Problem 6.1

Design a programmable timer using 8254 and 8086. Interface 8254 at an address 0040H for counter 0 and write the following ALPs. The 8086 and 8254 run at 6 MHz and 1.5 MHz respectively.

(i) To generate a square wave of period 1 ms.

(ii) To interrupt the processor after 10 ms.

(iii) To derive a monoshot pulse with quasistable state duration 5 ms.

Solution

Neglecting the higher order address lines (A_{16}–A_8), the interfacing circuit diagram is shown in Fig. 6.10. The 8254 is interfaced with lower order data bus (D_0–D_7), hence A_0 is used for selecting the even bank. The A_0 and A_1 of the 8254 are connected with A_1 and A_2 of the processor. The counter addresses can be decoded as given below. If A_0 is 1, the 8254 will not be selected at all.

A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0	
0	1	0	0	0	0	0	0	= 40H Counter 0
					0	1	0	= 42H Counter 1
					1	0	0	= 44H Counter 2
					1	1	0	= 46H Control word Reg.

(i) For generating a square wave, 8254 should be used in mode 3.

Let us select counter 0 for this purpose, that will be operated in BCD mode (may even be operated in HEX mode). Now suitable count is to be calculated for generating 1 ms time period.

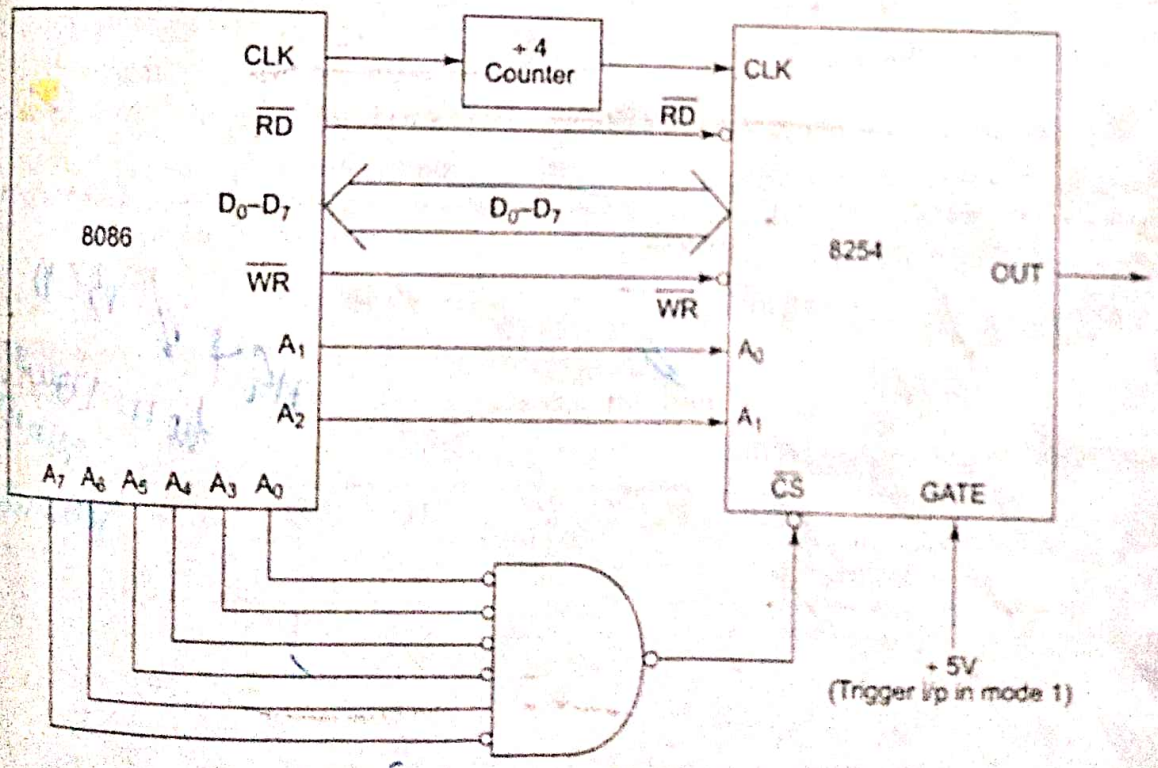

Fig. 6.10 *Interfacing 8254 with 8086 for Problem 6.1*

$f = 1.5$ MHz,

$$\Rightarrow \quad T = \frac{1}{1.5\times10^{-6}} = 0.66\,\mu s$$

If N is the number of T states required for 1ms,

$$N = \frac{1\times10^{-3}}{0.66\times10^{-6}} = 1.5\times10^{3}$$
$$= 1500 \text{ states}$$

The control word is decided as below:

SC1	SC0	RL1	RL0	M2	M1	M0	BCD
0	0	1	1	0	1	1	1

$= 37$ H

The ALP is given in Program 6.1.

```
CODE      SEGMENT
ASSUME    CS : CODE
START:    MOV AL,37H        ; Initialize 8254,
          OUT 46H,AL        ; counter 0 in mode3.
          MOV AL, 00        ; Write 00 decimal
          OUT 40H, AL       ; in LSB of count reg. and
          MOV AL, 15        ; 15 decimal in MSB as a
          OUT 40 H, AL      ; count.
          MOV AH,4CH
          INT 21H
CODE      ENDS
          END START
```

Program 6.1 *ALP For Problem 6.1(a)*

(ii) For generating interrupt to the processor after 10 ms, the 8254 is to be used in mode 0. The OUT1 pin of 8254 is connected to interrupt input of the processor. Let us use counter 1 for this purpose, and operate the 8254 in HEX count mode.

No. of T states required for 10 ms delay $= \frac{10\times10^{-3}}{0.66\times10^{-6}} = 15\times10^{3}$
$= 15000$
$= 3A98$ H

The Control word is written below:

SC1	SC0	RL1	RL0	M2	M1	M0	BCD
0	1	1	1	0	0	0	0

$= 70$ H

The ALP is written in Program 6.2.

```
CODE      SEGMENT
ASSUME    CS : CODE
START:    MOV AL, 70 H
          OUT 46H, AL       ; Initialize 8254 with
          MOV AL, 98H       ; Counter1 in mode 0.
          OUT 42H, AL       ; Load 98H as LSB of count
          MOV AL, 3AH       ; in count reg of counter1
                            ; then load 3AH in MSB
```

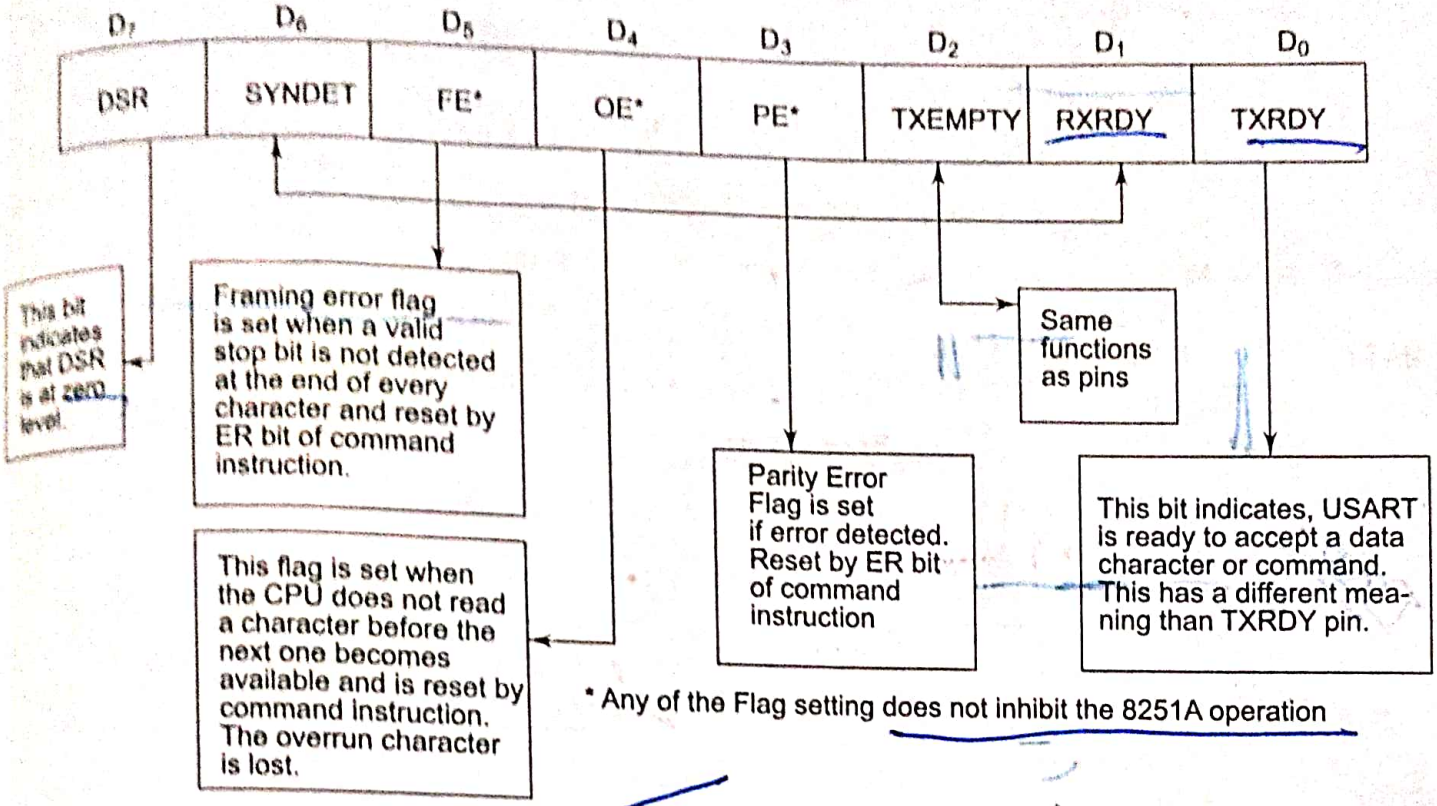

Fig. 6.34 *Status Read Instruction Format*

6.4.4 Interfacing and Programming 8251 with 8086

The following problem explains the interfacing and programming of 8251A in an 8086 system.

Problem 6.7

Design the hardware interface circuit for interfacing 8251 with 8086. Set the 8251A in asynchronous mode as a transmitter and receiver with even parity enabled, 2 stop bits, 8-bit character length, frequency 160 kHz and baud rate 10 K.

(a) Write an ALP to transmit 100 bytes of data string starting at location 2000:5000H.

(b) Write an ALP receive 100 bytes of data string and store it at 3000:4000H.

Solution

The interfacing connections of 8251A with 8086 are shown in Fig. 6.35.

Asynchronous mode control word for Problem 6.6 (a)

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	
1	1	1	1	1	1	1	0	= 0FE H
2 stop bits		Even parity enabled		8-bit format		CLK scaled by 16		

(a) ALP to initialize 8251 and transmit 100 bytes of data

```
ASSUME  CS : CODE
CODE    SEGMENT
START:  MOV AX, 2000H      ;
        MOV DS, AX         ; DS points to byte string segment
        MOV SI, 5000H      ; SI points to byte string
        MOV CL, 64H        ; length of the string in CL(hex)
        MOV AL, OFEH       ; Mode control word out to
        OUT OFEH, AL       ; D0-D7.
        MOV AX, 11H        ; Load command word
        OUT OFEH, AL       ; to transmit enable and error reset
WAIT:   IN AL, OFEH        ; Read status,
        AND AL, 01H        ; check transmitter enable
        JZ WAIT            ; bit,if zero wait for the transmitter to
                           be ready
        MOV AL, [SI]       ; If ready, first byte of string data
        OUT OFCH, AL       ; is transmitted.
        INC SI             ; Point to next byte.
        DEC CL             ; Decrement counter.
        JNZ WAIT           ; If CL is not zero, go for next byte.
        MOV AH, 4CH        ; If CX is zero, return to DOS
        INT 21H
CODE    ENDS
        END START
```

Program 6.8 *ALP to Transmit 100 Bytes of Data*

For Problem 6.6 (b), the command instruction word can be calculated as 14H.

(b) An ALP to initialize 8251 and receive 100 bytes of data.

```
ASSUME  CS : CODE
CODE    SEGMENT
START:  MOV AX, 3000H      ;
        MOV DS, AX         ; Data segment set to 3000H
        MOV SI, 4000H      ; Pointer to destination offset
        MOV CL, 64H        ; Byte count in CL
        MOV AL, 7EH        ; Only one stop bit for
        OUT OFEH, AL       ; receiver is set
        MOV AL, 14H        ; Load command word to enable
        OUT OFEH, AL       ; the receiver and disable
                           transmitter
NXTBT:  IN AL, OFEH        ; Read status
        AND 38H            ; Check FE, OE and PE,
        JZ READY           ; If zero, jump to READY
        MOV AL, 14H        ; If not zero, clear them
        OUT OFEH, AL       ;
READY:  IN AL, OFEH        ; Check RXRDY.If the
        AND 02H            ; receiver is not ready,
        JZ READY           ; wait
        IN AL, OFCH        ; If it is ready,
        MOV [SI], AL       ; receive the character
        INC SI             ; Increment pointer to next byte
```