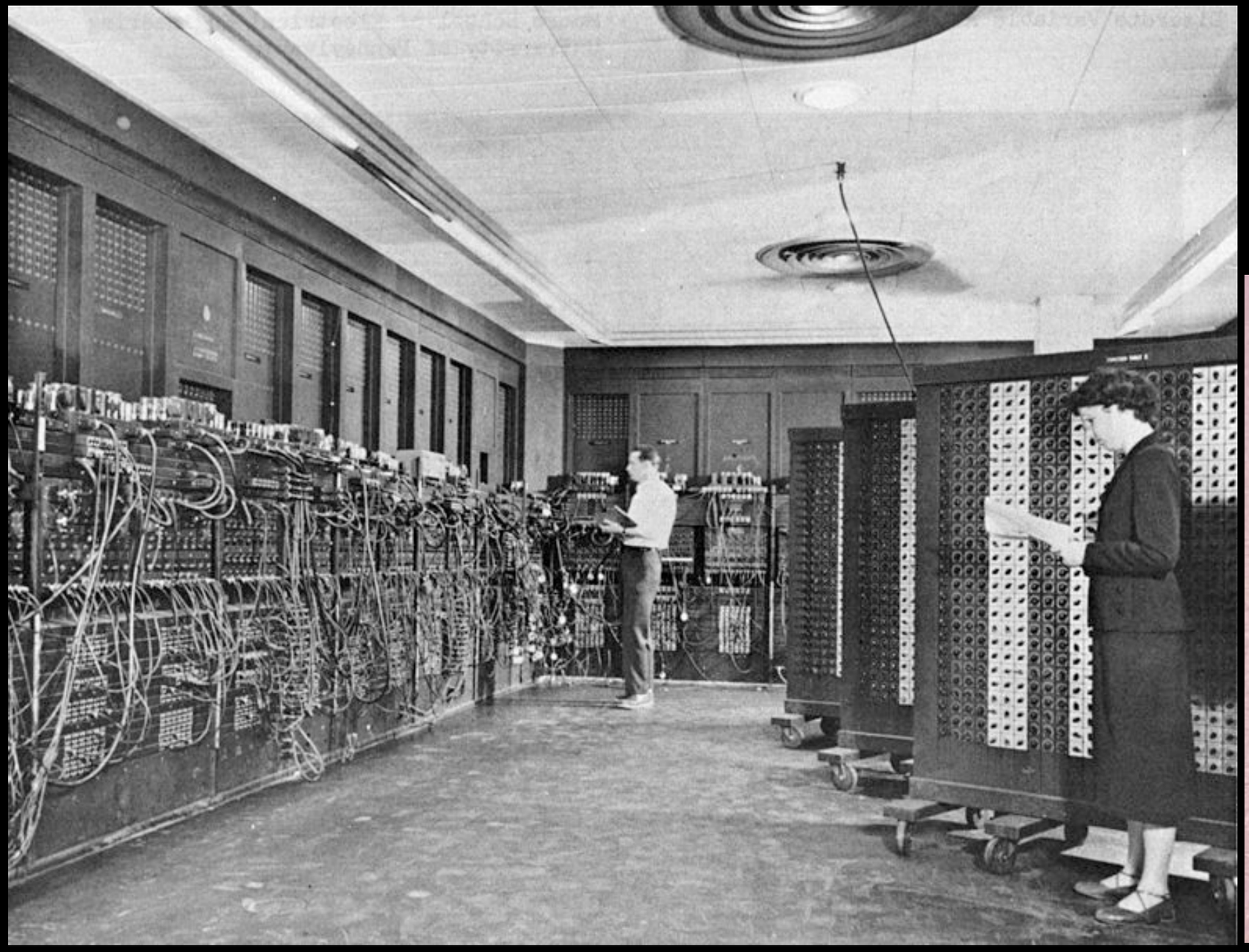
1849



Wikimedia, Carsten Ullrich, 2005

Before Integrated Circuits

Vacuum Tubes

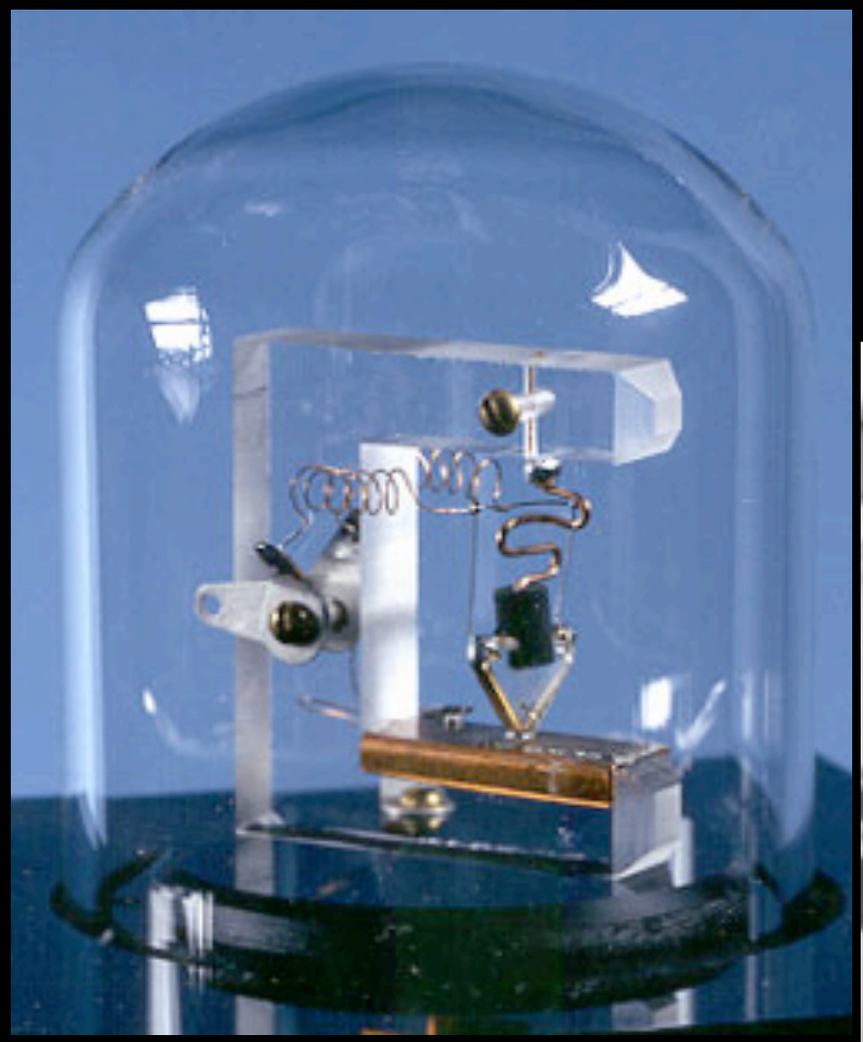


1945

Wikimedia, US Army Photo

Before Integrated Circuits

Transistors

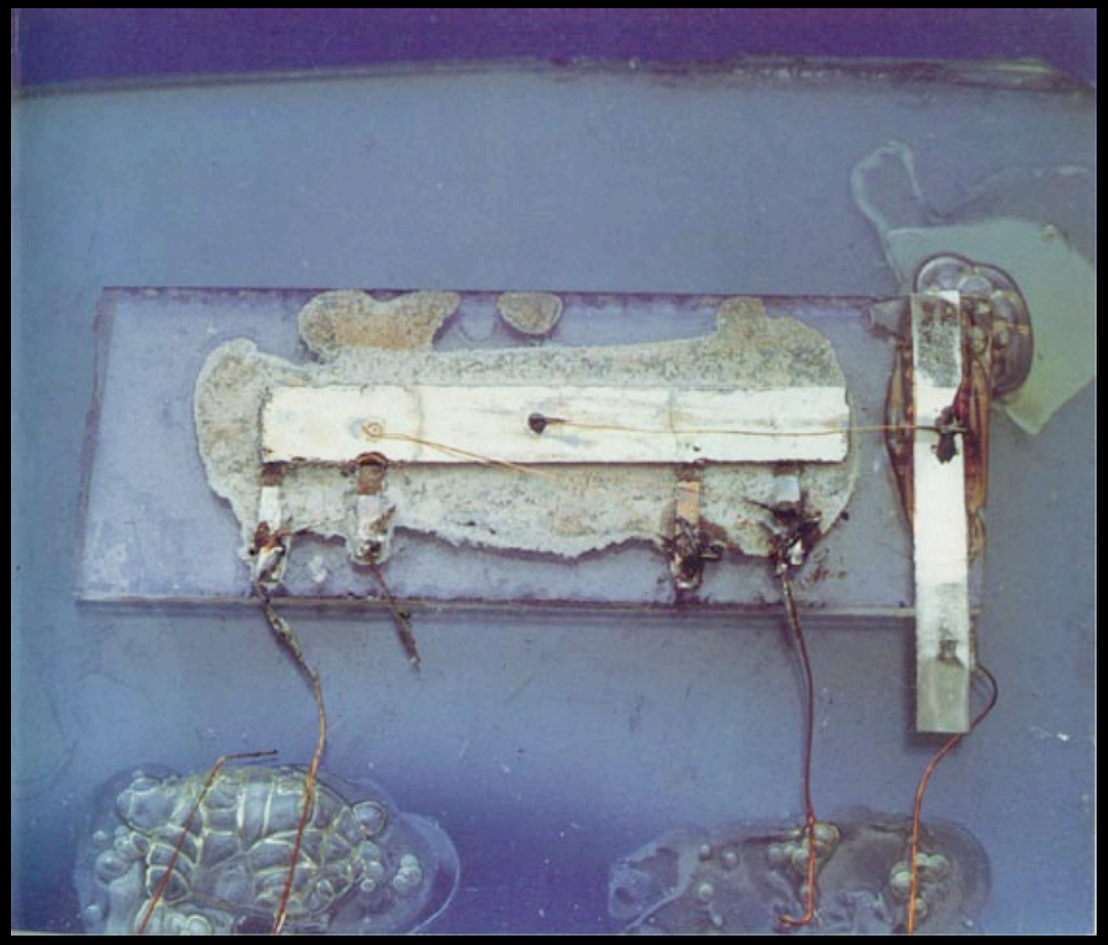


1947

1955

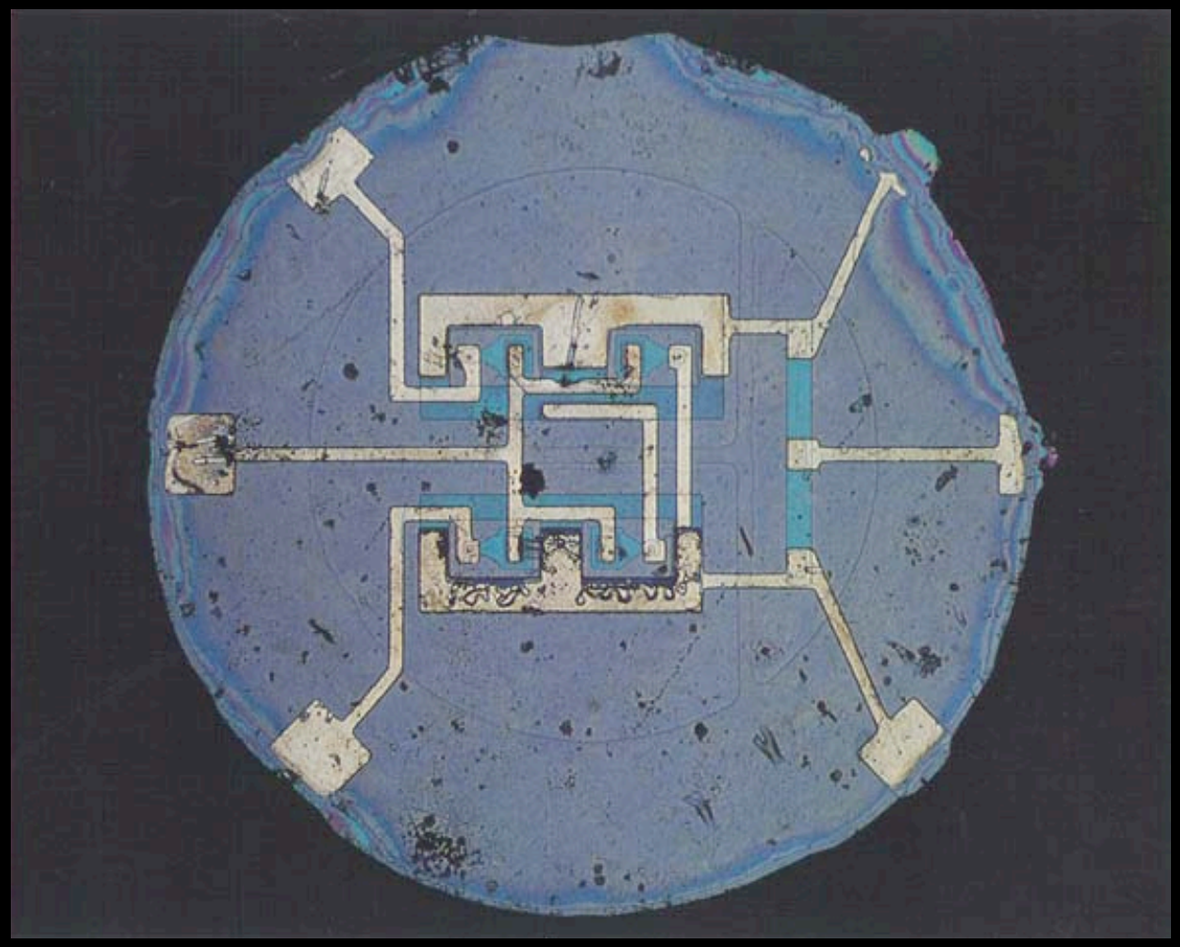
Integrated Circuits

Multiple Components on a Single Substrate



STATE OF THE ART ©Copyright Stan Augarten

1958



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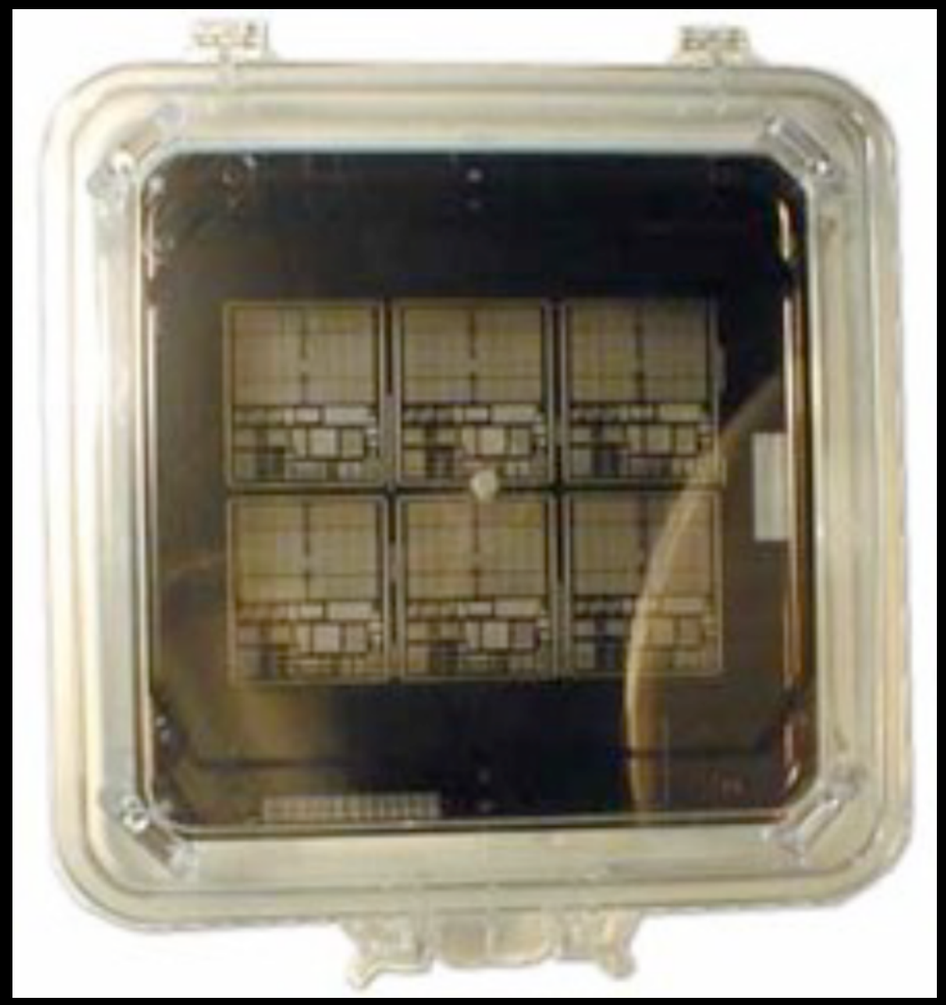
1961

Integrated Circuits Manufacturing

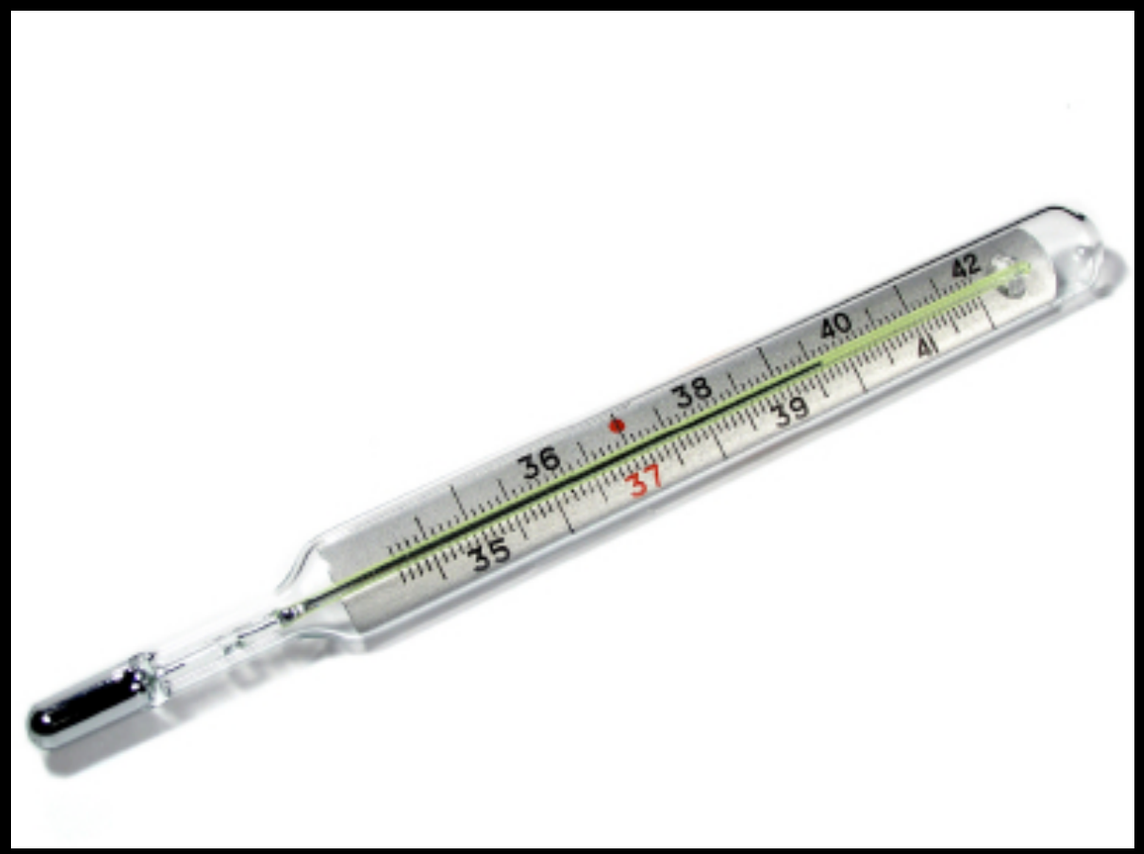
Similar to Silkscreening



Analog vs Digital

‘Real World’ vs ‘Computer World’

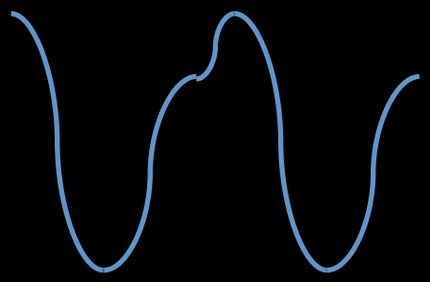
Analog



Digital

ADCs and DACs

Convert from Analog to Digital and Back Again



ADC

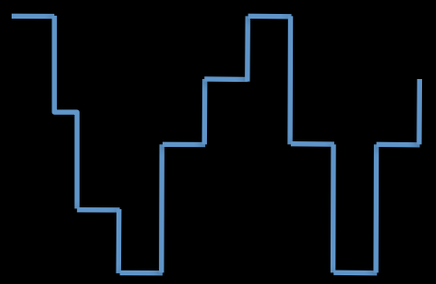
Microchip
MCP 3208

0xFF, 0x12, 0x0F, ...

0xFF, 0x12, 0x0F, ...

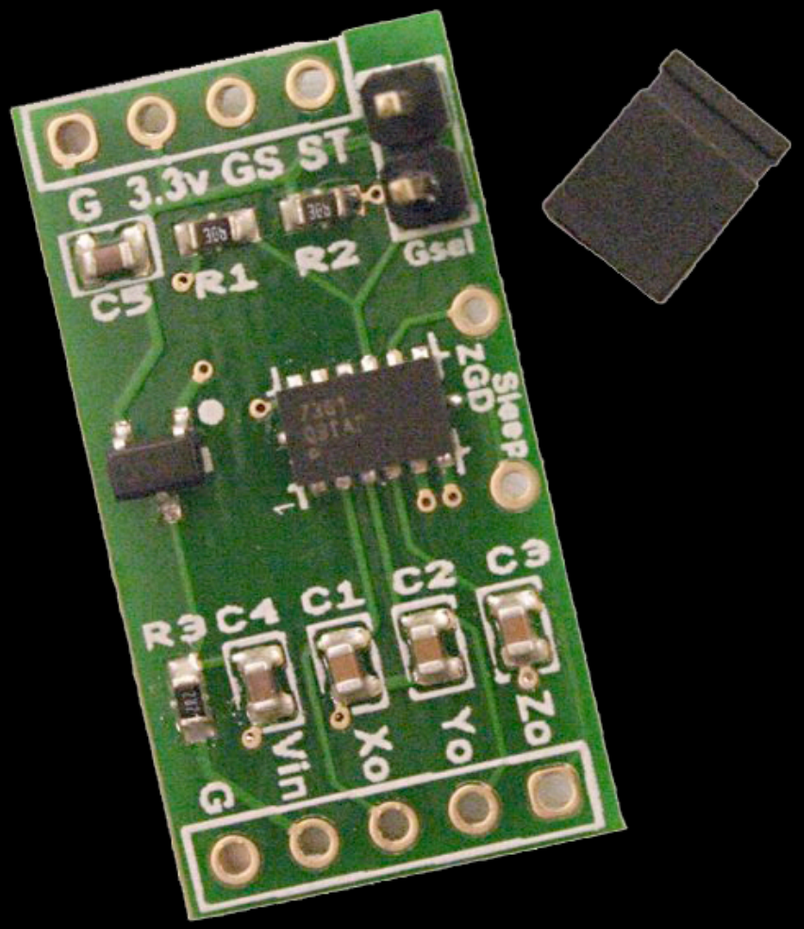
DAC

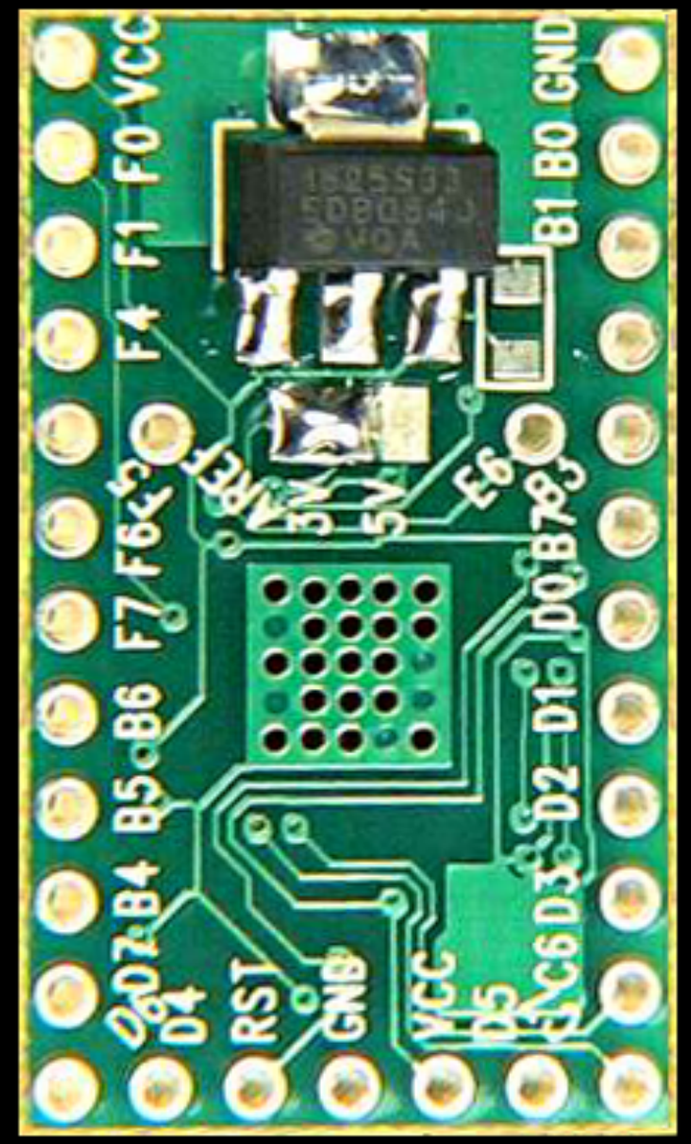
Analog Devices
AD 420



Analog ICs

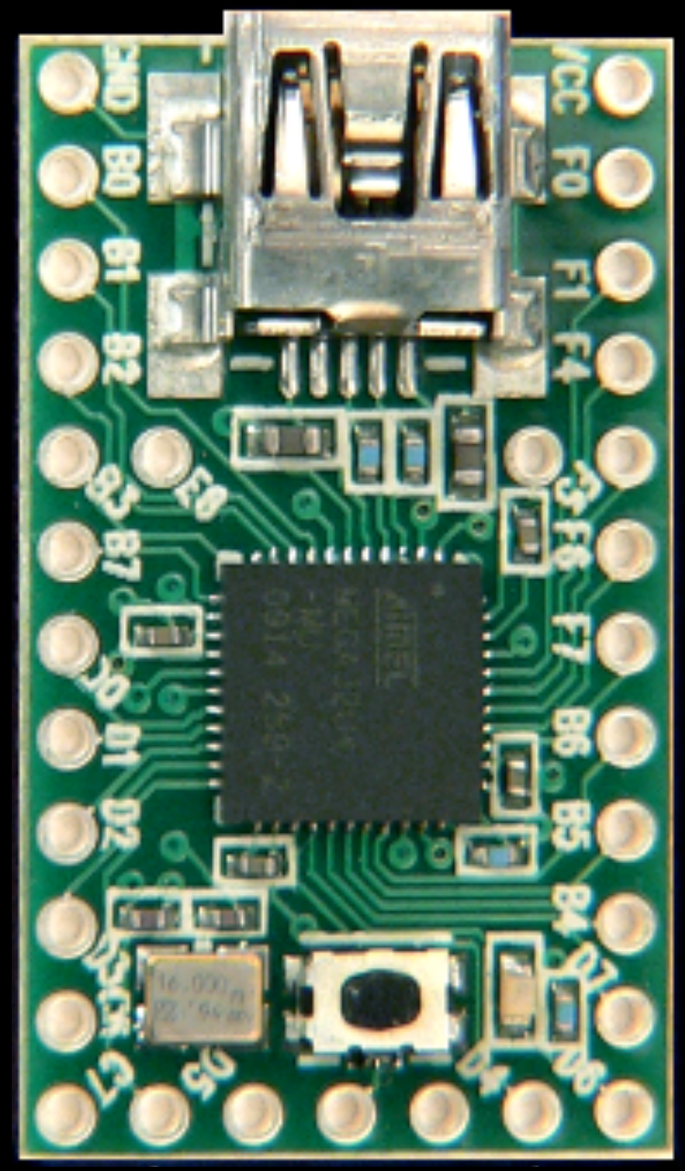
You Have Already Used A Few!





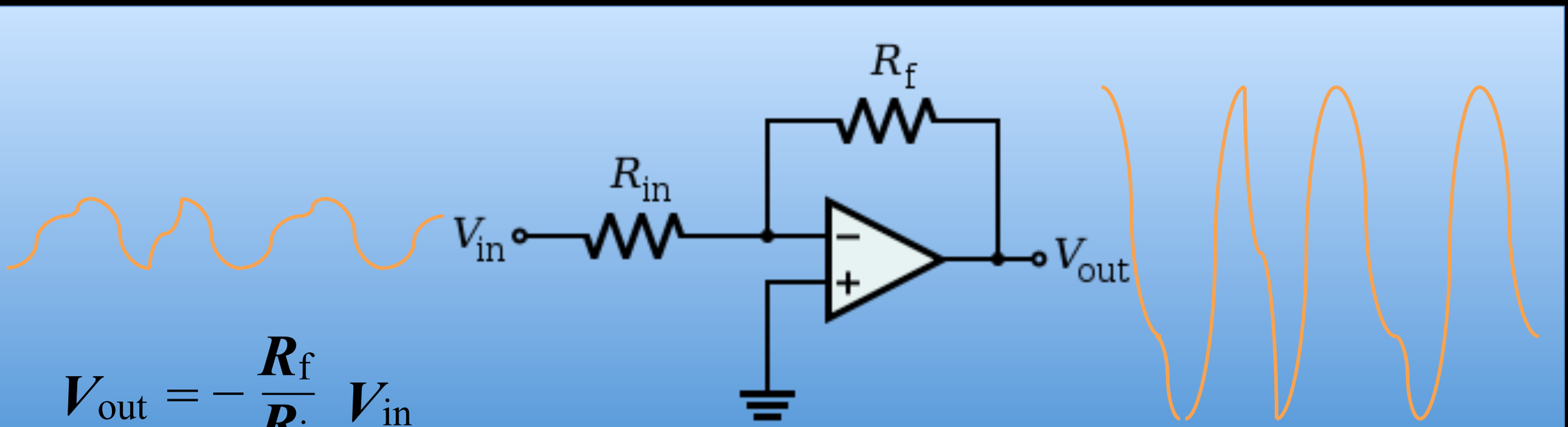
Analog ICs

Operational Amplifier

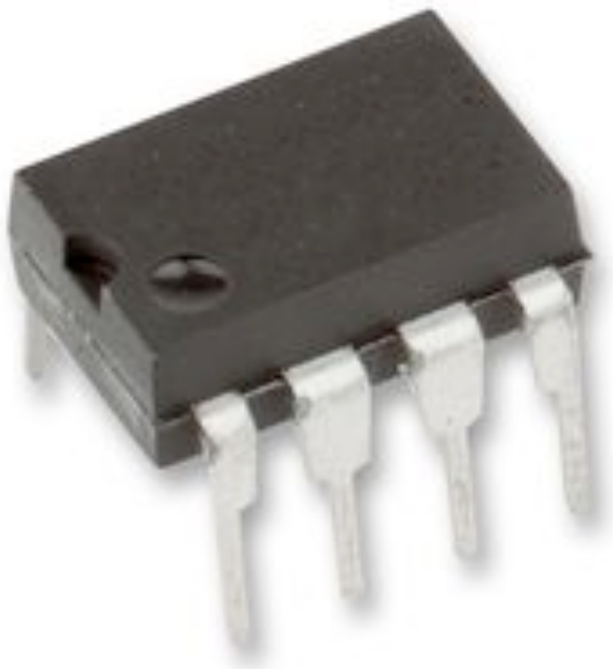


Analog ICs

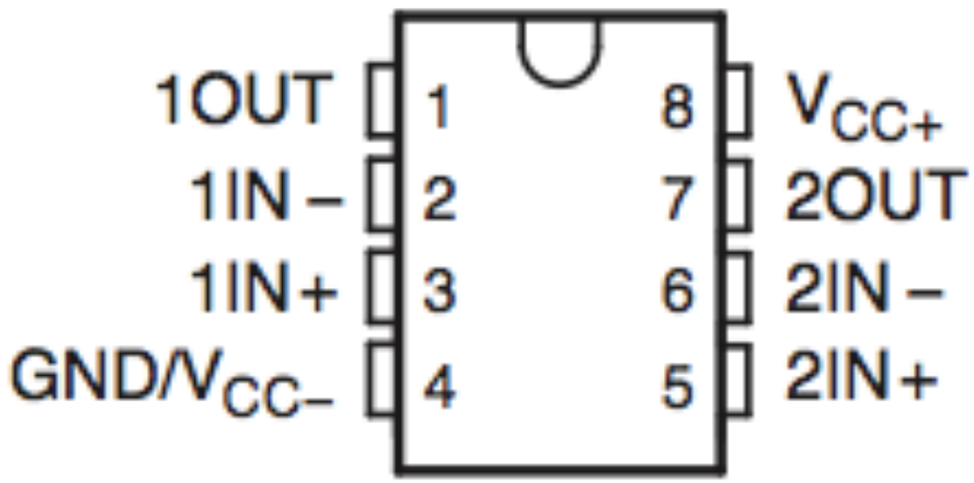
Operational Amplifier



$$V_{out} = -\frac{R_f}{R_{in}} V_{in}$$



LMV822 . . . D OR DGK PACKAGE
(TOP VIEW)



Analog ICs

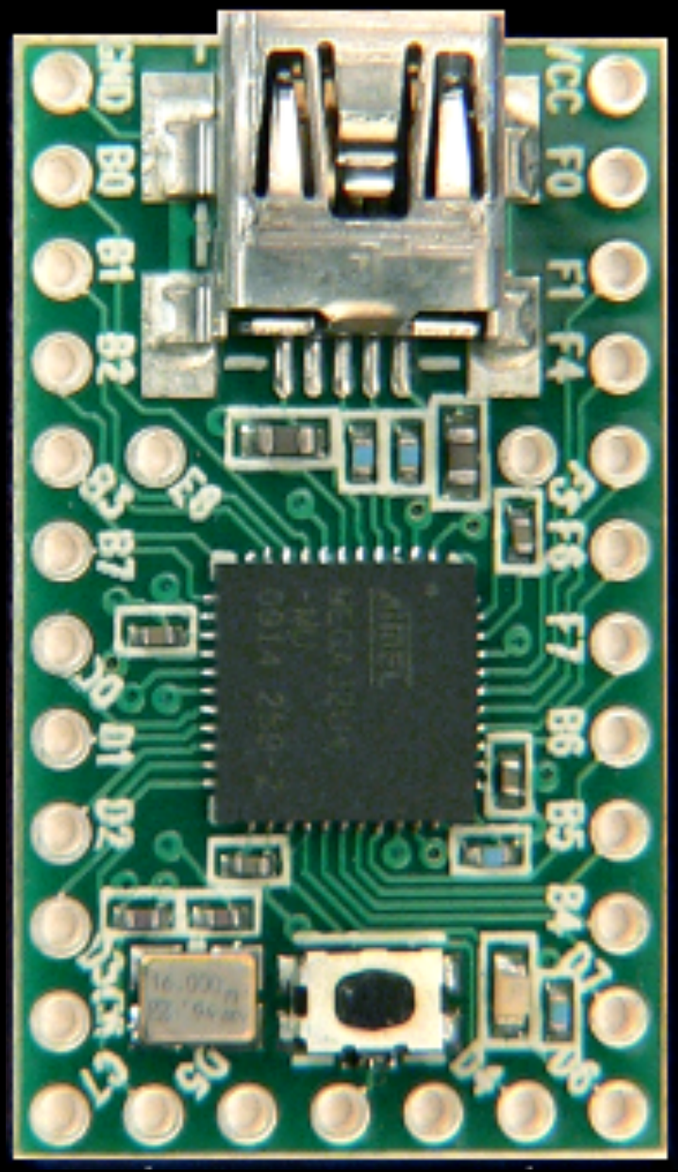
Filter Chips

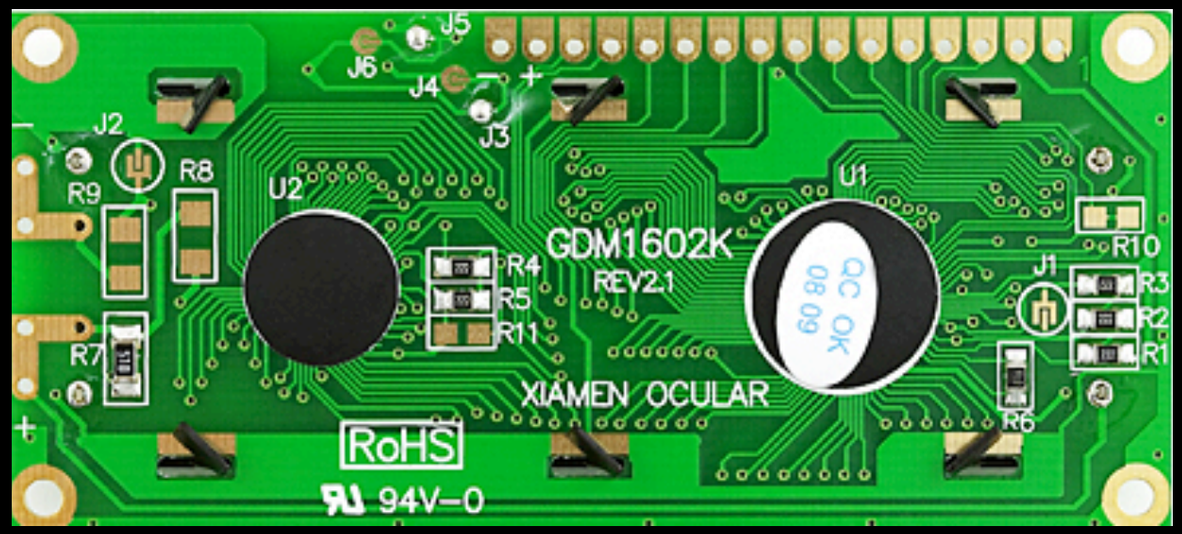
or

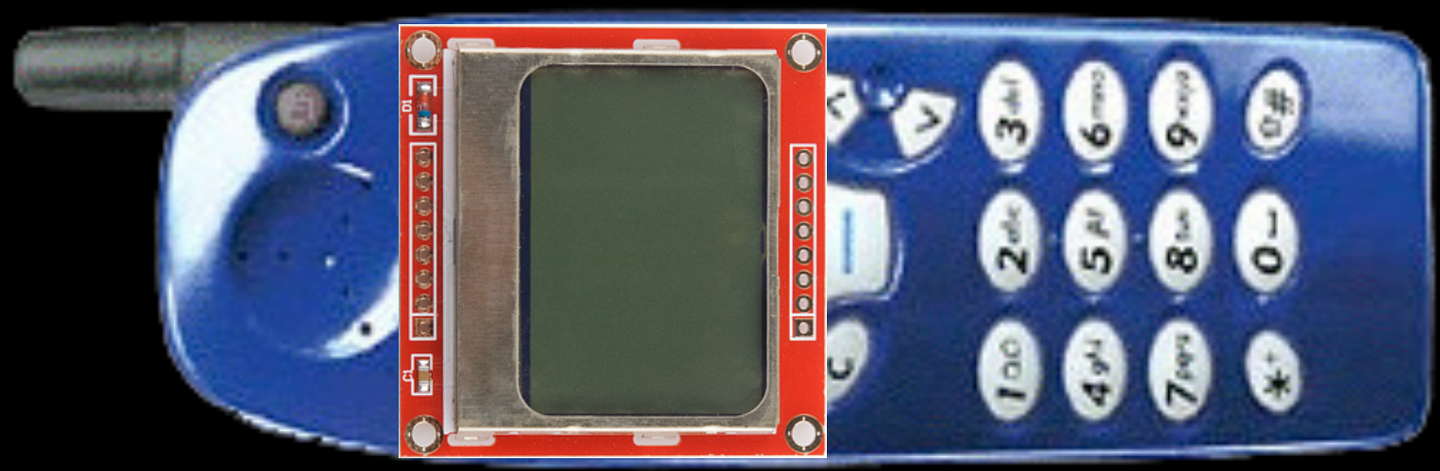
Can design your own with R's and C's

Digital ICs

You Have Already Used a Ton!





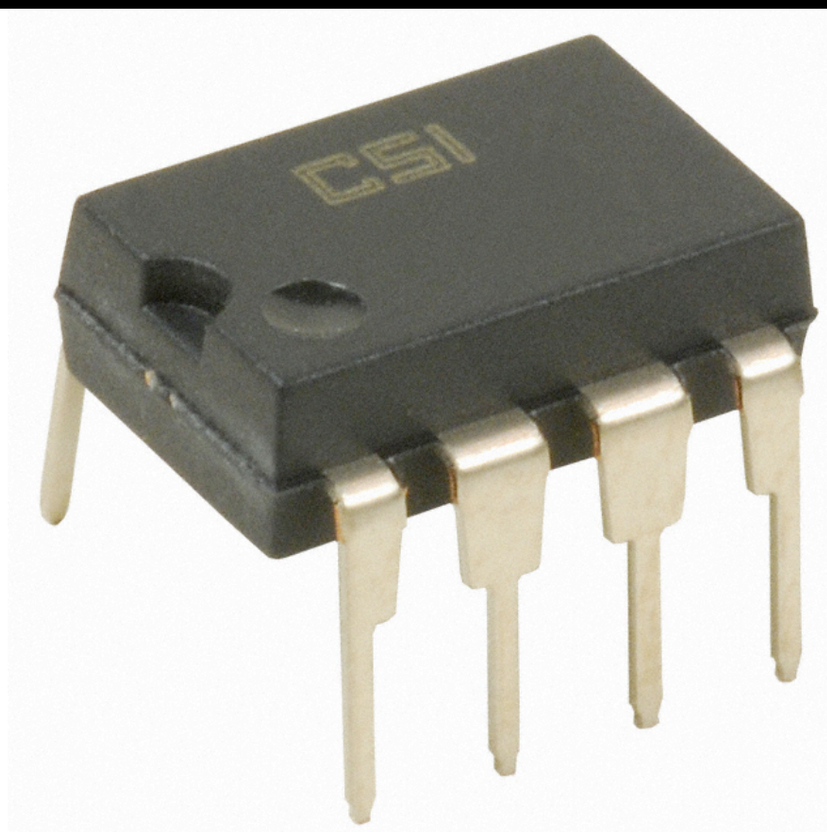


Digital ICs

Memory

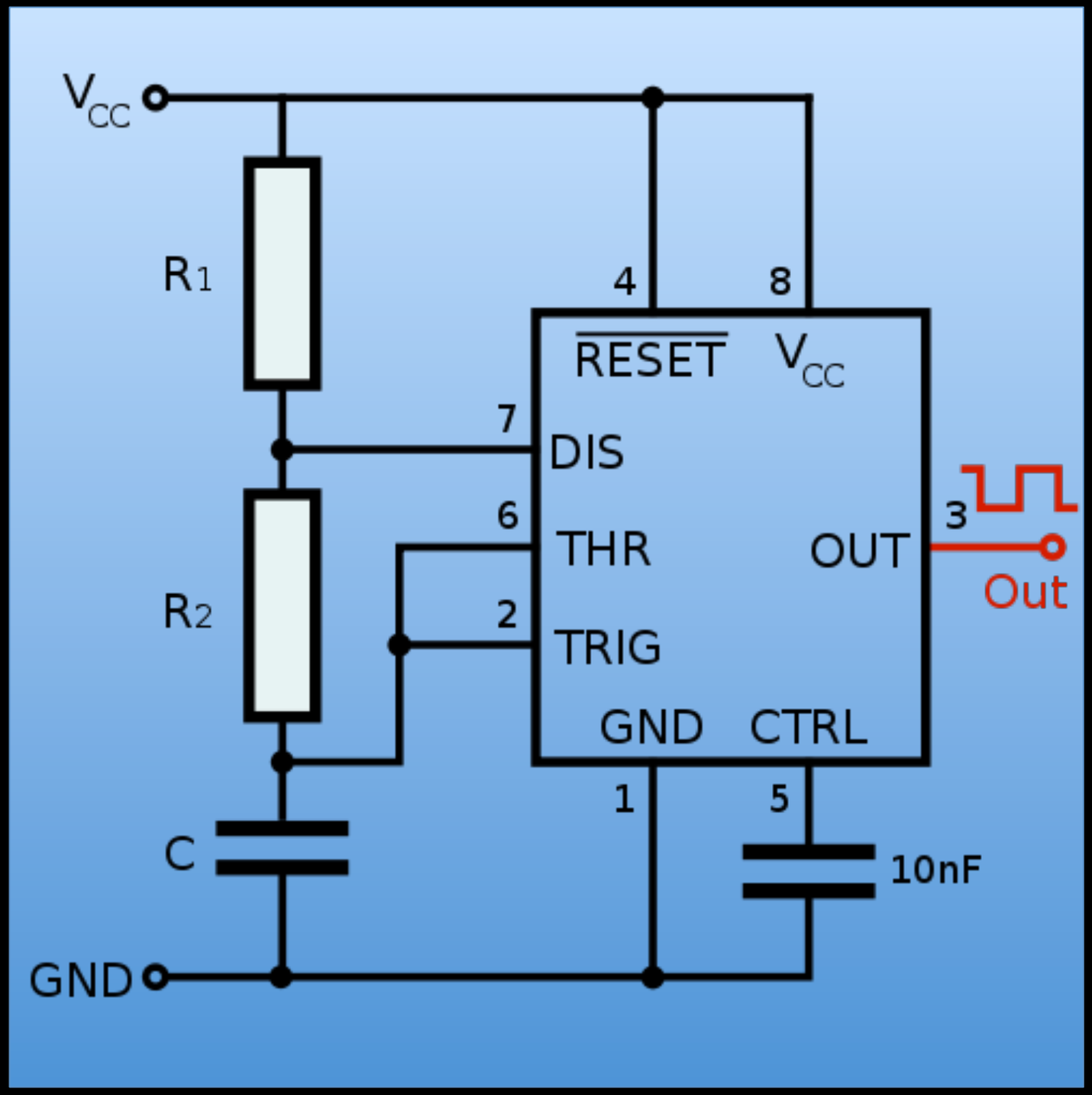
FLASH

EEPROM



Digital ICs

555 Timer



$$f = \frac{1}{\ln(2) \cdot C \cdot (R_1 + 2R_2)}$$

Digital ICs

555 Timer

ASTABLE OPERATION

When the circuit is connected as shown in figure 4 (pin 2 and 6 connected) it triggers itself and free runs as a multivibrator. The external capacitor charges through R_A and R_B and discharges through R_B only. Thus the duty cycle may be precisely set by the ratio of these two resistors.

In the astable mode of operation, C charges and discharges between 1/3 V_{CC} and 2/3 V_{CC}. As in the triggered mode, the charge and discharge times and therefore frequency, are independent of the supply voltage.

Figure 5 shows actual waveforms generated in this mode of operation.

The charge time (output HIGH) is given by :

$t1 = 0.693\ (R_A + R_B)\ C$

and the discharge time (output LOW) by :

$t2 = 0.693\ (R_B)\ C$

Thus the total period T is given by :

$T = t1 + t2 = 0.693\ (R_A + 2R_B)\ C$

The frequency of oscillation is then :

$$f = \frac{1}{T} = \frac{1.44}{(R_A + 2R_B)C}$$

The duty cycle is given by : $D = \frac{R_B}{R_A + 2R_B}$

Figure 4

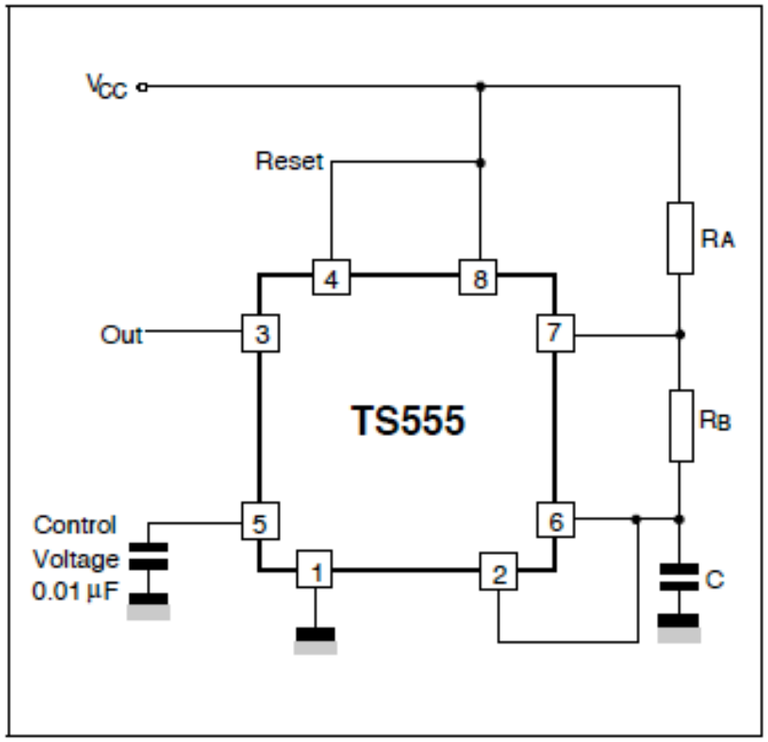
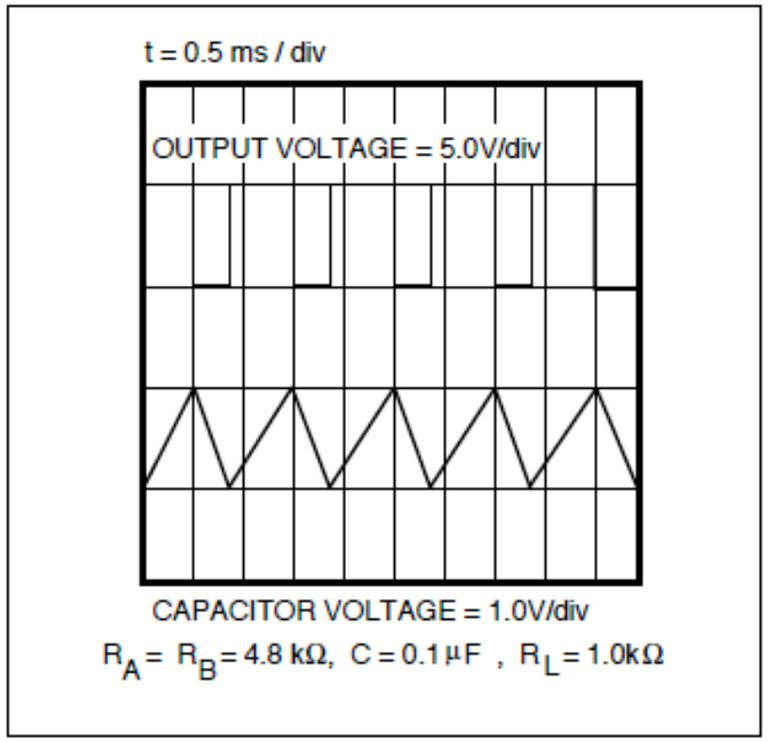


Figure 5



Digital ICs

555 Timer

HOME | LEARNING | CIRCUITS | LINKS | EMAIL US

555 Timer Circuits

555 Timers are fun and a great way to start learning electronics

Learning

The 555 timer is a simple integrated circuit that can be used to make many different electronic circuits. With this information you will learn how how the 555 works and will have the experience to build some of the circuits below.

Fun Circuits

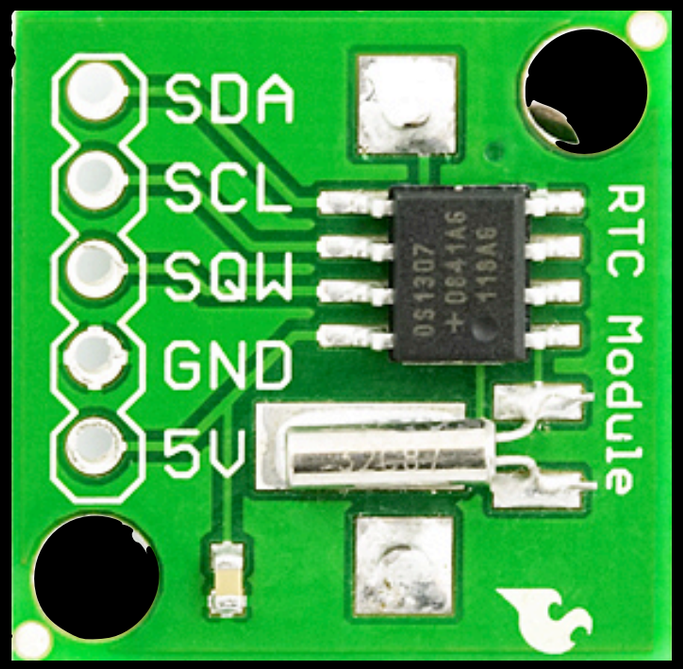
The following are complete electronic circuits that you can build, they all utilize the 555 Timer circuit.

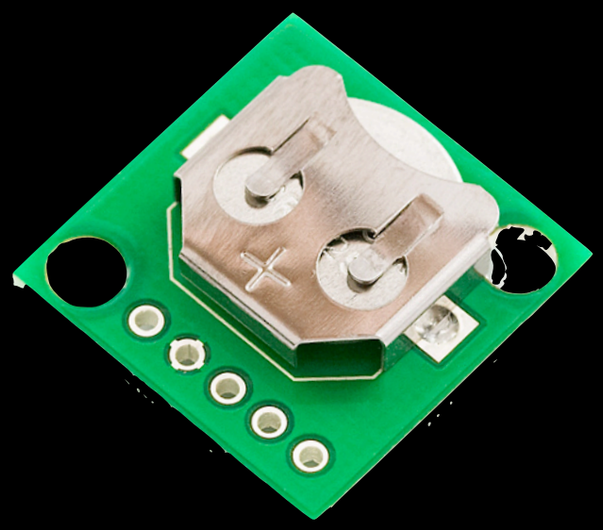
- 3x3x3 LED Cube
- 555 Amplifier
- Automatic Curtain Closer
- Bike Turning Signal
- Bi-Polar LED Driver
- Car Tachometer
- Laser Ray Sound
- Latch
- LED Dice
- LED Dimmer
- Light Detector
- Machine Gun
- Siren 100dB
- Stepper Motor Controller
- Stun Gun
- Ticking Bomb
- Tilt Switch
- Touch Switch

Digital ICs

Real-Time Clocks

DS1307



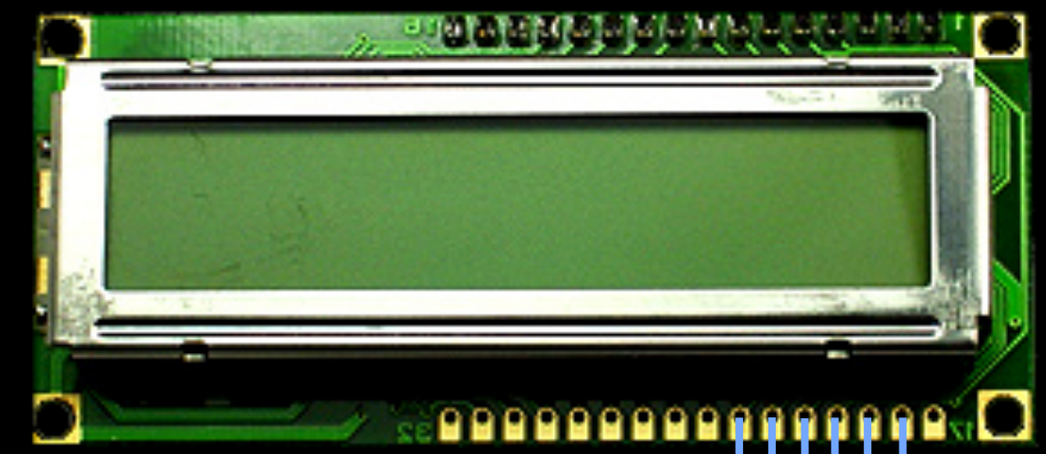


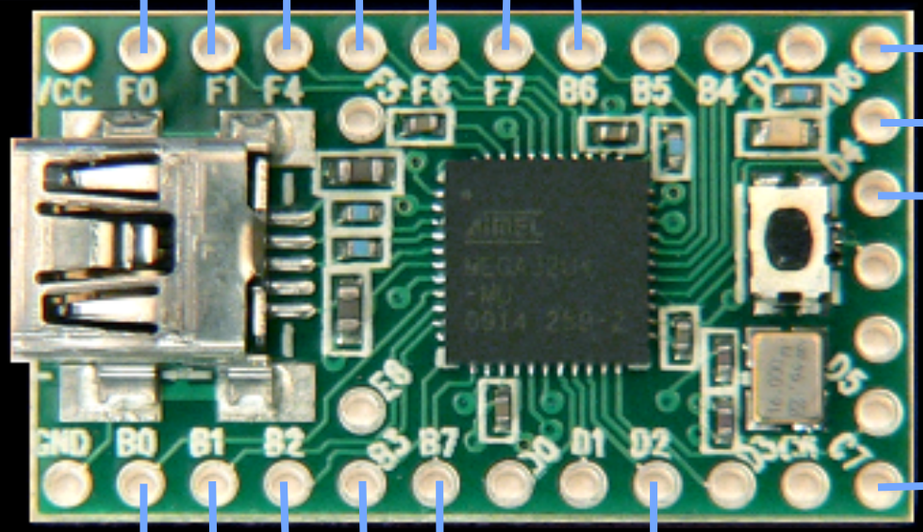
- Seconds, minutes, hours, date, month and year
- Battery lasts for 7-9 years
- Keeps track of leap years!

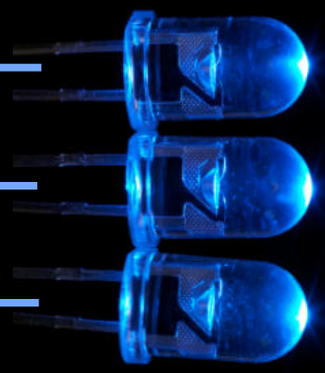
Visit http://www.sparkfun.com/products/99

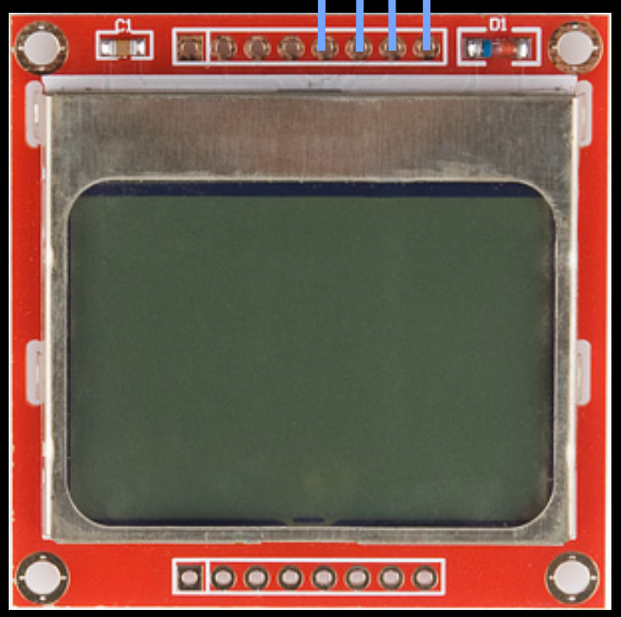
Digital ICs

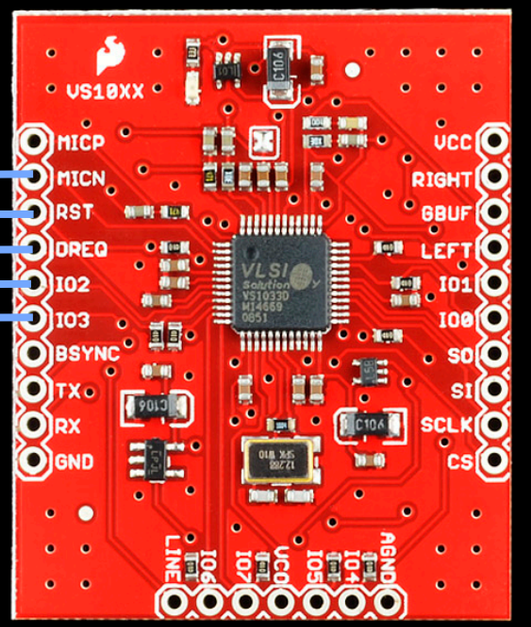
Saving Pins





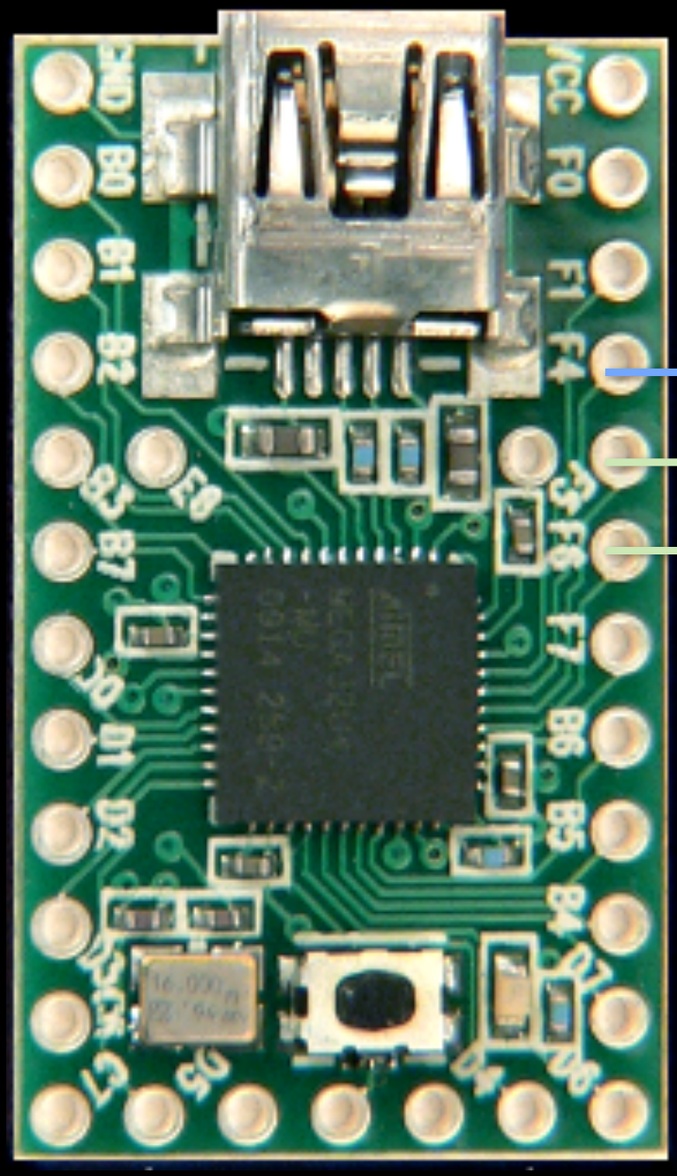


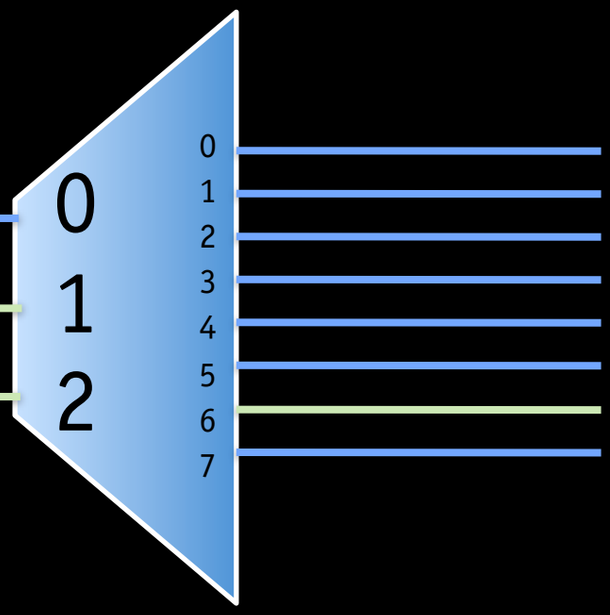




Digital ICs

Decoder

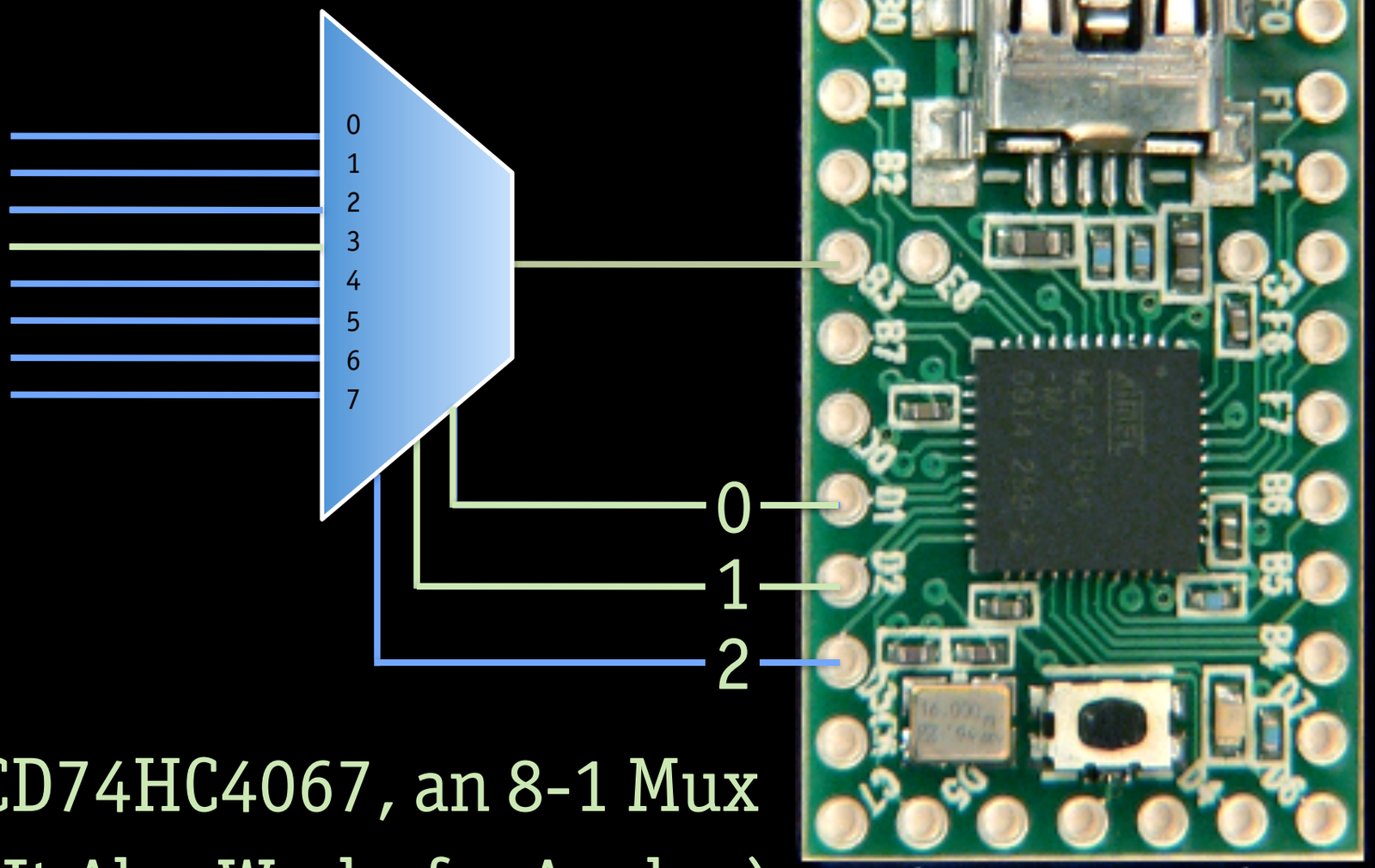




Chip Select Lines

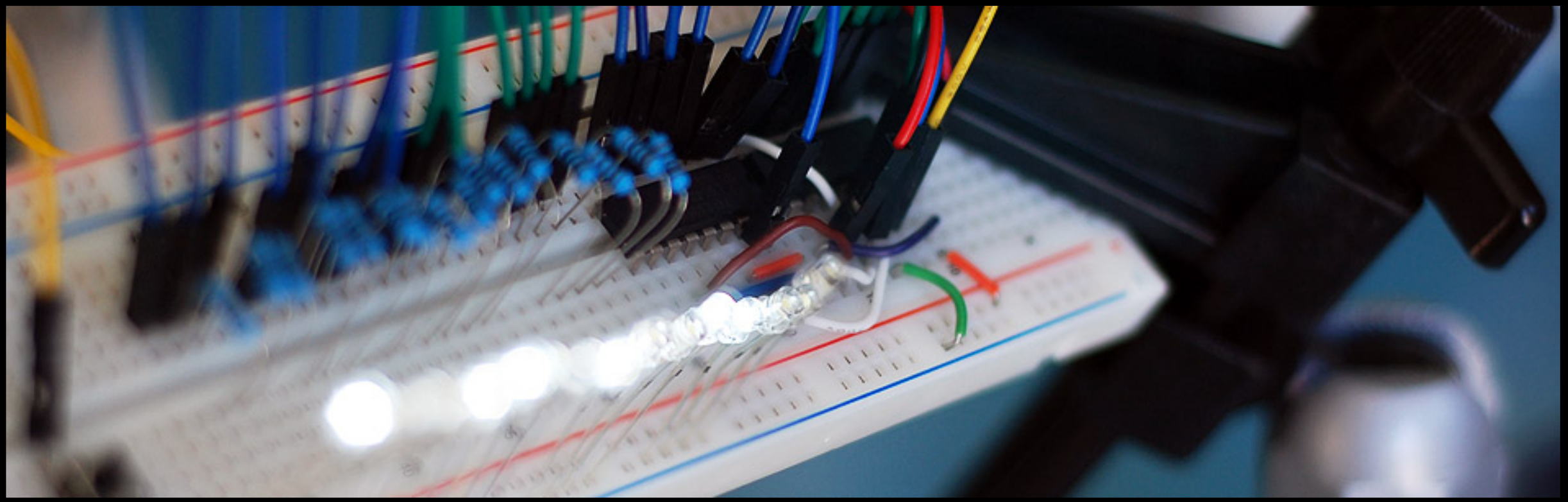
74HC238, a 3-8 Decoder

Digital ICs
Multiplexer



CD74HC4067, an 8-1 Mux
(It Also Works for Analog)

Digital ICs
Shift Register

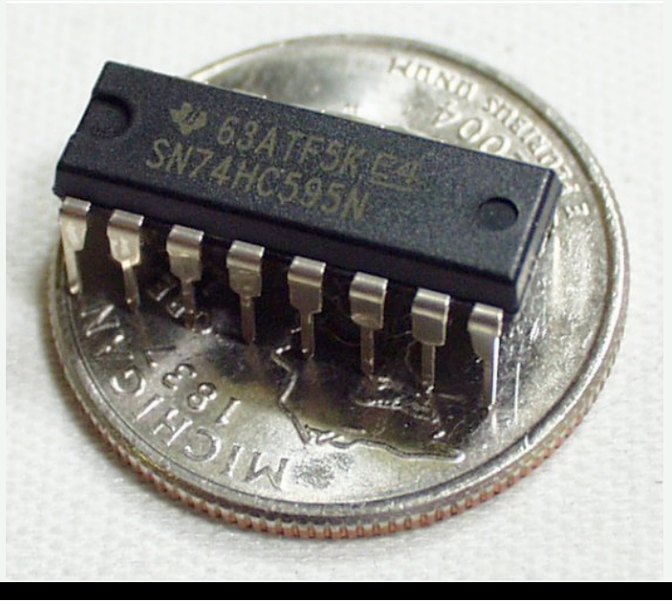


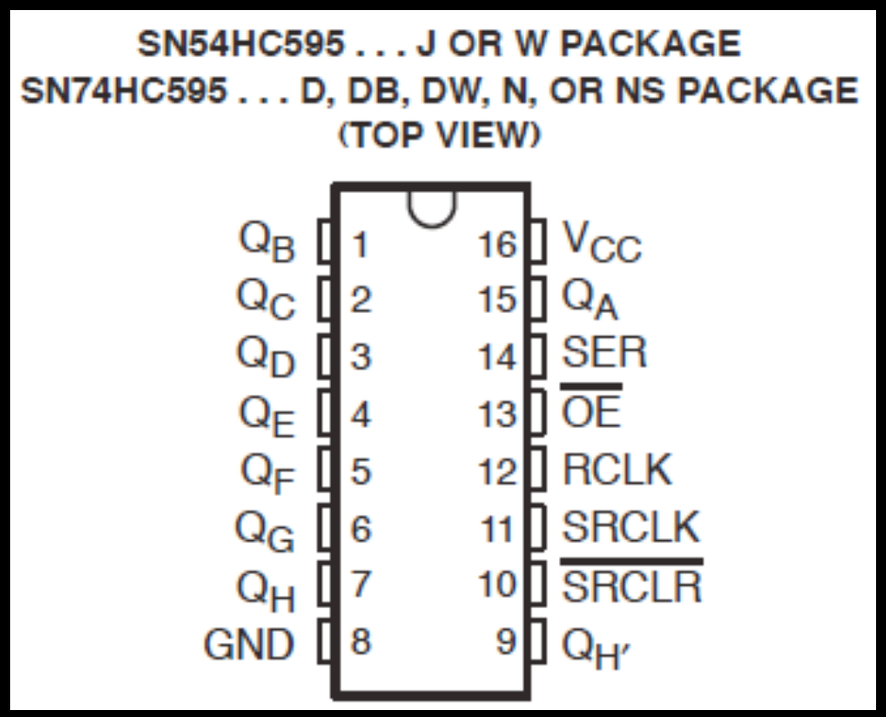
Say you want to control a huge number of LEDs with your Teensy…

Visit http://bildr.org/2011/02/74hc595/

Digital ICs

Shift Register





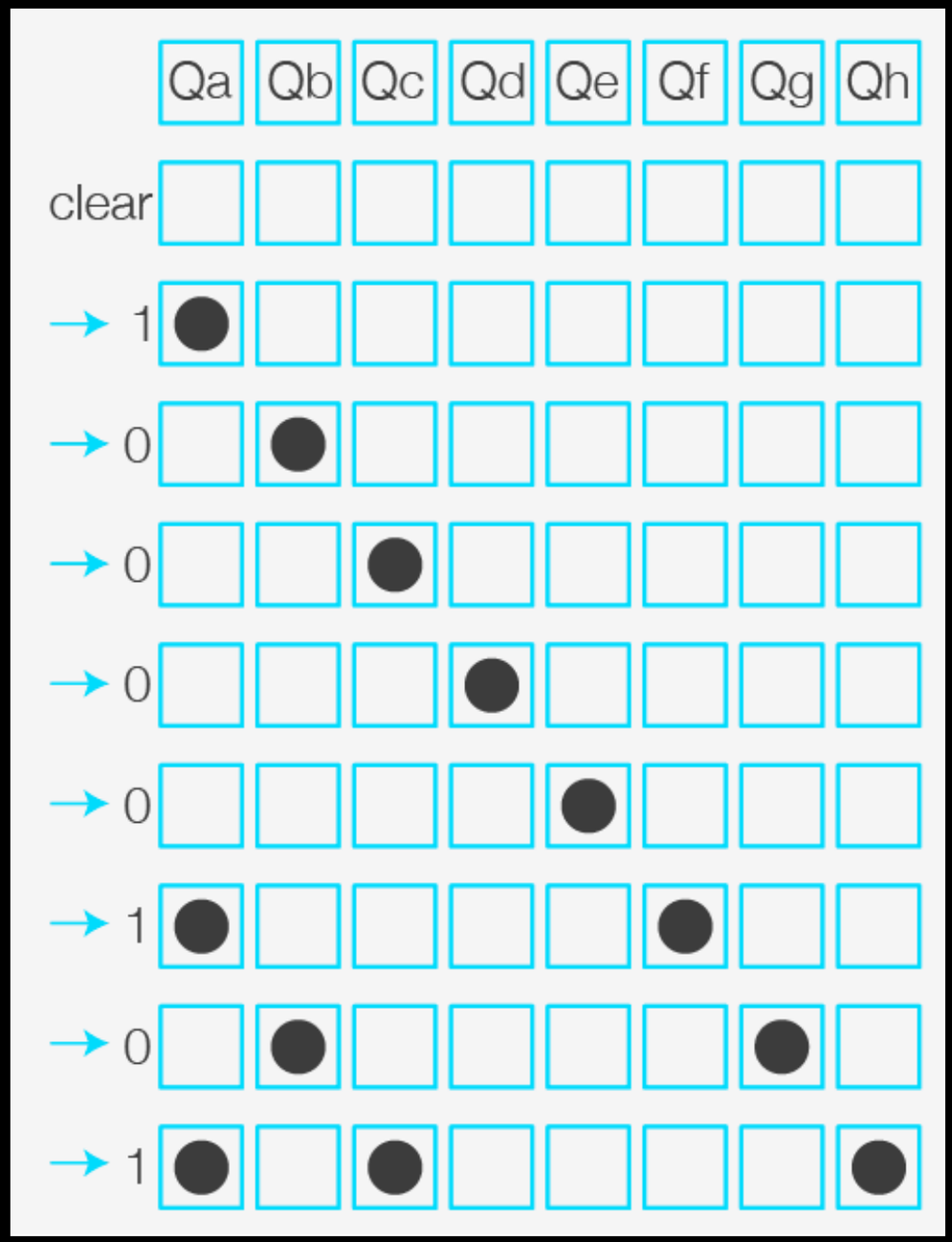
What does a shift register really do?

- Data is read in on the serial (SER) input line
- Data is shifted once with each clock cycle (SRCLK).
- The 'register clock' (RCLK) acts like a clutch, and holds current values when set LOW.

Digital ICs
Shift Register

To turn on the 1st, 3rd and 8th LEDs:

- [ ] Pull SRCLR low to clear the register
- [ ] Pull RCLK low to clutch the output
- [ ] Pulse SER 1, 0, 0, 0, 0, 1, 0, 1 with each CLK pulse
- [ ] Pull RCLK high to turn on the LEDs

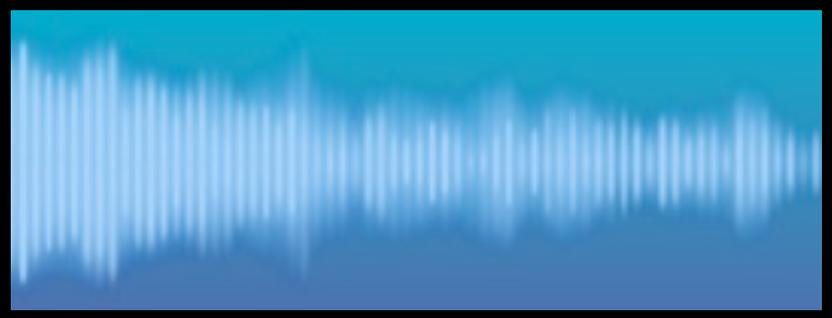


Integrated Circuits

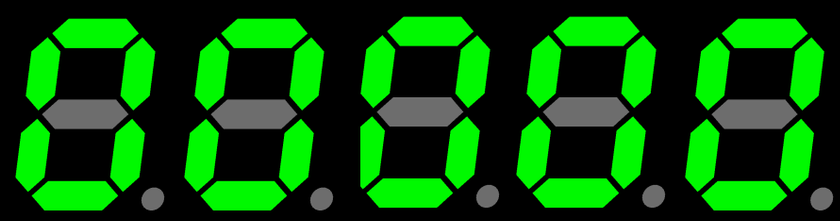
There Are So Many More!

Specialized Processors (Like Your Mp3 Decoder)

- Digital Signal Processors



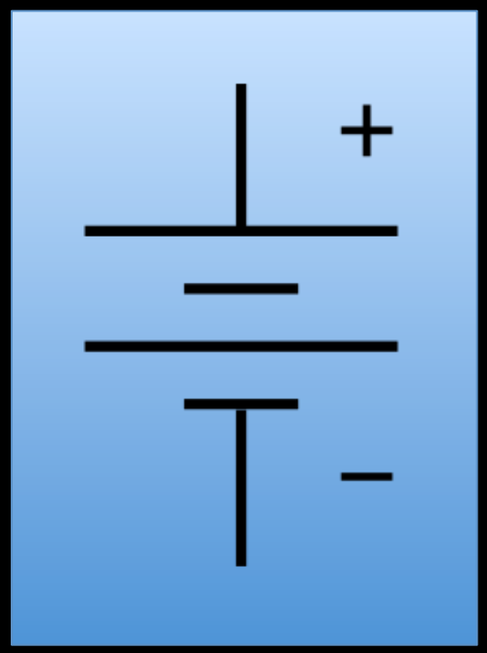
- 7-Segment Display Driver (MC14489B)



- Check out SparkFun's General ICs page for more!

Choosing ICs

Voltage & Current



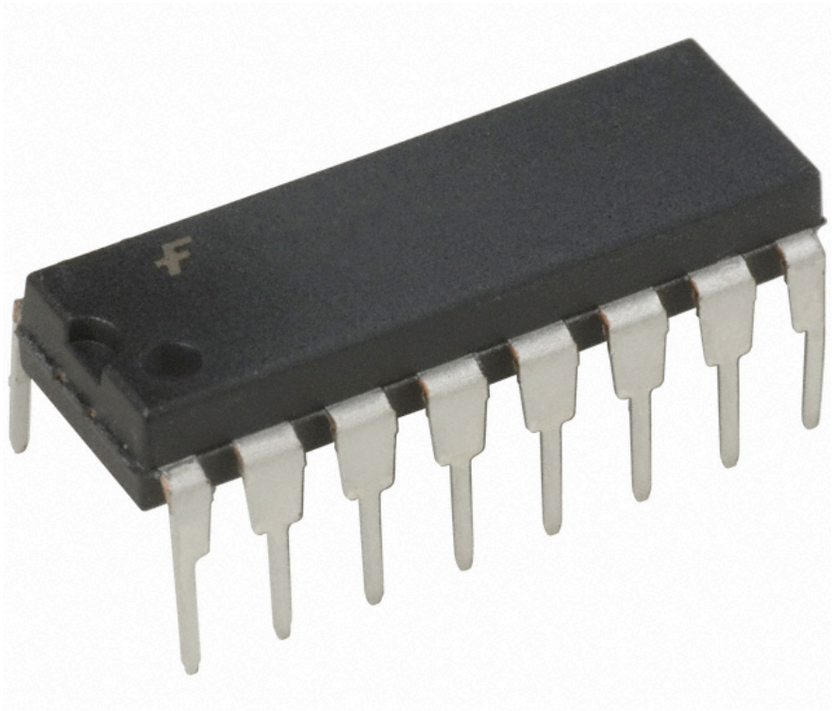
- Choosing parts with the same operating voltage will save major headaches and components!

- Keep your power source in mind. USB, batteries and voltage regulators can only provide so much current.

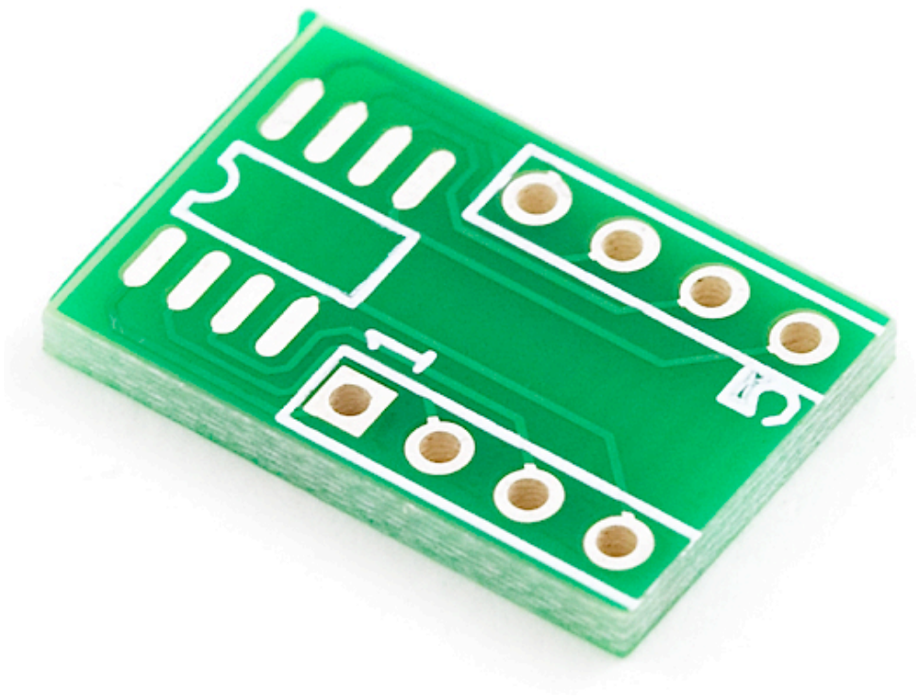
Choosing ICs

Packaging

16-DIP



8-SOIC to DIP Adapter



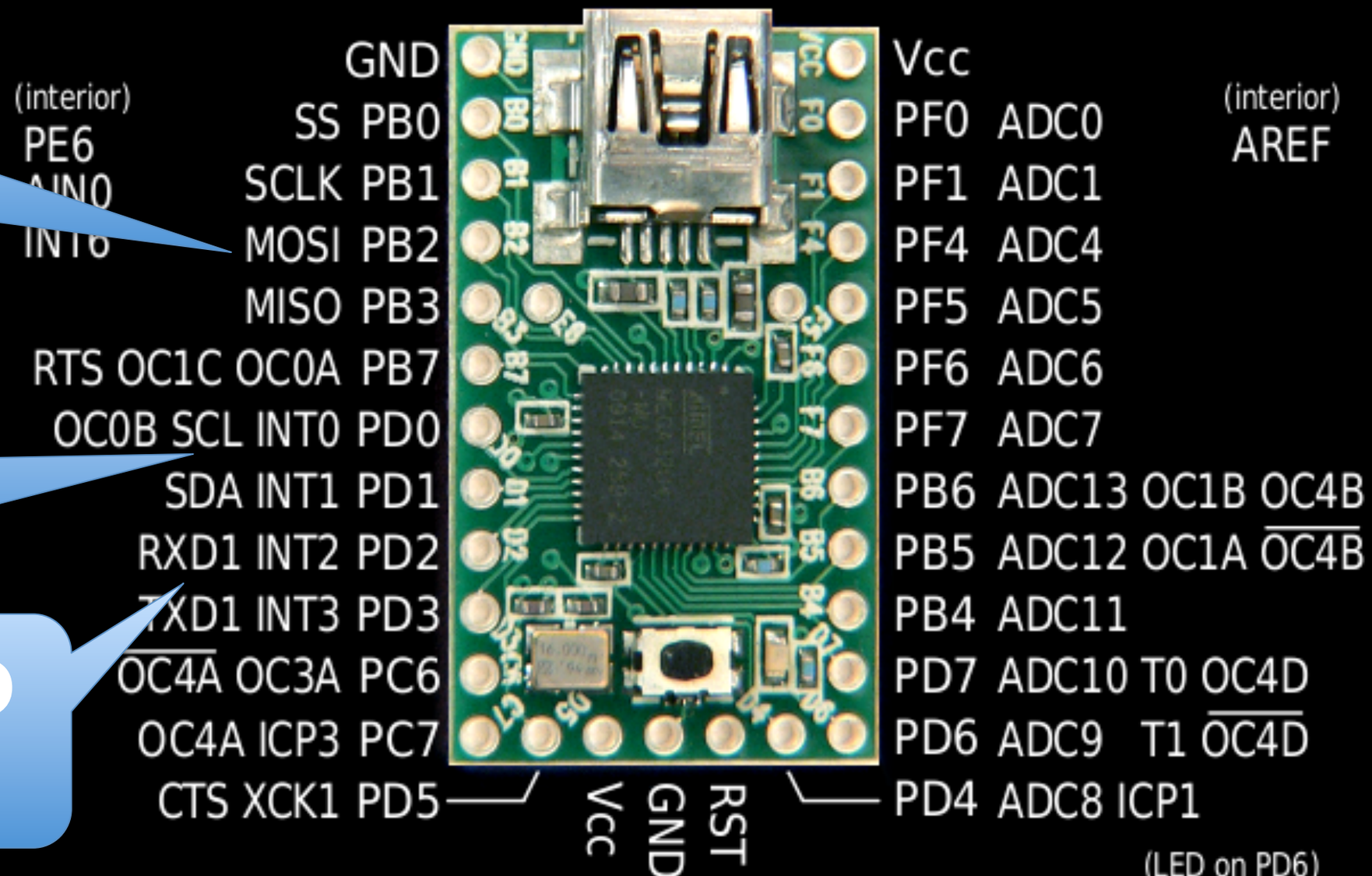
Choosing ICs

Communication Interface

SPI?

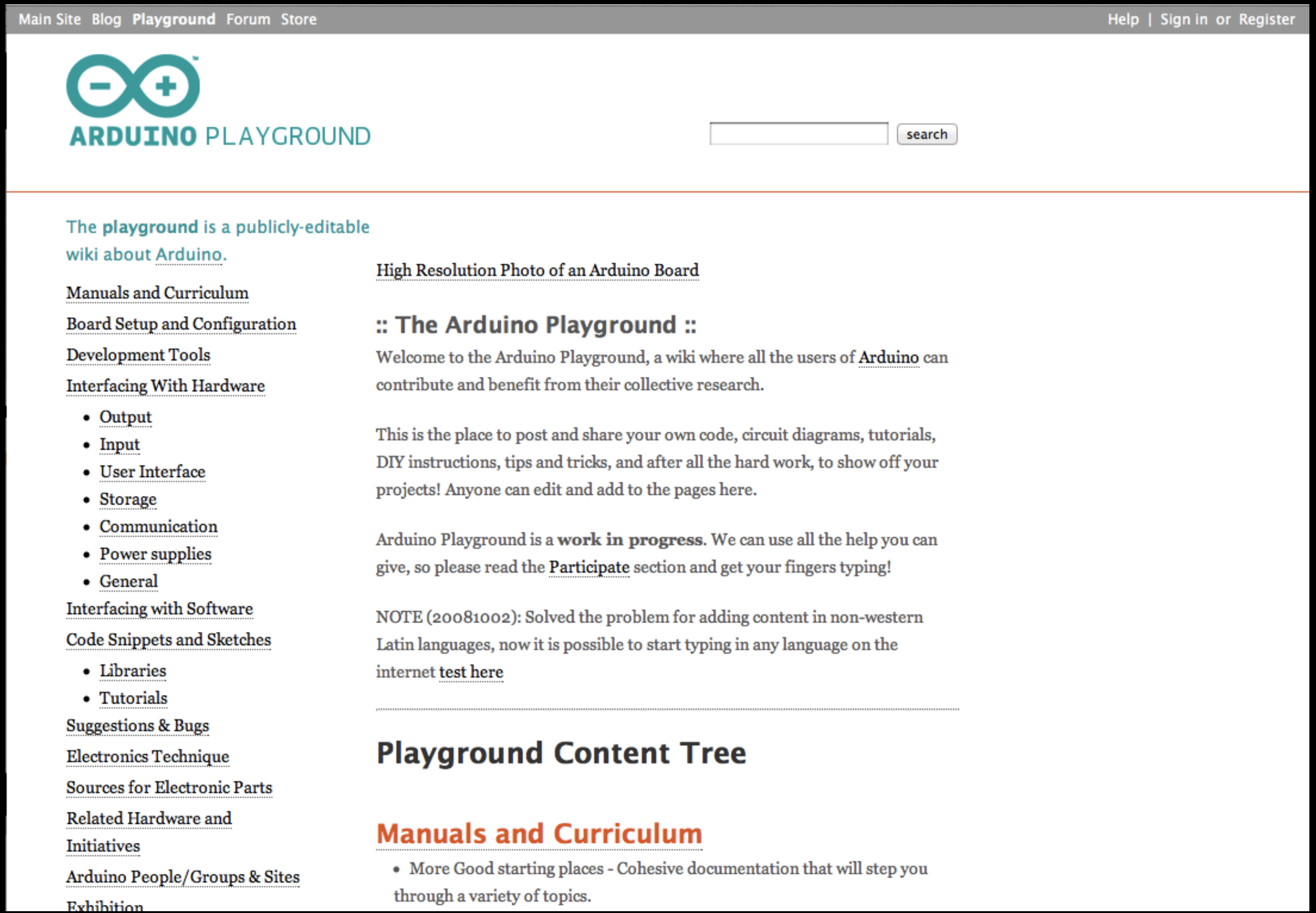
I²C?

UART?



Choosing ICs

Community Support



Lab 6 Preview

Using Your MP3 Decoder (Finally!)

Interrupt Handlers (ISRs)

Debouncing Buttons

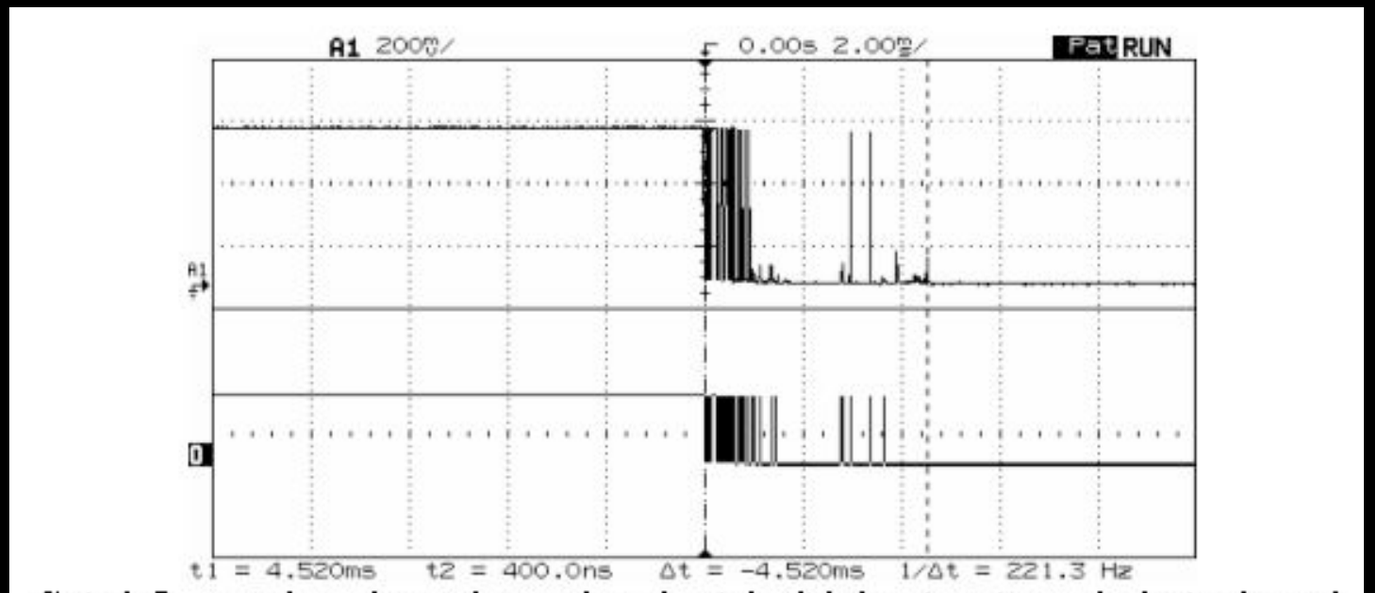
Lab 6 Preview

Interrupts

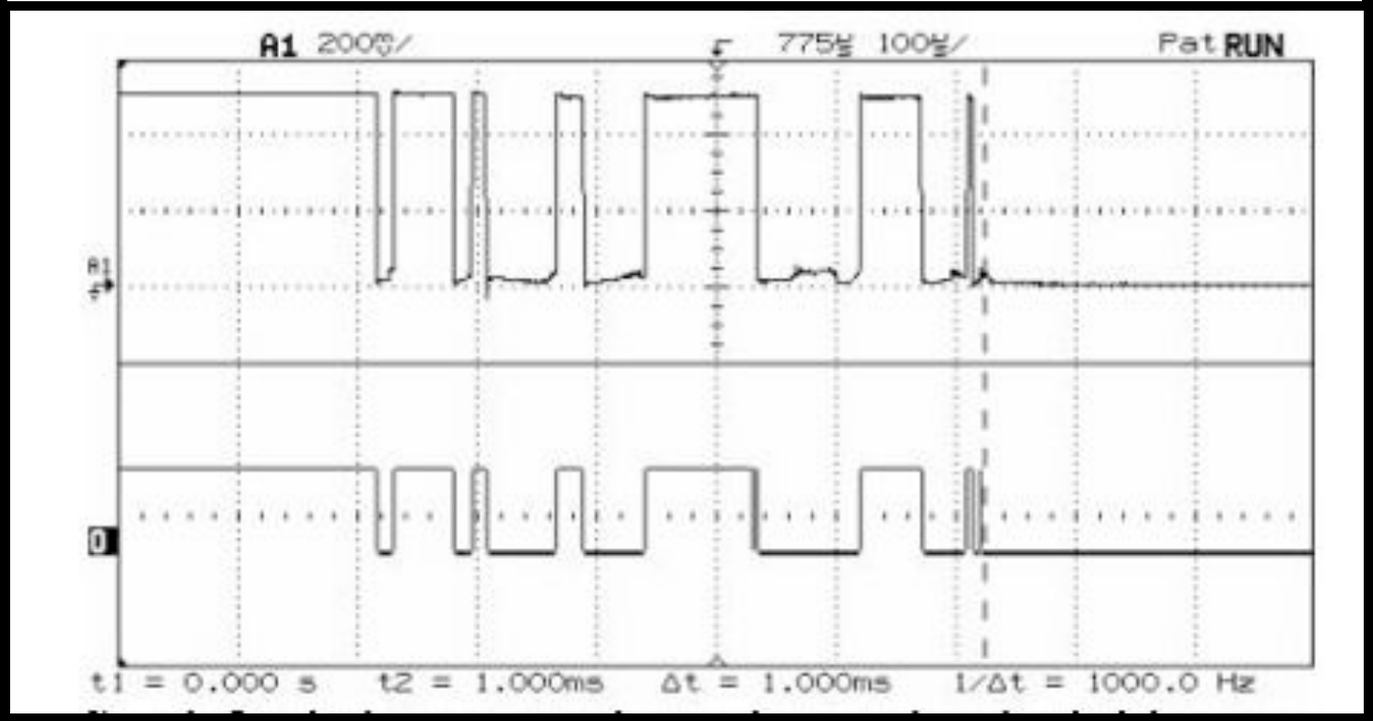
Write a special function (an 'Interrupt Service Routine' or ISR) that gets called exactly when the button is pressed.

Lab 6 Preview
Debouncing

What happens when you press a button?



Switch B – note how the analog peak to the right didn't quite trigger the logic channel.



Images from the Ganssle Group

Mindmaps

How to Brainstorm on Your Own

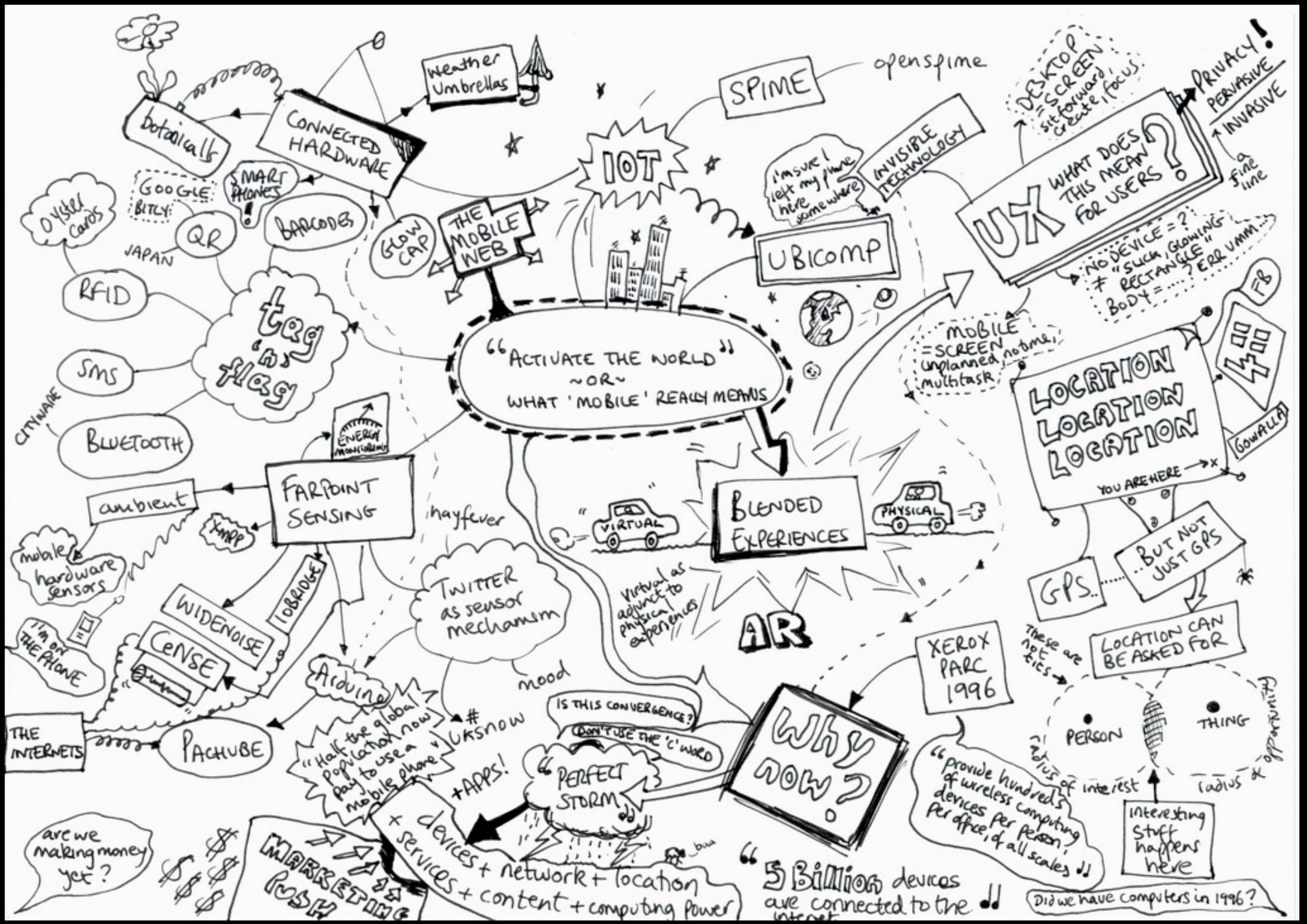


Image from Flickr: dmje

MP3 Project Design Activities

Create a Mindmap

Develop a Point of View

Draw Sketches and Diagrams

Requirements and States (If Ready)

Paper Prototype an Interface to Your Player