

* Digital Clock

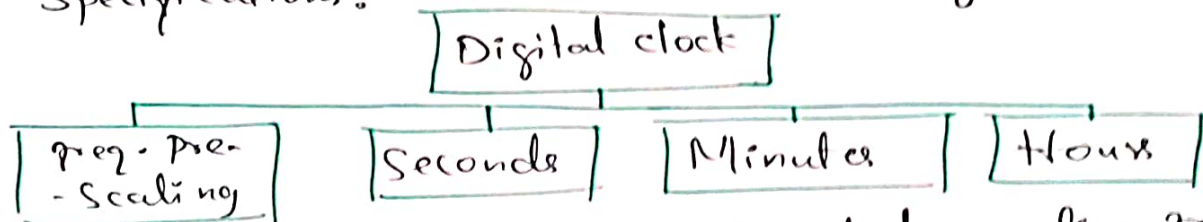
①

- One of the most common applications of counters is the digital clock that displays the time of day in hours, minutes and seconds.
- Digital clocks are used in different kinds of devices such as cars, radios, televisions, microwave ovens, standard ovens, computers and cellphones.
- For battery operated clocks or watches, the basic freq. is normally obtained from a quartz-crystal oscillator.
- Digital clocks operated from the ac power line can use the 60 Hz power freq. as the basic clk freq.

fig:- block dig. of a digital clock.

- * The basic freq. must be converted to 1Hz (or) 1 pulse per second (PPS).
- * The 1PPS signal is used as a synchronous clock for all of the counter stages, which are synchronously cascaded.

Specifications:- The section level of hierarchy.



input : 60 PPS (accuracy dependent on line freq.)

o/p : BCD Hours : 1 bit Tens 4 bits Units

BCD Minutes : 3 bits Tens 4 bits Units

BCD Seconds : 3 bits " "

PM indicator.

→ Minutes and seconds seg : BCD MOD 60

00-59 (decimal representation of BCD)

→ Hours seg. BCD MOD 12

01-12 (decimal representation of BCD)

→ Overall range of display

01:00:00 - 12:59:59

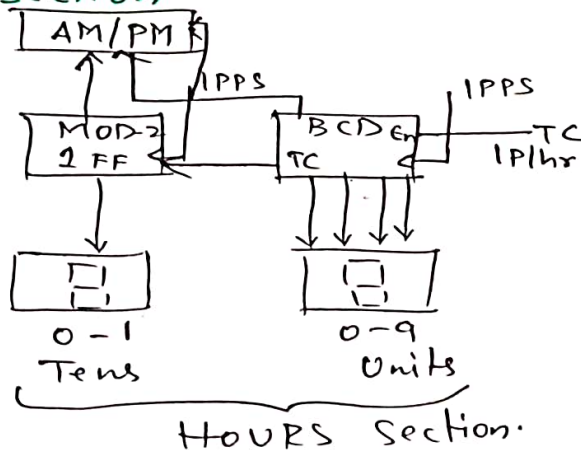
* AM / PM indicator toggles at 12:00:00

- * MOD-6 Counter in Seconds Section recycles every 60 Sec.

MINUTES Section : which counts and displays minutes from 0 through 59.

- The minutes section is identical to the seconds sec. & operates exactly the same manner.
- The 'TC' o/p of the MOD-6 Counter in the MINUTES Section has a freq. of 1 pulse per hour (i.e., the MOD-6 recycles every 60 min).
- The 'TC' o/p of minutes section is fed to the HOURS section.

HOURS Section



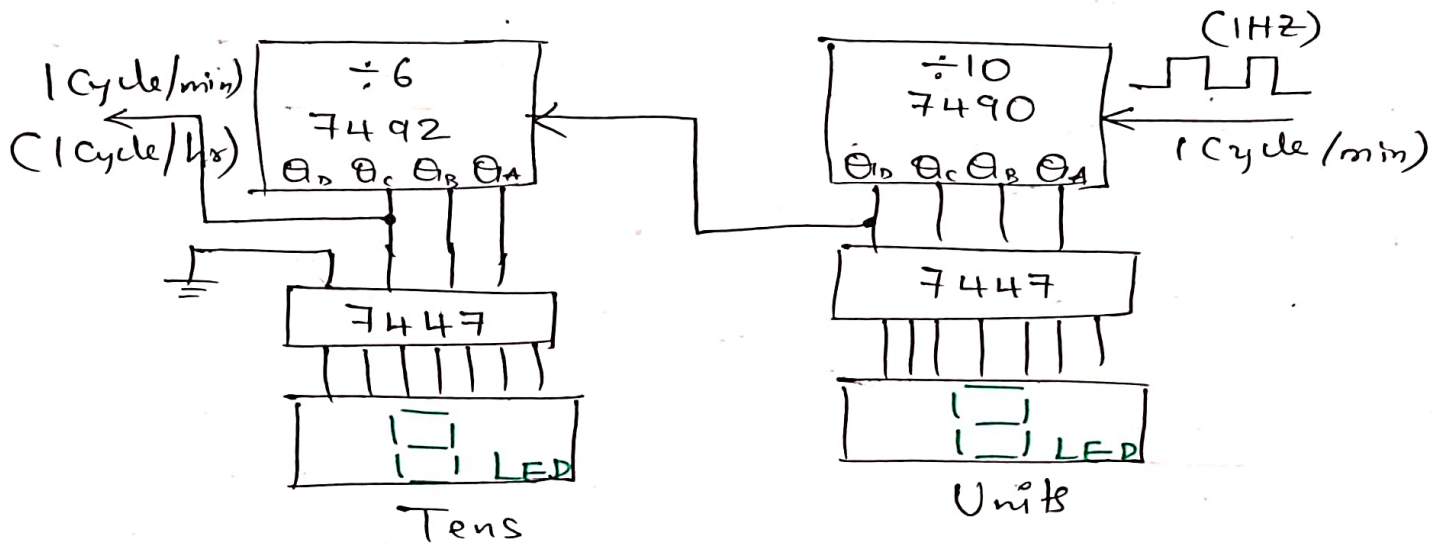
- It uses MOD-2 Counter (one flip-flop) & BCD Counter.
- The Hours Counter is enabled by the minutes and seconds stages for only one clock pulse every hour.

(3)

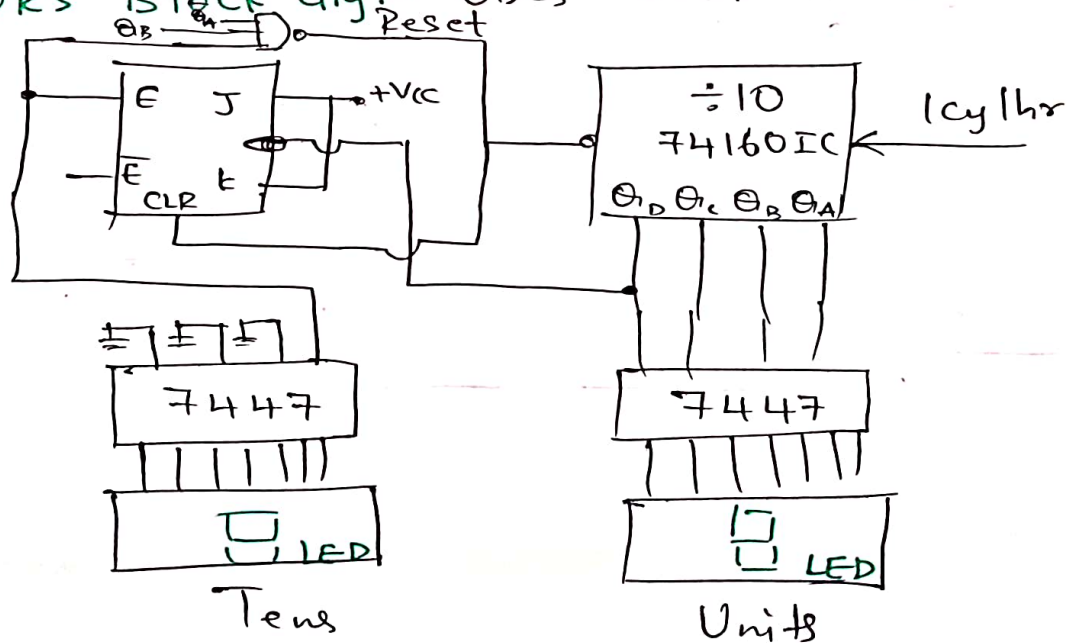
* Components Used:

- 1) 74LS47 IC $\rightarrow$ is a "BCD to 7-segment decoder / driver" integrated ckt.
- 2) 74LS160 IC (16 pins) :- Single 4 bit Synchronous Counter ckt. which can be wired for decade Counting.
- 3) 74LS90 IC :- is a 4-bit ripple-type (Asy) decade Counter (0 to 9)
- 4) Seven-Segment display :- is a form of electronic display device for displaying decimal numerals (material $\rightarrow$ LCD, LED)
- 5) 7492 IC :- (is often used in the hour tracking register of a digital clock).
 - $\rightarrow$ Contains 4-bit ripple counter with two counting ckt.
 - ① Divide by 2 (MOD-2) Counter
 - ② Divide by 6 (MOD-6) Counter.
 - $\rightarrow$ when combined MOD-2 & MOD-6, implements divide by 12 (MOD-12) Counter.
- 6) 74192 IC $\rightarrow$ is a Presettable Synchronous 4-bit UP/DOWN Decade Counter.

MINUTES Block Dig:- Uses Cascade of
 MOD 6 and MOD 10 Counter.
 ↓ ↓
 7492 IC 7490 IC



HOURS Block dig:- Uses MOD-12 Counter



→ The above Reset signal is used to remove the display of / reset the hours block. for not displaying the counts / values that are above "12" i.e, 13, 14, 15... 29.

* Important Points to be ⁽⁴⁾ considered while designing the Counter Ckt. for HOURS Section.

01 02 03 04 05 06 07 08 09 10 11 12 01-

- ① When the value is 01 through 08, increment the low digit and keep the high digit the same.
- ② When the value is 09, reset the low digit to 0 and force the high digit to 1.
- ③ When the value is 10 or 11, Increment the low digit and keep the high digit the same.
- ④ When the value is 12, reset the low digit to 1 and the high digit to 0.