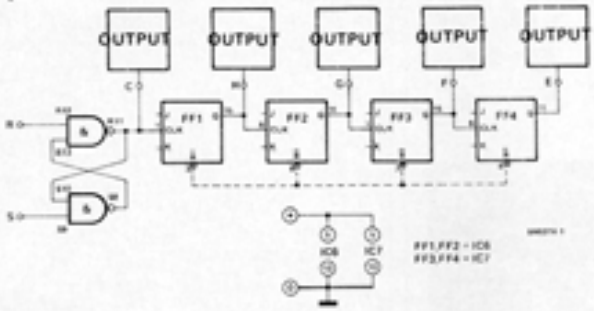
Digi-Course II

Chapter 5

We described the divider circuits based on Flipflops in the last chapter of Digi Course-II. We have seen that by feeding a series of pulses at the input of a Flipflop, we get only half the number of pulses at the outputs of the Flipflop. The input pulses toggle the Flipflop ON and OFF for every pulse, alternately. By cascading many such Flipflops together, it is possible to obtain a division by 4, 8, 16 .....

1



It can be easily observed that the output indicator LEDs light up in form of a binary number. That is, if we designate a glowing LED as "1" and an extinguished LED as "0", we get the group of 4 LEDs to represent a series of binary numbers. These binary numbers are shown in table 1

Table 1

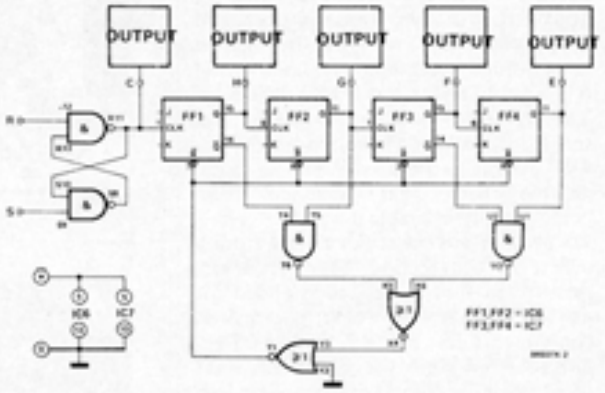
Input Pulses (Decimal)	Outputs E F G H (Binary)
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
10	1010
11	1011
12	1100
13	1101
14	1110
15	1111
16	0000

As can be seen from the sequence of binary numbers and the corresponding number of pulses, the group of 4 LEDs functions as a pulse counter. This pulse counter can count from 0 to 16, and is suitable for hexa decimal system. With the 16th pulse, the counter resets to 0000 and starts counting again.

Our observation about the cascaded dividers also applies to the counter, each additional Flipflop increases the counting capability by a factor of 2. Thus a counter with 5 Flipflops cascaded together would count from 0 to 32. It will reset on the 32nd pulse. A counter with 6 Flipflops will count from 0 to 64 and so on.

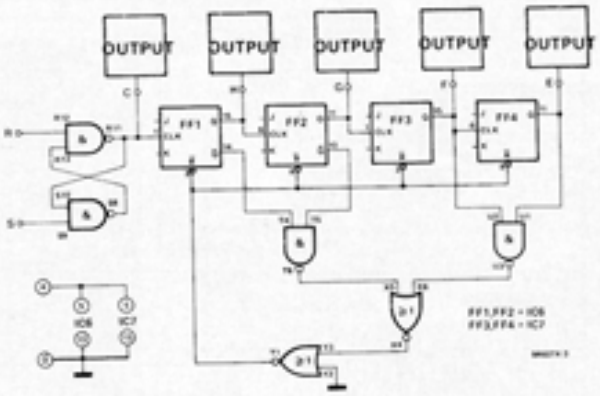
An adaptation of the hexadecimal counter to the decimal system is already known to us and it is given here again in figure 2. This counter resets to 0000 on the tenth pulse.

2



The decoder part using gates T, U, X and Y reacts to the binary combination 1010. We can reorganise the decode also to react to another binary combinations like 1100, which, then will reset on the 12th pulse and will function as a Duodecimal counter.

3



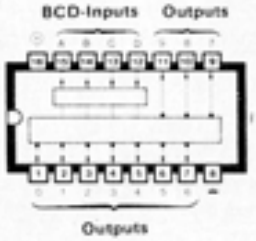
This type of decoder circuits are very important to the Computer Technology. The Central Processing Unit, (CPU) which is the brain of the computer works with various peripheral devices like the Keyboard, CRT Screen, Printer etc.

The CPU can select the desired peripheral by sending a binary code to the decoder circuit, which decodes the binary code and turns ON the Interface to that particular peripheral device.

Even in the Digital Technology, decoders have an important place. The most commonly encountered decoders digital circuits are the BCD-to-Decimal decoders and BCD to 7-Segment decoders. The standard ICs avaialble for these functions are 7442 and 7447. Figure 4 shows the pin connections of 7442.

4

SN 7442



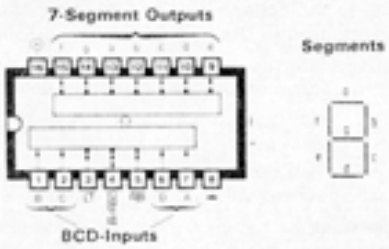
This IC can convert the output values available at the outputs E,F,G,H of our decimal counter to the corresponding decimal number. The particular pin corresponding to that decimal number is made "0" by the decoder, whereas all other 9 pins remain "1"

This decoder is not suitable for driving a seven segment digital display, which is the most commonly used display device in digital technology.

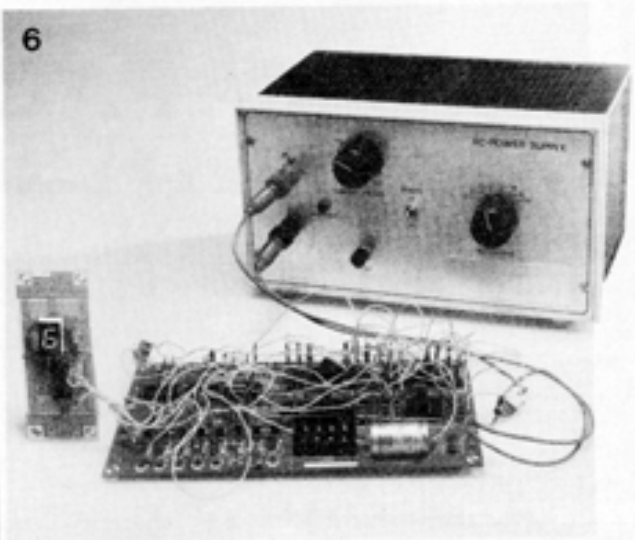
The seven segment LED display consists of seven tiny bar shaped LEDs arranged to make the figure of 8. The decoder IC 7447 has seven outputs which are connected directly to these seven segments. (In practice, current limiting resistors are also used, one for each segment)

5

SN 7447

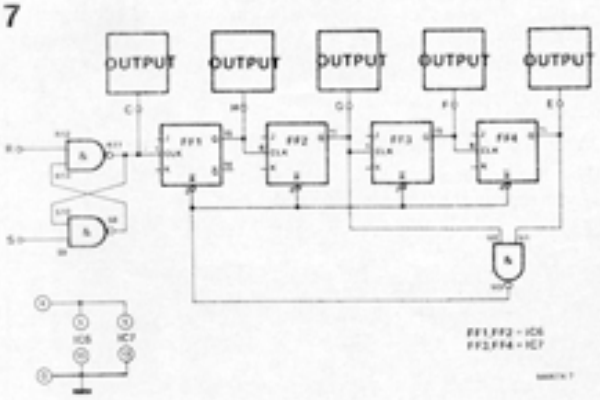


6



Let us go back to our decimal counter again. The 4 gates used in the decoder specifically react only to the 1010 combination. It will also be enough to decode only the 1st and 3rd binnary position to check if it is "1". Decimal ten is the first number which gives a "1" at the 1st and 3rd binary position simultaneously. If this condition is used to reset the counter the remaining decimal numbers which also give rise to this condition, will never be encountered as the counter will always reset on the tenth pulse. This simplified decoding arrangement is shown in figure 7.

7



The simplified decoder is called an "Incomplete Decoder" compared to the Complete Decoder shown in figure 2. However, even when using the incomplete decoder, the first combination that resets the counter is 1010, and remaining combinations like 1011, 1110 and 1111 are never allowed to reach.

Another important point to note is the spurious triggering that many take place and affect the functioning of the circuit. To take care of this problem, connect all unused inputs to "1" (Pins 4/9, 12/16, 2 and 7).