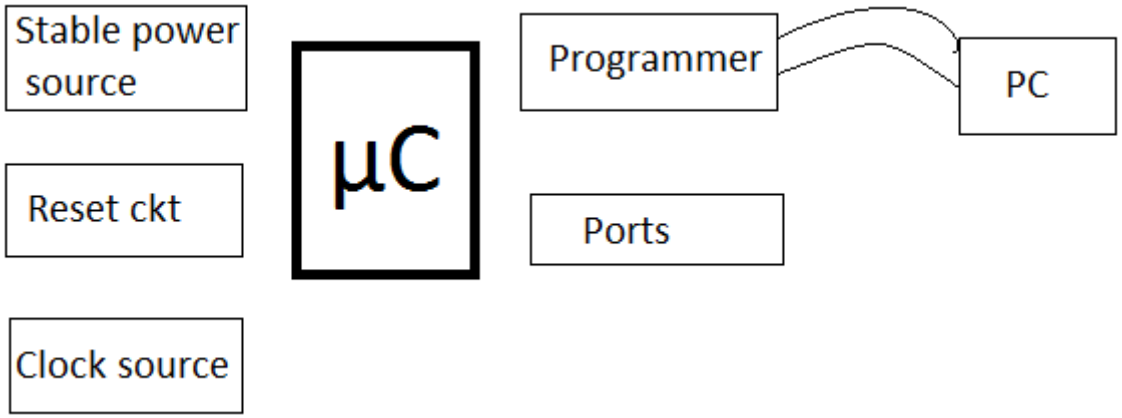
ASICS required for uC board

By *Deep*

Minimum requirements for µC to work properly



Stable power source

- µC generally requires voltage from 4.5 v to 5.5v DC.

- Battery
- Wall adapter
- USB

Batteries

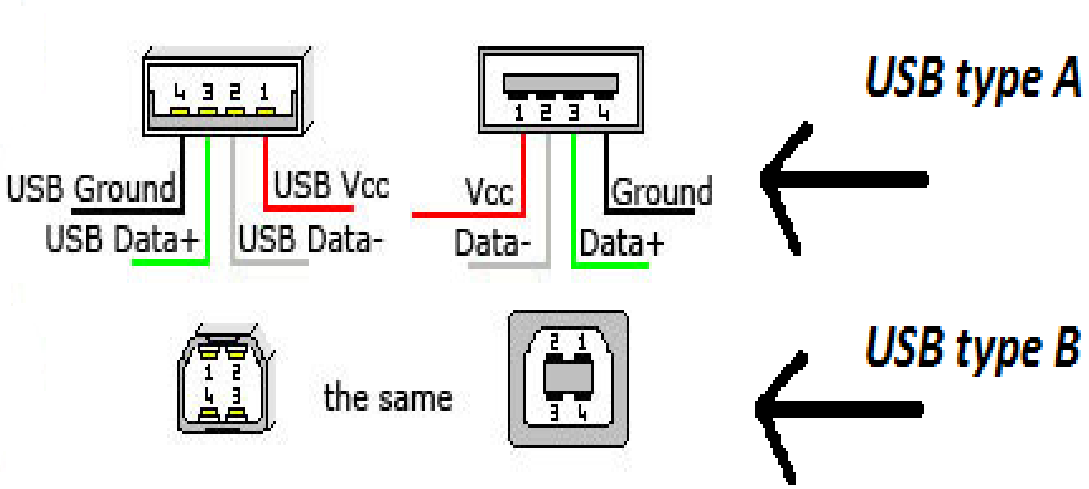
- A 100 mAh battery Life??
- 0.1hr for 1000mA
- 1hr for 100mA
- 10hrs for 10mA

- Current * Time =mAh (Constant)

Wall Adapters

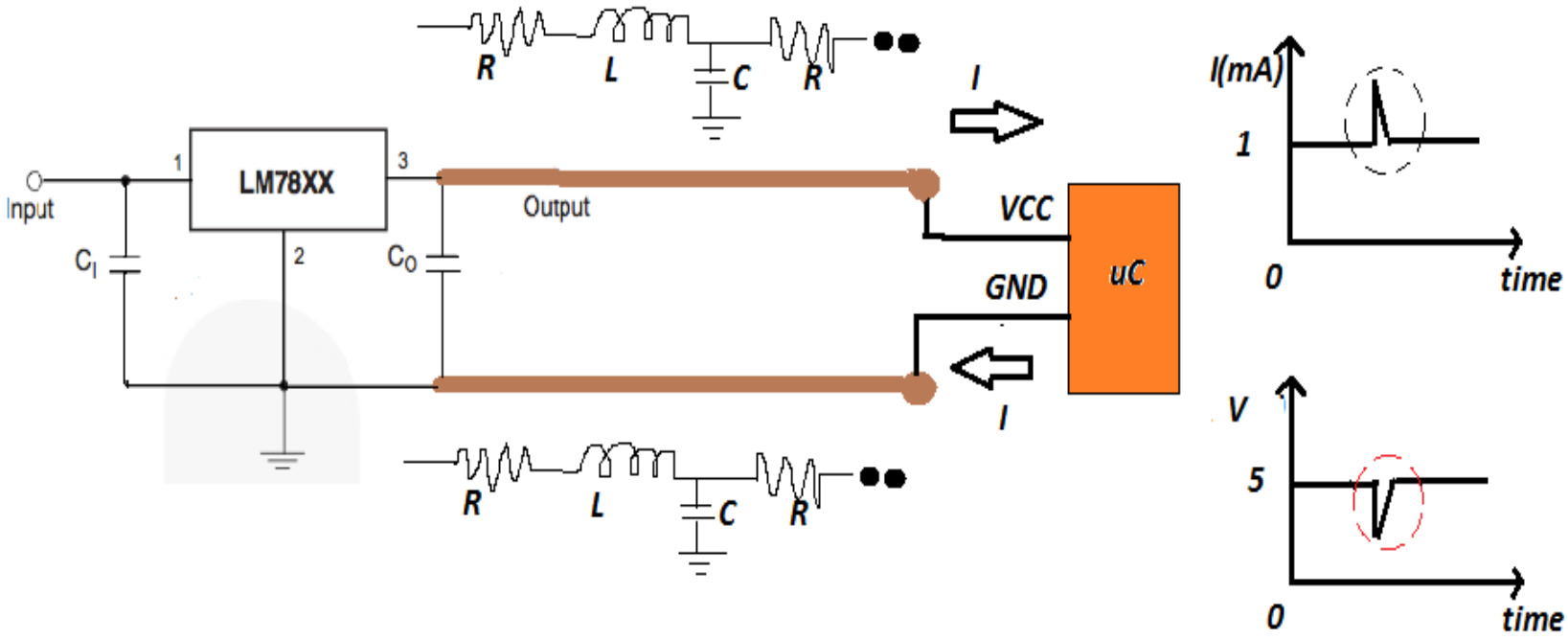
- Different ratings chargers are available having output voltages as 5V ,9V ,12 V etc.
- BUT we need 5V DC!!! How will we achieve this??
- Potential divider with resistors ?
- Potential divider with Capacitors ?
- Zener diodes?
- Better solution is Voltage regulators (Buck regulators). E.g. 7805 for 5V.

USB



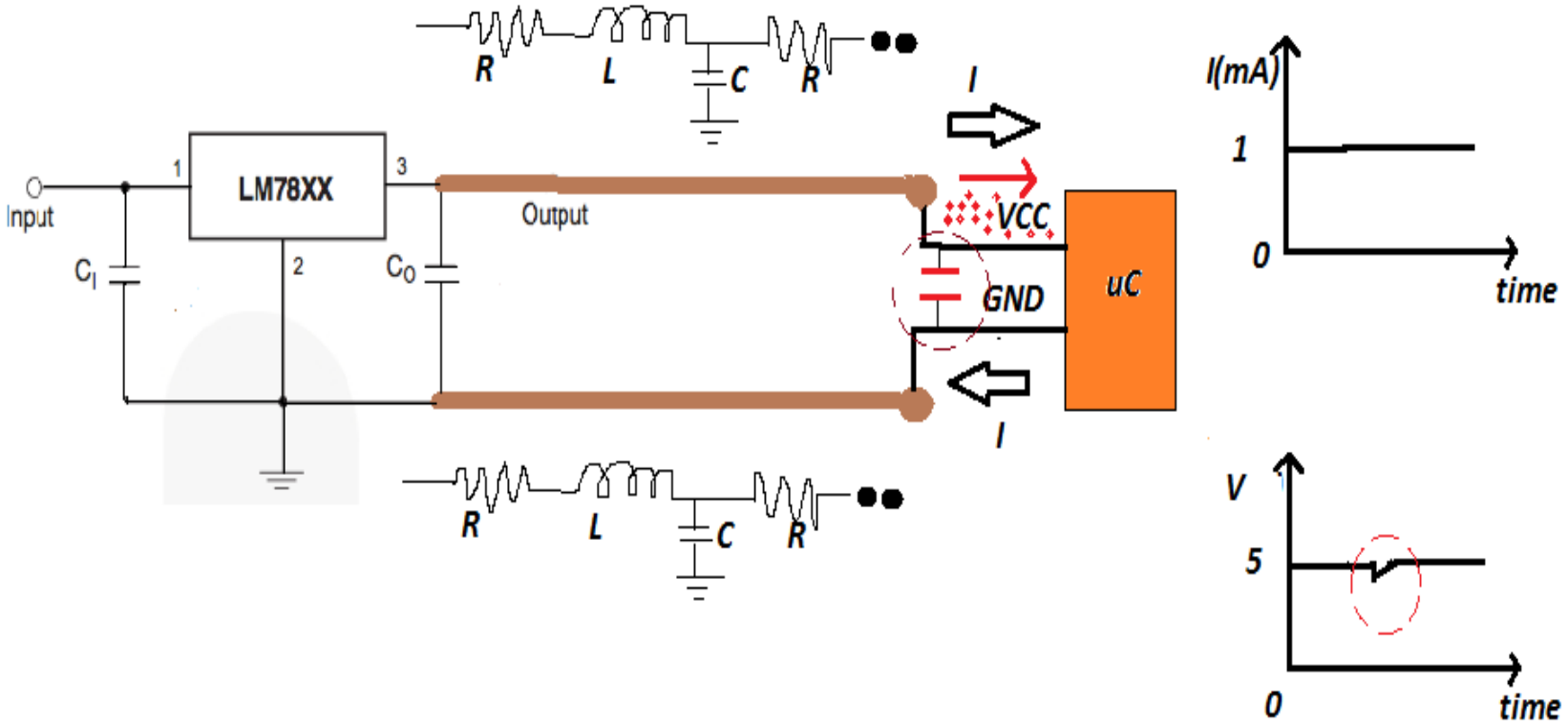
- USB runs at 5V.
- The max current you can draw is 500mA.
- Therefore the max load is 5V x 0.5A= 2.5Watts.

Voltage regulator



How to avoid Voltage dips near VCC pin???

DeCap is the solution…



Decap acts as a reservoir of charges & supplies them when needed.

Choice of Crystal oscillator over internal RC oscillator

- For an oscillator ,BW α phase noise.
- If BW↑ , phase noise ↑, frequency constantly changes (due to temperature changes & jitter)
- Quality factor $= \frac{f_{centre}}{BW}$
- $\frac{Q_{crystal}}{Q_{internal\ RC\ oscillator}} \cong 1000$

Crystal Vs Internal oscillator

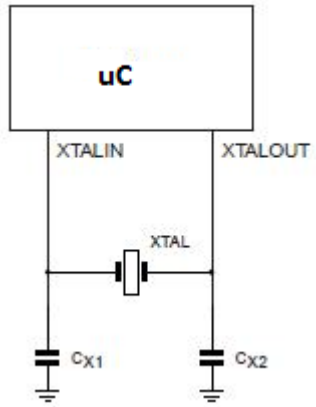
- Use Crystal oscillator when timing requirements are stringent otherwise you may go for internal oscillator.

- E.g. For an Real time clock (RTC) application

Crystal oscillator	Internal RC oscillator
0.05% accuracy	2% accuracy
0.05% of 365 $\cong$ 0.1825 day i.e. RESET clock after 5 $(\frac{1}{2})$ years.	2% of 365 $\cong$ 7.3 days i.e. RESET clock after every 7 days.

Why to use caps along with crystal?

- Crystal are designed for a given C_{load} & they give maximum accuracy for that value.

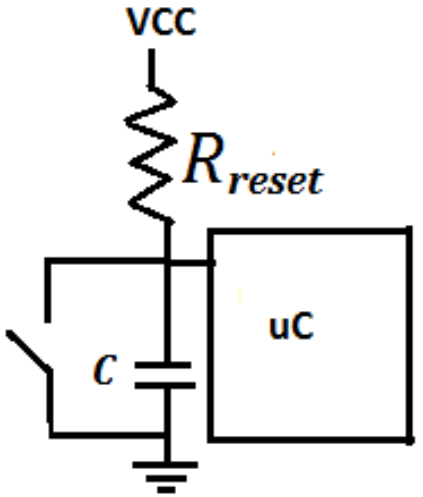


- $C_{load} = \frac{C_{x1}.C_{x2}}{C_{x1}+C_{x2}} + C_{stray}$
- Assuming that $C_{x1} = C_{x2}$ then the equation becomes:

$$C_{x1} = 2C_{load} - 2C_{stray}$$

- C_{load} is specified by the manufacturer & C_{stray} is generally from 2-5pf.

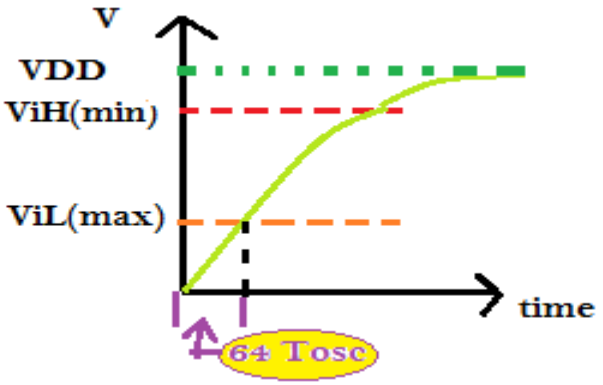
Reset Circuit



- It should be kept low for 64 oscillator cycles i.e. $t_{reset} = \frac{64}{f_{crystal}}$.

- $V_c(t_{reset}) = Vcc\left(1 - e^{-\frac{t_{reset}}{RC}}\right) < V_{IL}$

- $V_{IL}(datasheet) = 0.2\,Vcc\ - 1$.
  $For\ V_{cc} = 5v\ it\ is\ 0.9v.$



R_{reset} (datasheet). Take min value to calculate for worst case. $R_{reset(min)}$=50KΩ.

After calculations, we get C>0.269nF.

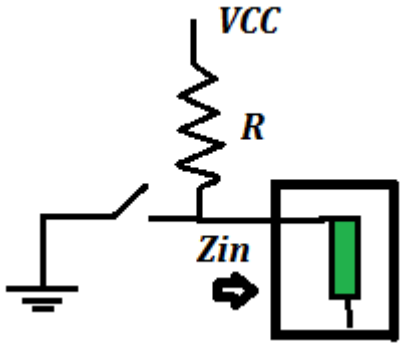
Dumping our Hex to uC

- Atmel chips can be programmed either by ISP (In-System Programming) or using Bootloader.
- For ISP, we require a programmer (hardware)

1. Serial port programmer
2. Parallel port programmer
3. Smart ISP programmer

- A bootloader is a small piece of software that runs on the uC when it is reset.
- It does not require any programmer.
- It basically sits there waiting for a new program to be downloaded, and **load**s it into memory not used by the bootloader.

Pull-up Resistor



- The pin is configured as i/p & what if there is no pull-up or pull-down?
- Some ports have internal pull-up whereas some have open-drain configuration(pull-up is needed).
- Two Criteria's need to be met

1. Not too low value (1kΩ) to avoid Power dissipation.
2. Not too High value (1 MΩ) to avoid low switching speed.

- Generally a10KΩ resistor is used for open-drain ports.

Switches interfacing


Push button


Rotary

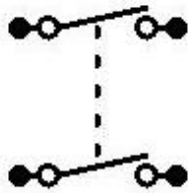

Toggle

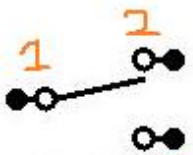

Slide

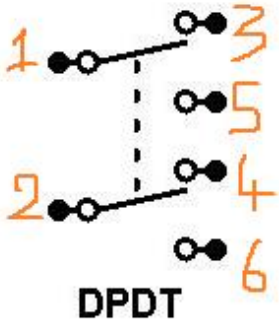

DIP


push button


SPST

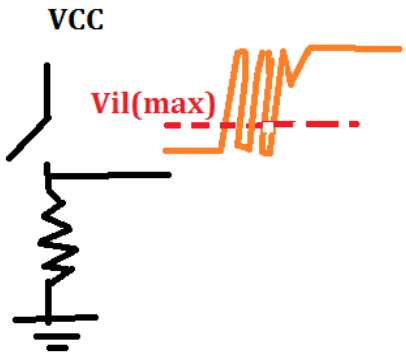

DPST

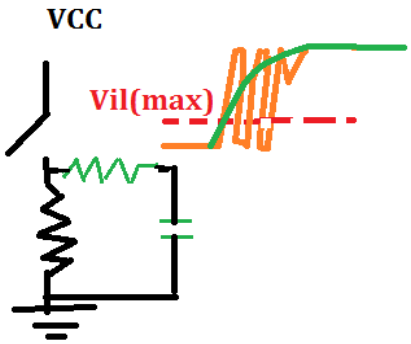




Switch bouncing & remedies…

- When the switch is closed, the two contacts actually separate and reconnect, typically 10 to 100 times over a period of about 1ms.This is called Switch bouncing!!!!

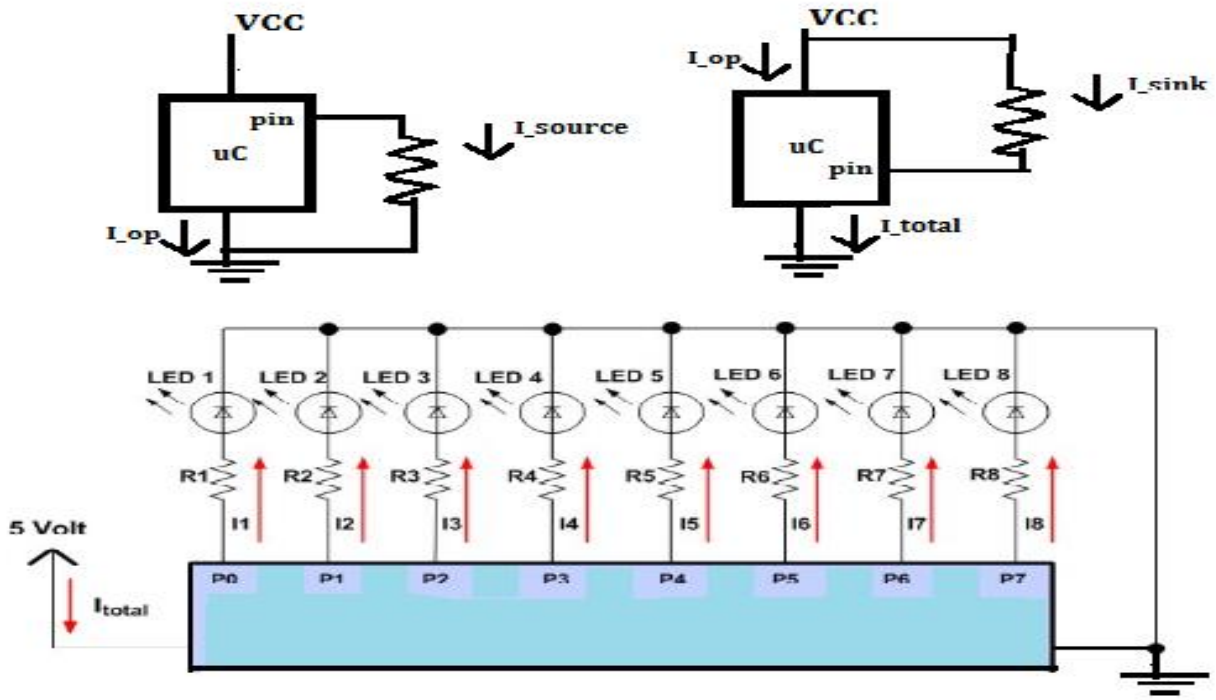




- REMEDIES
- Additional hardware (a cap & resistor).
- Software debouncing…

Ref: "The Art of electronics", Horowitz & Hill, Second edition, pg 506.)
Usually, the hardware works faster than the bouncing

Driving capabilities



- Let us say I_sourcemax(datasheet)=80mA, I_led=$\frac{5-3}{330} = 9.1mA$
- I_total=8*9.1+ 1=73.8mA
- (Still safe but there is possibility of blowing off if we don't take care.)

Tank yu!

(Thank you!)