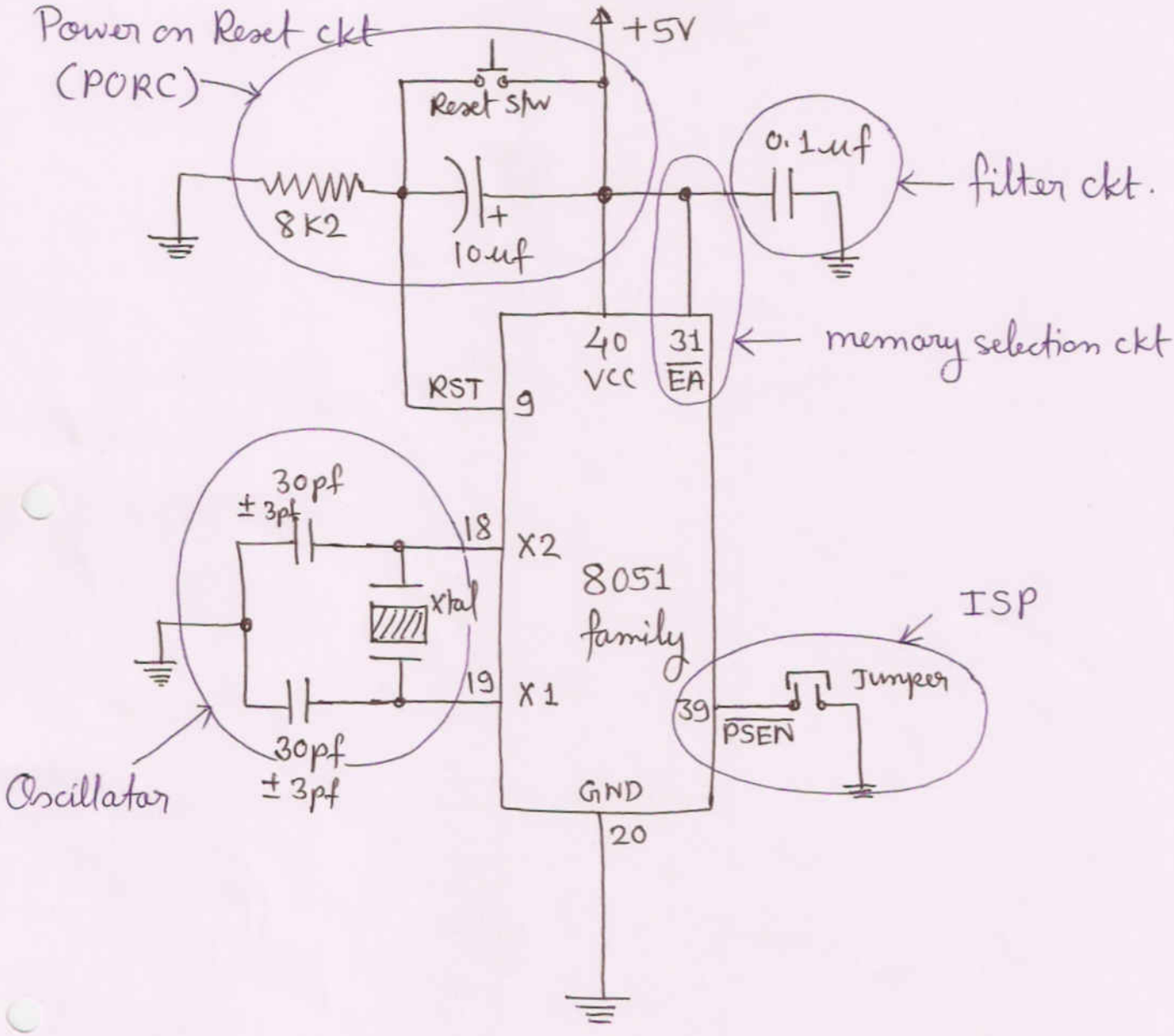
Basic Circuit Diagram of μC :-



-the above is the minimum system configuration that is required for a μc to start or to run properly. this the common circuit for any μc based embedded system. It has five basic blocks —

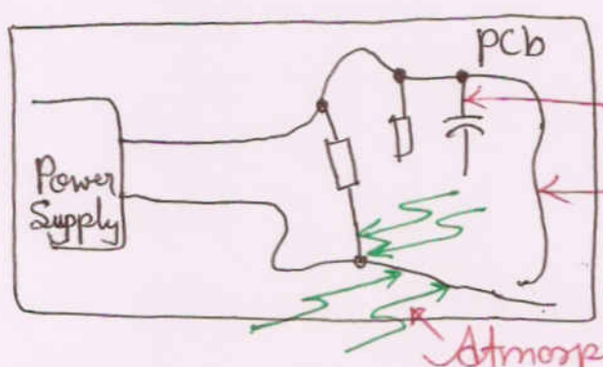
1. filter circuit unit
2. Xtal Oscillator circuit unit
3. Power on Reset circuit unit
4. Code memory selection unit
5. In System Programming unit.

① Filter Circuit Unit :-

the job of this circuit is to filter out any A.C. signal noise present in the power supply input. the uc requires pure D.C. volts (+5V) for its proper working. For this purpose we have connected 0.1uf capacitor between pin 40 of uc & ground. Capacitor have basic function of passing A.C. signal from it & blocking D.C. signal, because the impedance of capacitor is given by - $X_c = \frac{1}{2\pi f_c}$.

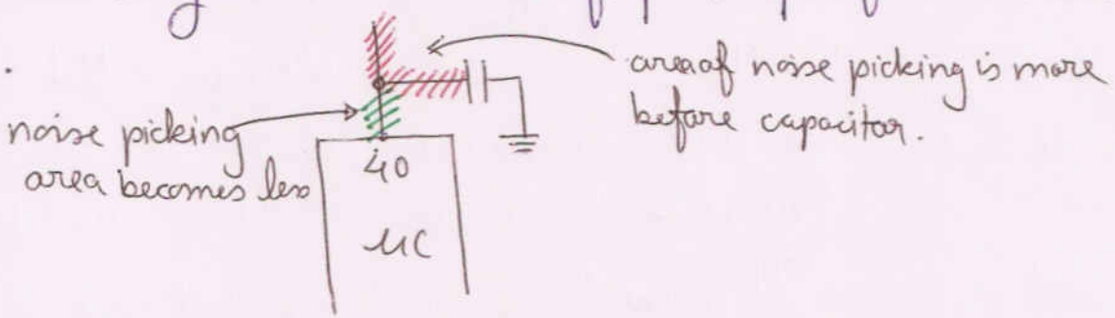
Q. The filter capacitor is also included in the power supply system, even though it is mandatory to connect it very near to pin no 40 of uc - why?

A. To answer this question first we will see how the A.C. noise is generated even though there is already filter circuit in the power supply system - there are various frequencies present in the atmosphere which continuously collide with the track of the PCB & the open legs of the various components mounted on it. Due to this flow of electrons are disturbed producing small waveform in the circuit. this is known as Component noise or Atmospheric noise.



this is the reason that again noise (A.C. signals) are induced in the circuit even there are several filter circuits in the power supply section.

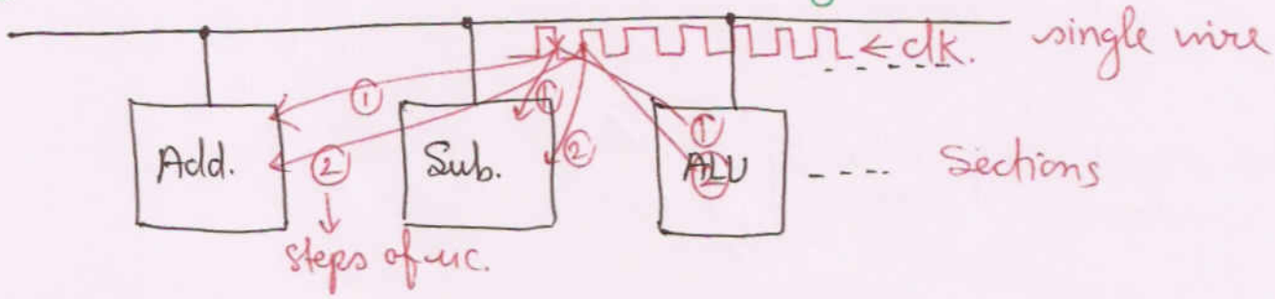
By connecting 0.1 uf capacitor very near to pin no 40 (i.e. near to Vcc of uc) makes it sure that all the component noise are reduced or filtered out and hence forth only pure D.C. will enter in uc. The noise entering to uc becomes very less as area of pickup of noise becomes very less.



{ In any embedded system we will find a filter cap. near to each digital IC – as recommended by datasheets. }

② Xtal Oscillator circuit Unit :-

the uc is internally made up of different blocks or individual sections. To syncronize the various operations of various sections in uc it requires a common clk pulse to be run. this is provided by the external Xtal connected. the operations are carried out at -ve going edge trigger ↓ of the pulses simultaniously by each sections.



Thus the speed of µC depends upon the frequency of the clk pulse. the external clk is divided internally by 12 in case of standard 8051 family µC. We can connect 0 – 24 MHz crystal according to datasheet. the capacitors are used to support the crystal for oscillations and values are standard according to datasheet (30pf ± 3pf).

Q. What is standard Crystal ?

A. Any Crystal value that is multiple of divider value of µC is standard crystal. thus 12MHz crystal is generally assumed as standard crystal for 8051.

Q. If 12MHz crystal is standard crystal then why we use 11.0592 MHz crystal in most of embedded systems?

A. 11.0592 MHz crystal is generally used in communication based system where µC needs to communicate with its UART (i.e. serial port - universal asynchronous receive & transmit). For serial communication µC needs to generate one of the following standard baud rates –

110 bps
300 bps
1200 bps
2400 bps
4800 bps
9600 bps
⋮
115200 bps.

def. of baud rate :- total no of bits passing through any cross section of a conductor in one second is known as baud rate. it is measured as bps. i.e. bits per second.

the formula to generate baudrate is given by the following equation —

Reload Value = 256 − Abs (((crystal f^n/12)/32)/baud Rate)

here crystal is part of it. if we substitute 12MHz crystal value in the equation then the reload value of timer will not be an integer data for all the standard baud rates. 11.0592 MHz crystal generate exact baud rate values which is very important in any com^n system otherwise data will be garbage at the reciver end.

Q. In which Type of embedded system 12MHz crystal is used?

A. 12MHz crystal is used in timebased application where we require exact time delays. In uc 12MHz value is divided by 12 producing 1MHz clk pulse. the time between successive -ve going edge trigger is 1 uS.

for 1 MHz clk.

thus to generate specific time delay (say 100uS) just count that many no of pulses (100 pulses) and we will get that.

---

thus —

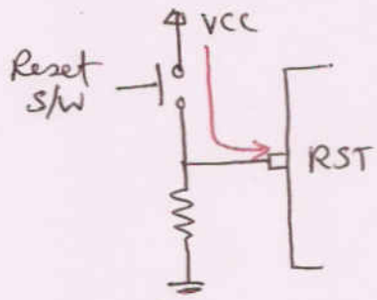
for time based App^n — 12MHz

for Com^n based App^n — 11.0592MHz.

③ Power On Reset Circuit :-

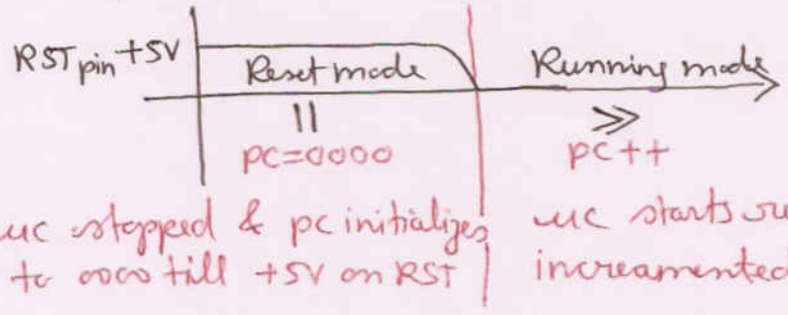
Reset circuit is generally used to restart the code execution process of uc from the starting code mem. location (i.e. 0000h) in case of hanging. to reset uc we need to apply high logic to the pin no 9 (i.e. RST - Reset). When it is hald for nearly two machine cycles while oscillator is running resets the controller.

To achieve this we can use a simple ckt like following -

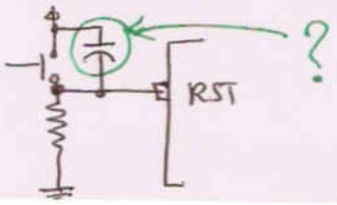


(picture - I)

in the above circuit when the switch is pressed momentaly vcc goes to the reset pin & controller goes in reset mode till the switch is pressed. thus the behaviour can be shown as -

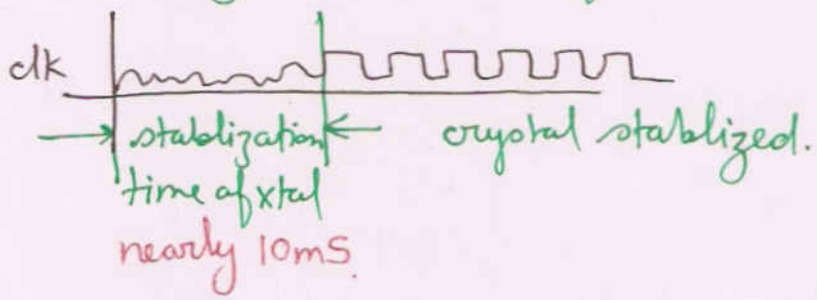


Q. When we can achieve Reset condition of uc just by using the above picture - I circuit; Why the 10uf capacitor is connected in P.O.R.C. ? What is its use ?

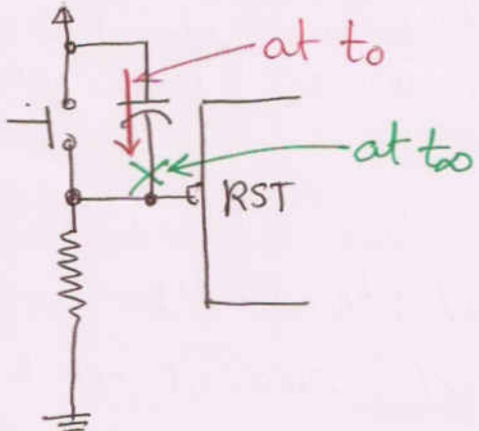


A. the reason to use capacitor have relation with the xtal oscillations connected →

When we switch on the power supply, voltage immediatly raises from 0 to +5V. the crystal is a device that takes some time to get initialized. It gets vibrated or becomes unstable initially, after some time its oscillations are stablized. → this time is known as stablization time of xtal.



if the uc starts fetching instructions when the crystal is unstable, it will start misbehaving & will get hanged as the clk to all its sections are not proper & synchronization will not occure. So as to avoid this situation we introduce a capacitor between VCC & RST pin. the capacitor have properties like - initially short circuit & finally open circuit.



so as soon as the power is applied to the system, cap.

gives a path for D.C. current to RST pin which fources controller to go in reset mode. (i.e. controller does not fetches instructions). After some time when capacitor is charged it acts like an open circuit for D.C. current and uc pin RST is by default connected to GND via resister producing logic low on pin. Now the uc starts fetching instructions.

the charging of capacitor takes more time than stablization of xtal and it is given by formula—

$$time = R \times C$$

this time is also known as RC. time constant or Reset timing of uc. in our circuit it is —

$$82mS = 8.2K \times 10u$$

thus → when we switch on power supply uc gets started after 82mS.

→ crystal takes approx. 10mS to get stablized.

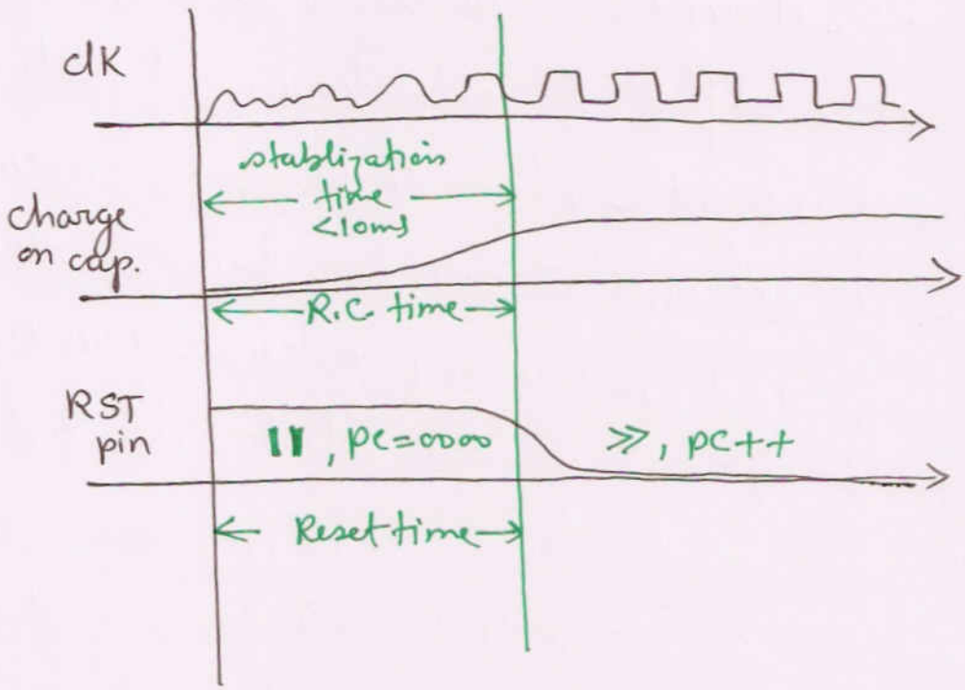
→ it is guaranteed that uc will never hang & will start properly whenever we switch on the power supply.

Q. Why this circuit is known a Power on Reset Circuit & not only reset circuit ?

A. Since the capacitor comes in picture only when we start power supply it is known as PORC. after this capacitor has no use.

Q. What is the waveform at the time of POR.

A.



Q. What is the reset timing of the Project?

A. Reset timing of project is nothing but the RC time constant. it is 82mS in our case. acording to datasheet it should be always greater than 10mS.

Reset timing indicates time delay between power supply switching & actual execution of system.

④ Code Memory Selection Unit :-

this circuit connectivity tells uc whether to fetch instructions from internal code memory or from external code memory. When our code size is more than the uc code mem. capacity then we interface external code memory to the system & the instructions are stored in that. the $\overline{EA}$ (external Access bar)

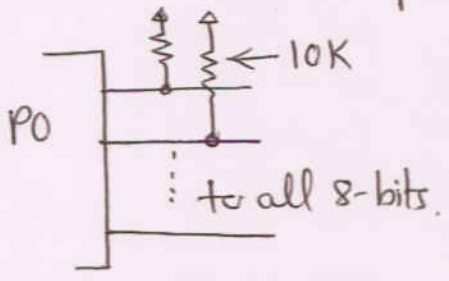
should be connected to GND in this case. As we are not using external instruction memory, we have connected it to VCC.

(5) In System Programming setting (ISP):-

$\overline{PSEN}$ (program store enable bar) is used to toggle uc in programming mode. when we connect this pin to GND & then switch on the power supply then the controller is in programming mode & no instructions are being executed. In this mode we can connect the uc with PC-serial port (RS-232) and code can be downloaded in it. In system Programming is generally used in P89C51RD2BN controller.

Extra :-

Sometime we connect pull resistors to uc port 0.



this pull resisters are known as Resister N/W of 10K. the job of these resisters are to increase the voltage (pull-up) of port 0 as they are weak by nature. they provides only 1.7 volts as they have no internall pull-ups. and are open-drain port.