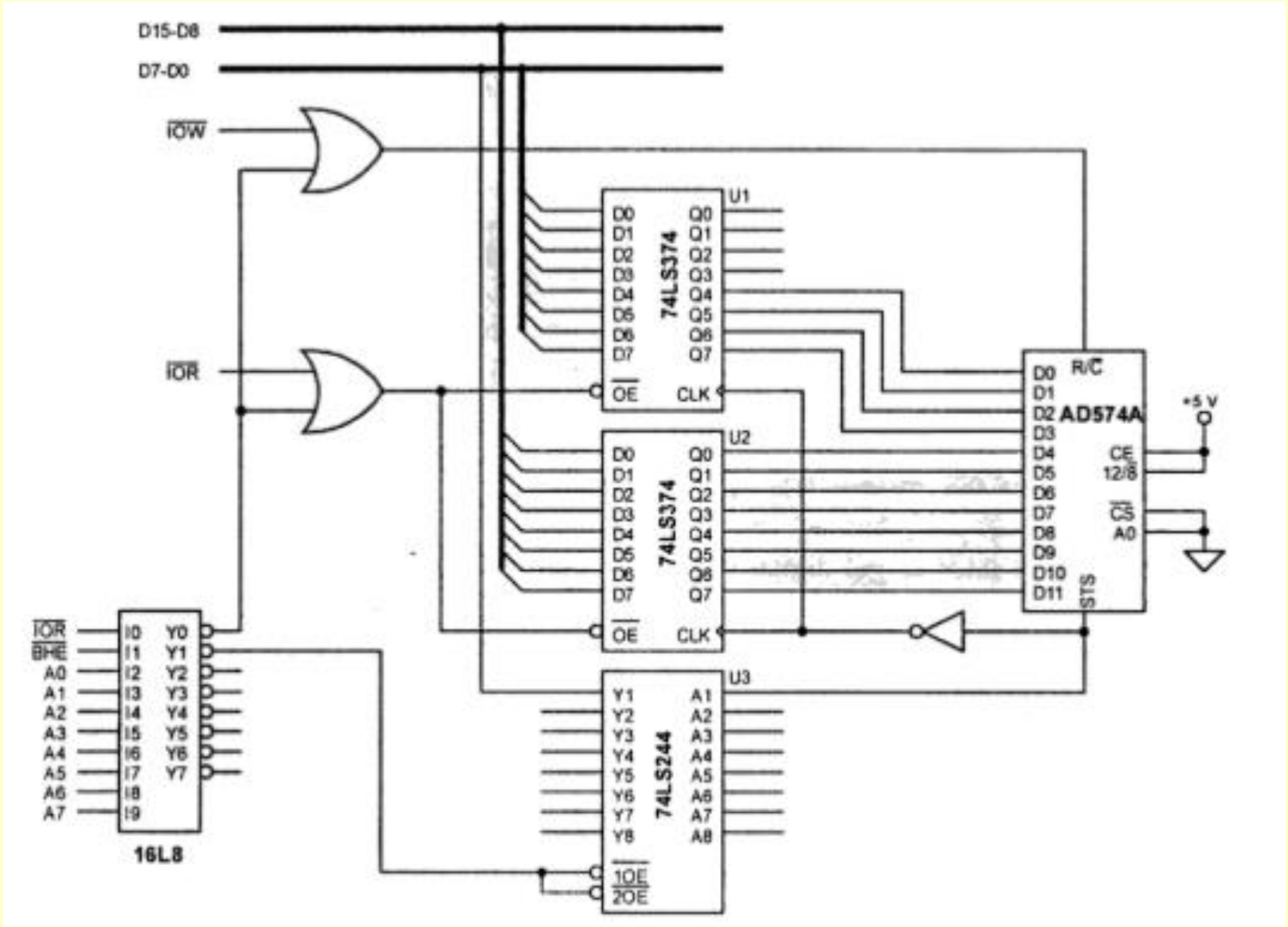
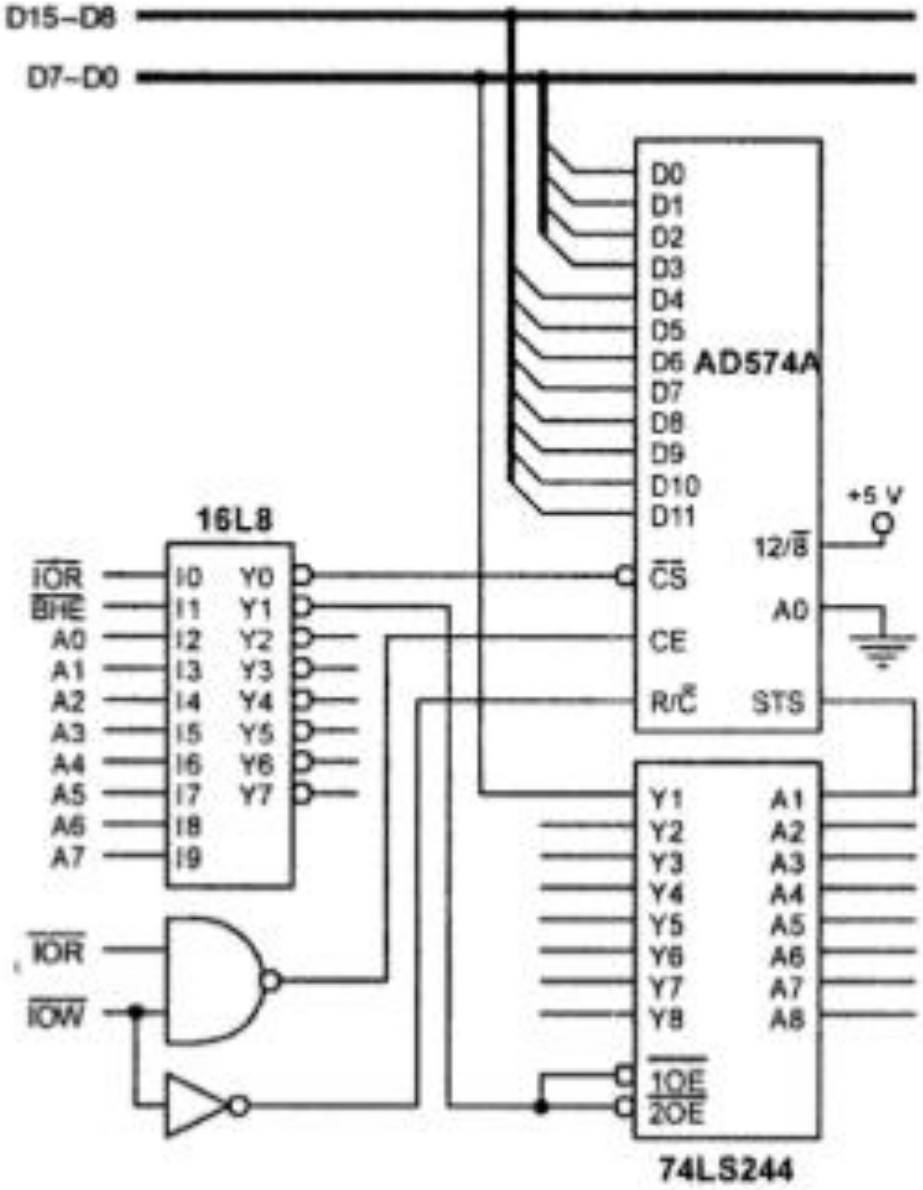
C14
Aplicatii

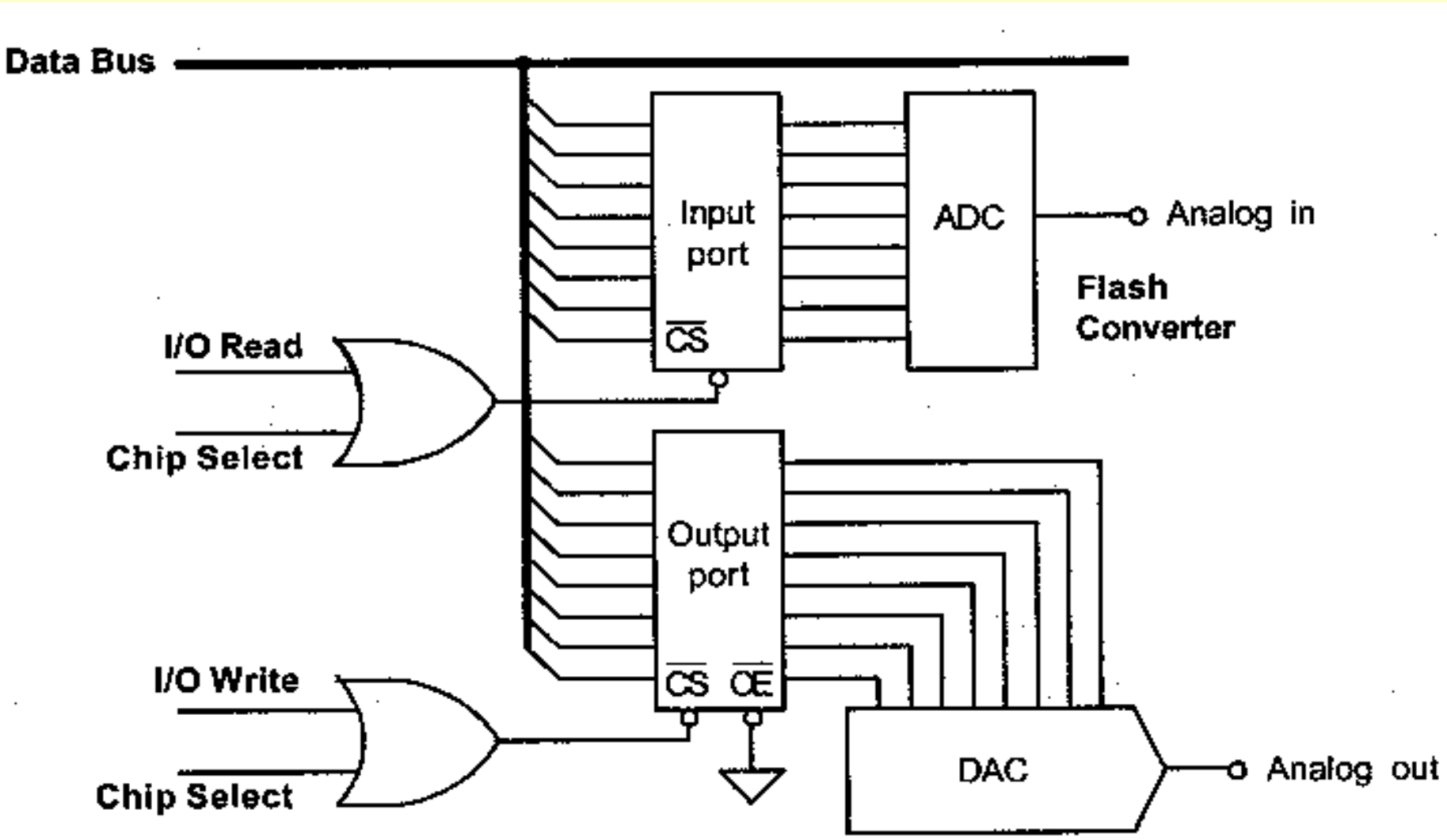
Interfatarea DAC si ADC la microprocesor


D15-D8
D7-D0
IOW
IOR
U1
74LS374
D0
D1
D2
D3
D4
D5
D6
D7
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
OE
CLK
U2
74LS374
U3
74LS244
Y1
Y2
Y3
Y4
Y5
Y6
Y7
Y8
A1
A2
A3
A4
A5
A6
A7
A8
1OE
2OE
AD574A
R/C
D0
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
STS
CE
12/8
CS
A0
+5 V
IOR
BHE
A0
A1
A2
A3
A4
A5
A6
A7
I0
I1
I2
I3
I4
I5
I6
I7
I8
I9
Y0
Y1
Y2
Y3
Y4
Y5
Y6
Y7
16L8

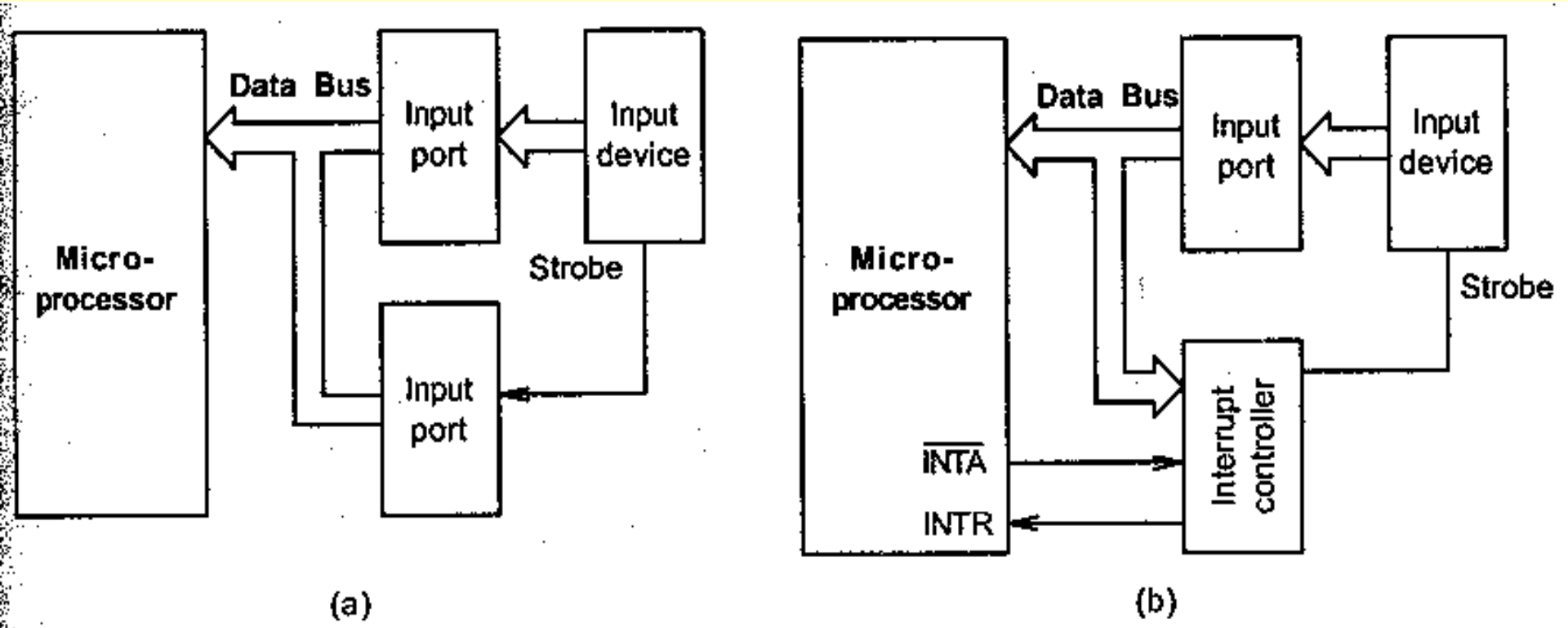


(b)

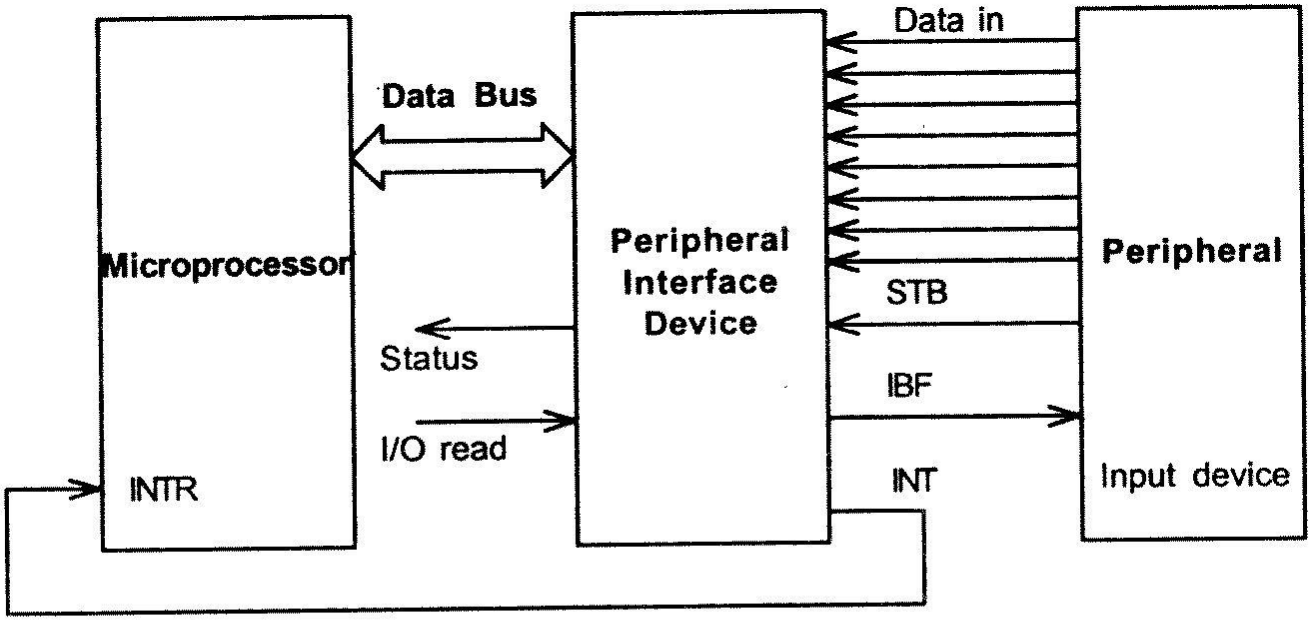
Interfacing AD574A to 8086—(a) stand-alone configuration, (b) direct connection.



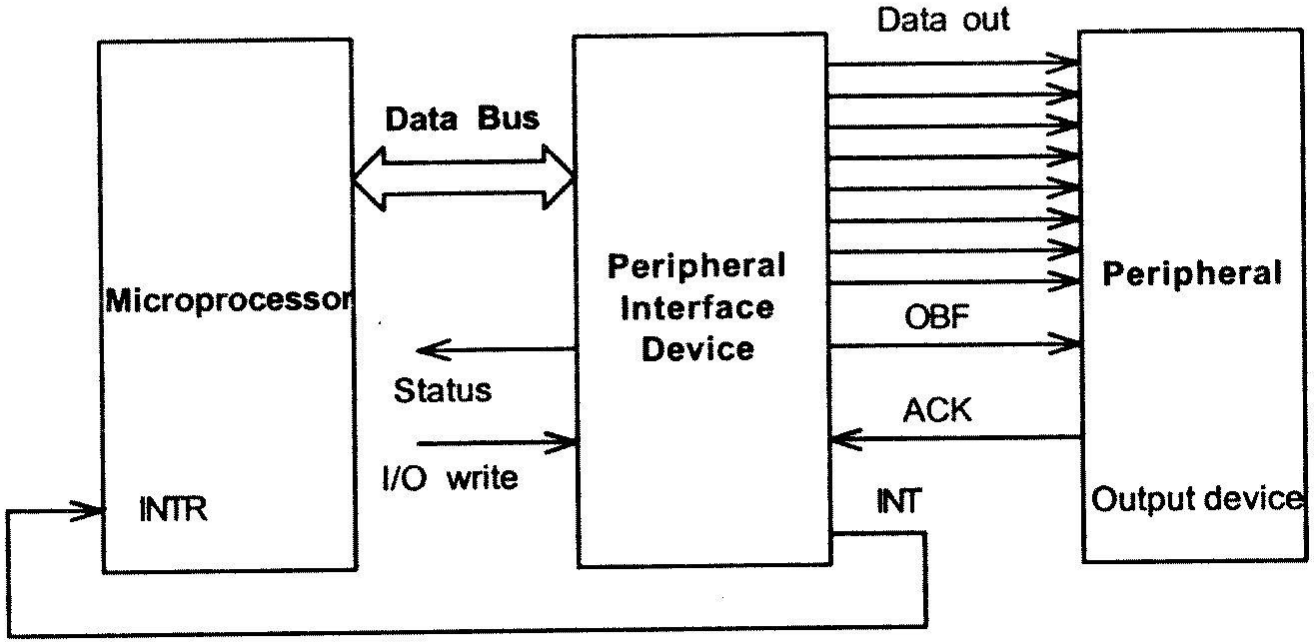
Data transfer by simple I/O.



Strobe I/O—(a) polling, (b) interrupt.



(a)

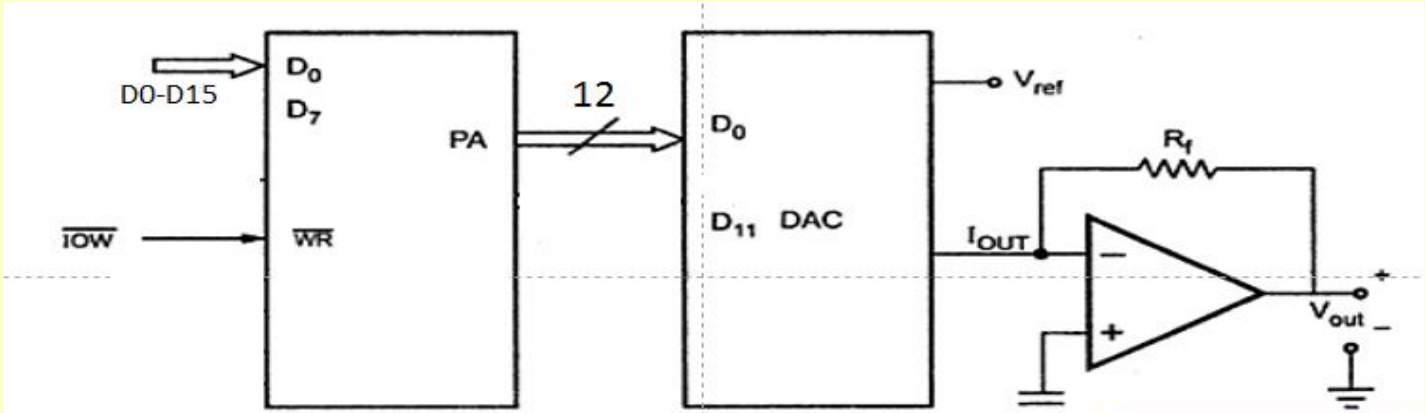


(b)

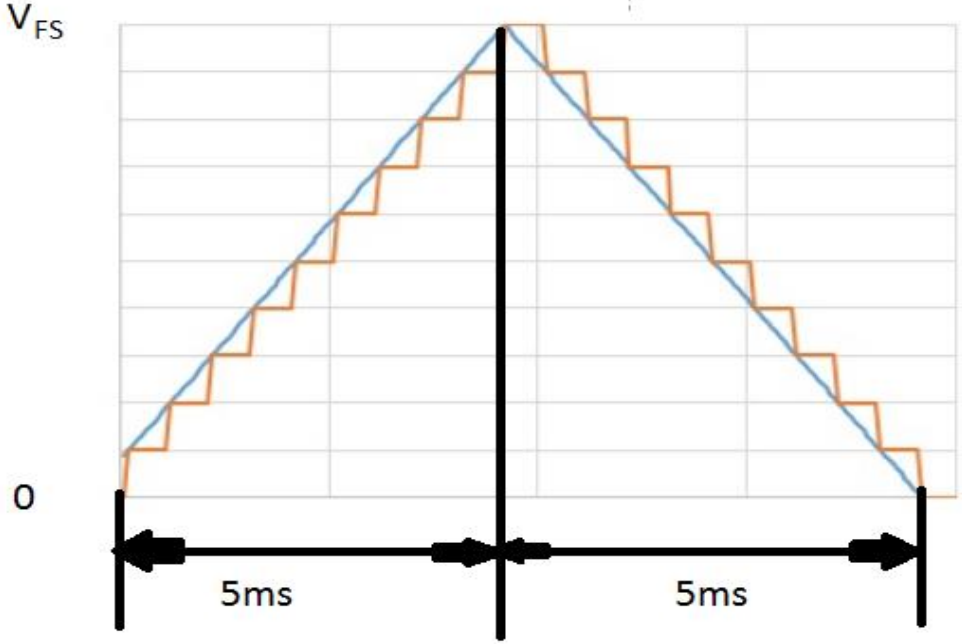
andshake I/O—(a) input operation, (b) output operation.

Problema.

Interfatati un DAC de 12 biti la un sistem cu microprocessor 8086, care are un CLK=5MHz. Convertorul e conectat la un port de 16 biti cu adresa 80h. Scrieti aplicatia care genereaza la iesirea DAC un semnal triunghiular cu frecventa de 100Hz avand amplitudinea de V_{FS}. Timpul minim pentru a scoate un nivel pe iesirea DAC este de 4.6us ~ 5us.



$$Vout = \frac{Vref}{2^n} \, xn$$



$$n_{pasi\ 0\text{-}4095} = \frac{5\,ms}{5\,\mu s} = 1000\ pasi$$

$$n_{LSB/pas} = \frac{4095}{1000} = 4{,}095 \sim 5\ LSB/pas$$

$$4095 = 5 \cdot 819 \Rightarrow 819\ pasi\ (0 \dots 4095)$$

$$t_{pas} = \frac{5\,ms}{819} \simeq 6{,}1\,\mu s > 5\,\mu s$$

$$\frac{t_{pas}}{T_{cl.}} = \frac{6{,}1\,\mu s}{0{,}2\,\mu s} = 30{,}05\ \underset{\text{processore}}{cicli} \sim 30\ cicli/pas$$

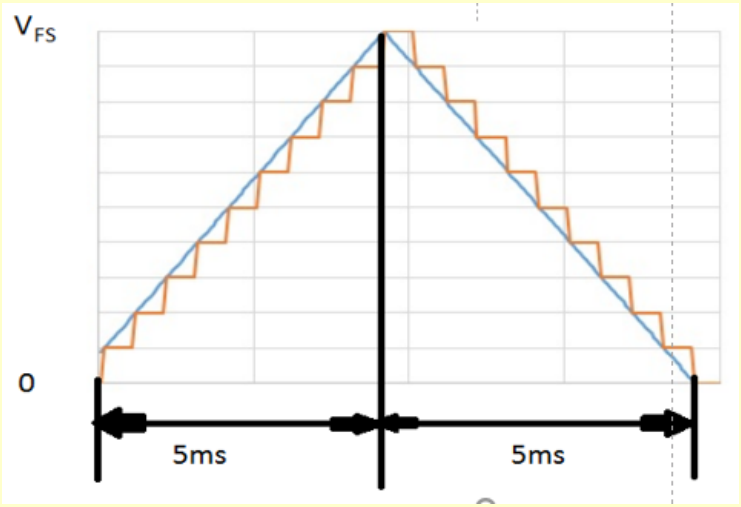
Cx=contor pasi; BX=val. DAC; AX

```
ST:     MOV CX,819    ;4CLK
        MOV BX,0      ;4CLK
BK0:    MOV AX,BX     ;2CLK
        OUT  80h,AX   ;10CLK
        ADD  BX,5     ;4CLK
        MOV  DX,DX    ,2CLK
        MOV  DX,DX    ;2CLK
        NOP           ;3CLK
        DEC CX        ;3CLK
        JNZ BK0       ;4/2CLK
```

30CLK

```
        MOV CX,819    ;4CLK
        SUB BX,5      ;4CLK
BK1:    MOV AX,BX     ;2CLK
        OUT  80h,AX   ;10CLK
        MOV  BX,BX    ;2CLK
        MOV  BX,BX    ;2CLK
        NOP           ;3CLK
        DEC CX        ;3CLK
        JNZ  BK1      ;4CLK
        JMP ST        ;15CLK
```

30CLK



ADConverter - AD 574A

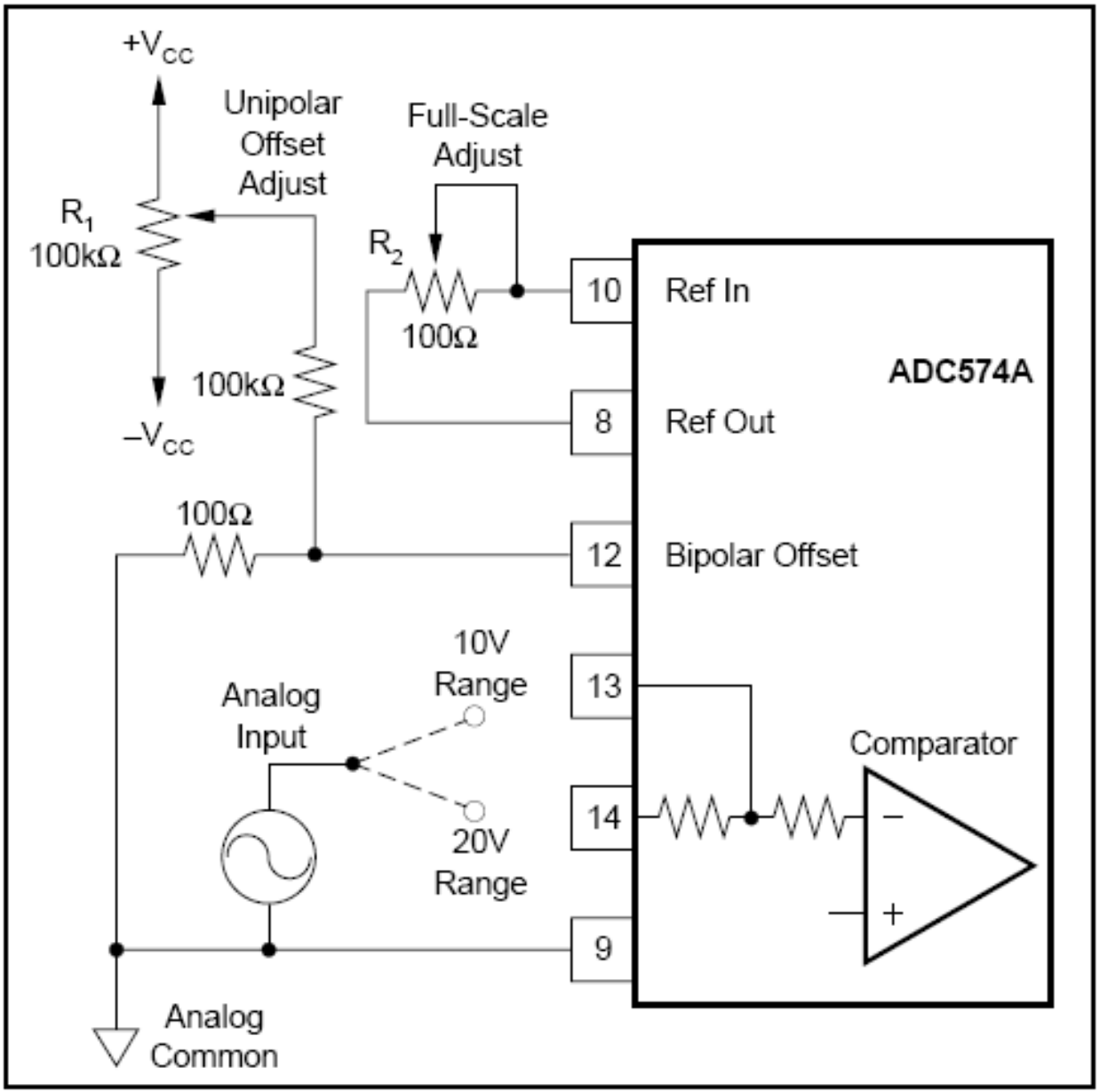


FIGURE 2. Unipolar Configuration.

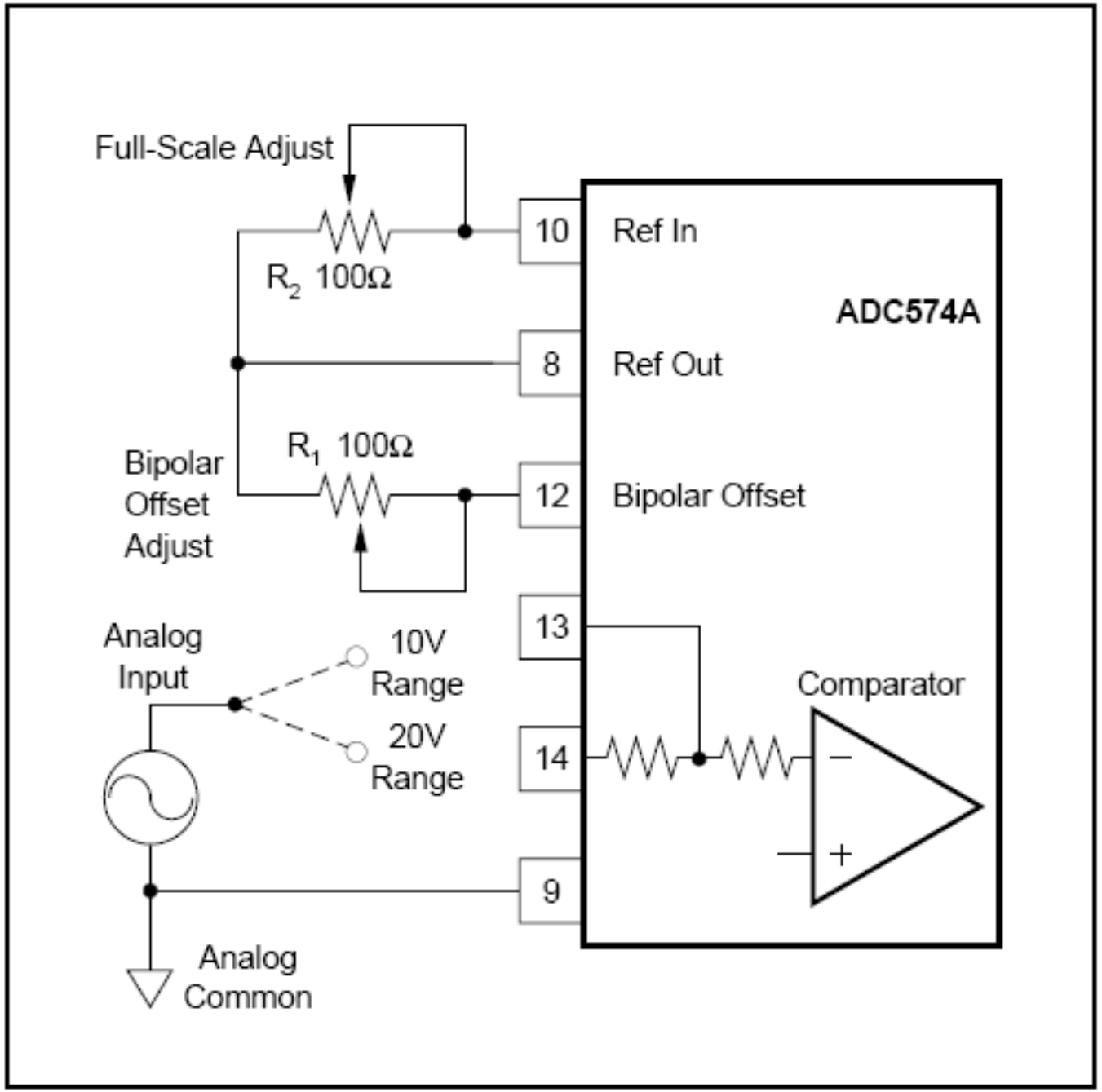


FIGURE 3. Bipolar Configuration.

CE	$\overline{CS}$	R/$\overline{C}$	12/$\overline{8}$	A_0	OPERATION	
0	X	X	X	X	None	
X	1	X	X	X	None	
↑	0	0	X	0	Initiate 12-bit conversion	2
↑	0	0	X	1	Initiate 8-bit conversion	
1	↓	0	X	0	Initiate 12-bit conversion	
1	↓	0	X	1	Initiate 8-bit conversion	
1	0	↓	X	0	Initiate 12-bit conversion	
1	0	↓	X	1	Initiate 8-bit conversion	1
1	0	1	1	X	Enable 12-bit output	
1	0	1	0	0	Enable 8 MSBs only	2
1	0	1	0	1	Enable 4 LSBs plus 4 trailing zeros	

TABLE III. Control Input Truth Table.

PIN DESIGNATION	DEFINITION	FUNCTION
CE (Pin 6)	Chip Enable (active high)	Must be high ("1") to either initiate a conversion or read output data. 0-1 edge may be used to initiate a conversion.
$\overline{CS}$ (Pin 3)	Chip Select (active low)	Must be low ("0") to either initiate a conversion or read output data. 1-0 edge may be used to initiate a conversion.
R/$\overline{C}$(Pin 5)	Read/Convert ("1" = read) ("0" = convert)	Must be low ("0") to initiate either 8- or 12-bit conversions. 1-0 edge may be used to initiate a conversion. Must be high ("1") to read output data. 0-1 edge may be used to initiate a read operation.
A_0 (Pin 4)	Byte Address Short Cycle	In the start-convert mode, A_0 selects 8-bit (A_0 = "1") or 12-bit (A_0 = "0") conversion mode. When reading output data in two 8-bit bytes, A_0 = "0" accesses 8 MSBs (high byte) and A_0 = "1" accesses 4 LSBs and trailing "0s" (low byte).
12/$\overline{8}$ (Pin 2)	Data Mode Select ("1" = 12 bits) ("0" = 8 bits)	When reading output data, 12/$\overline{8}$ = "1" enables all 12 output bits simultaneously. 12/$\overline{8}$ = "0" will enable the MSBs or LSBs as determined by the A_0 line.

TABLE II. ADC574A Control Line Functions.

CONVERSION TIME (4)							
8-Bit Cycle	10	13	17	*	*	*	µs
12-Bit Cycle	15	20	25	*	•	•	µs

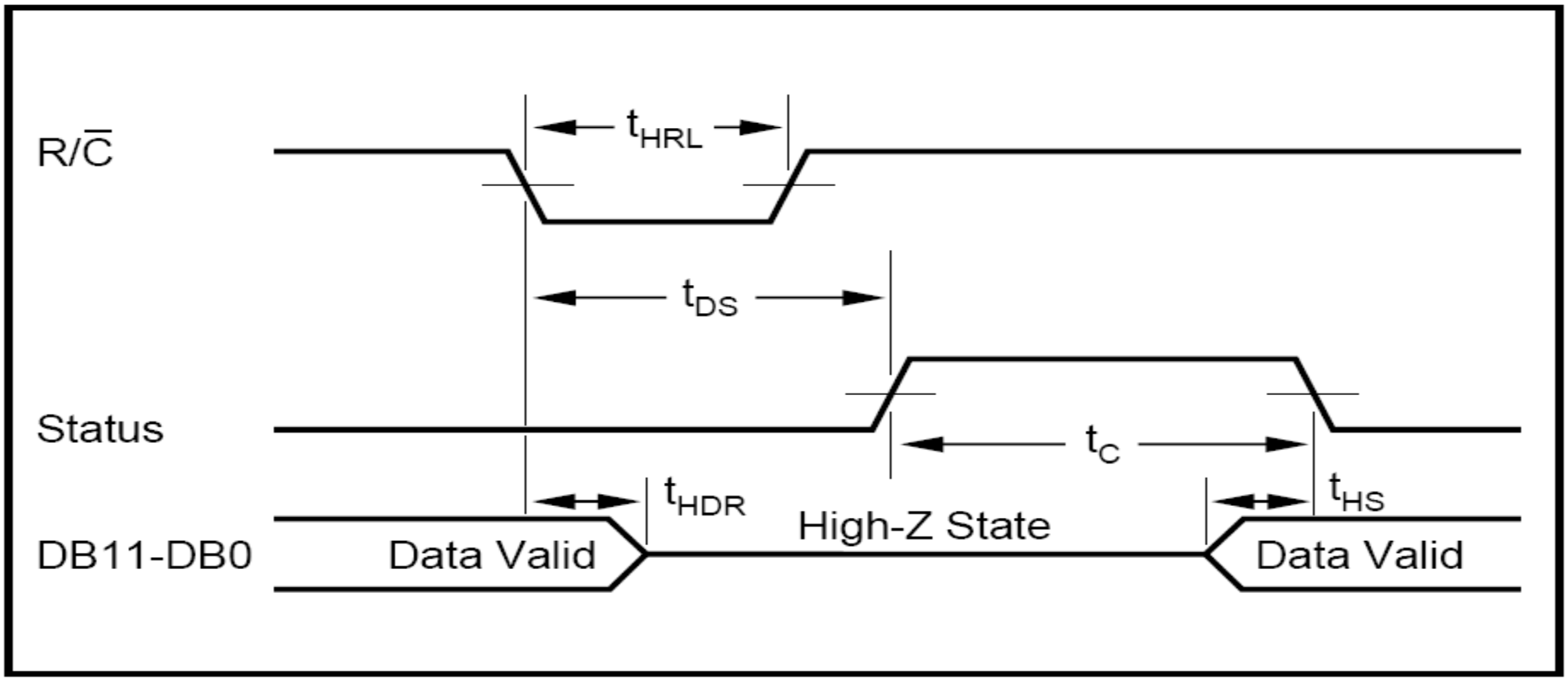


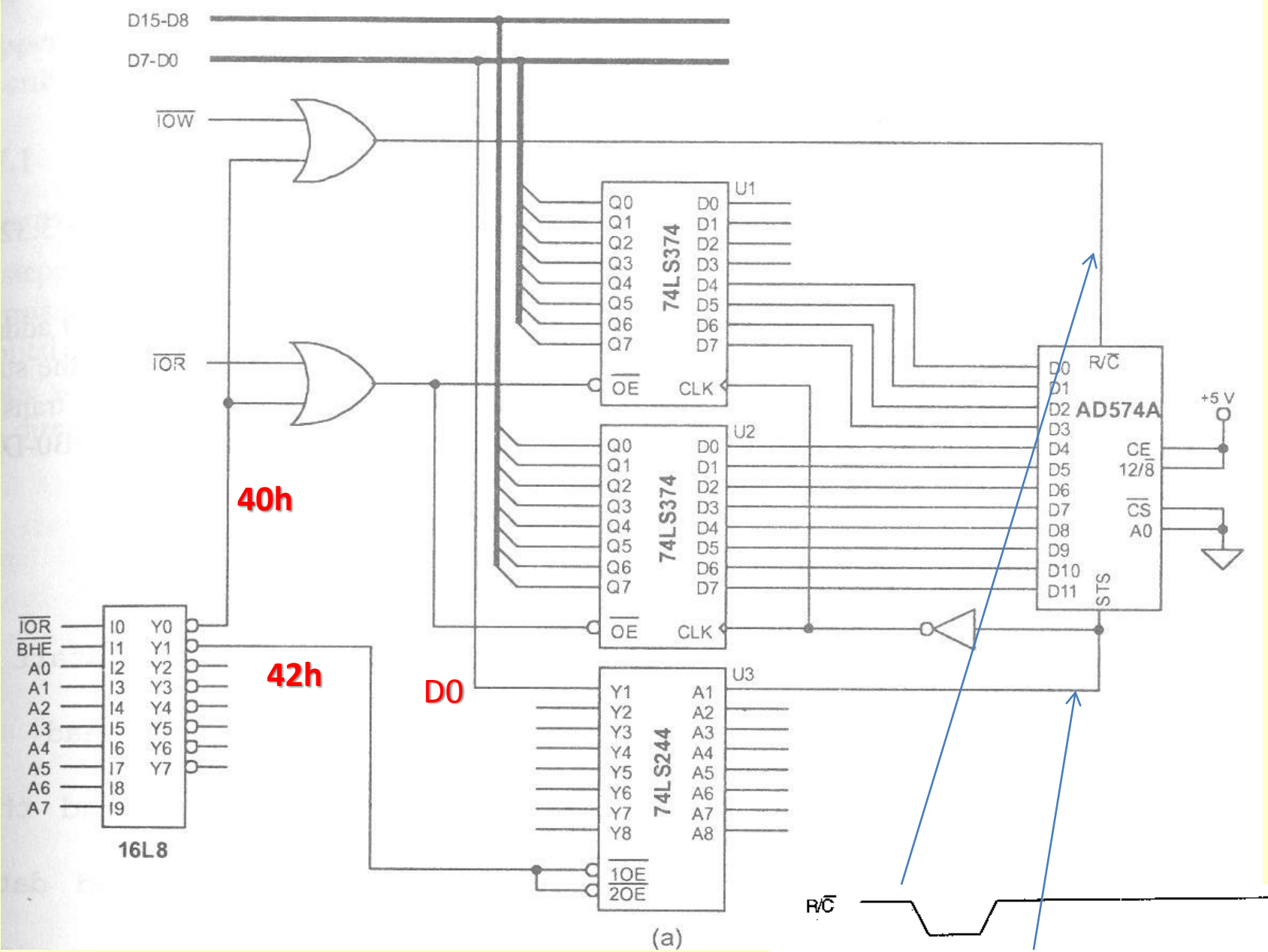
FIGURE 4. R/$\overline{C}$ Pulse Low—Outputs Enabled After Conversion.

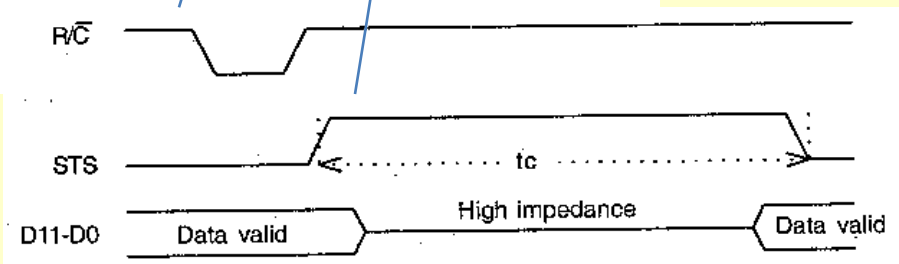
LS374

D_n	LE	$\overline{OE}$	O_n
H	⌐¬	L	H
L	⌐¬	L	L
X	X	H	Z*

SN74LS244

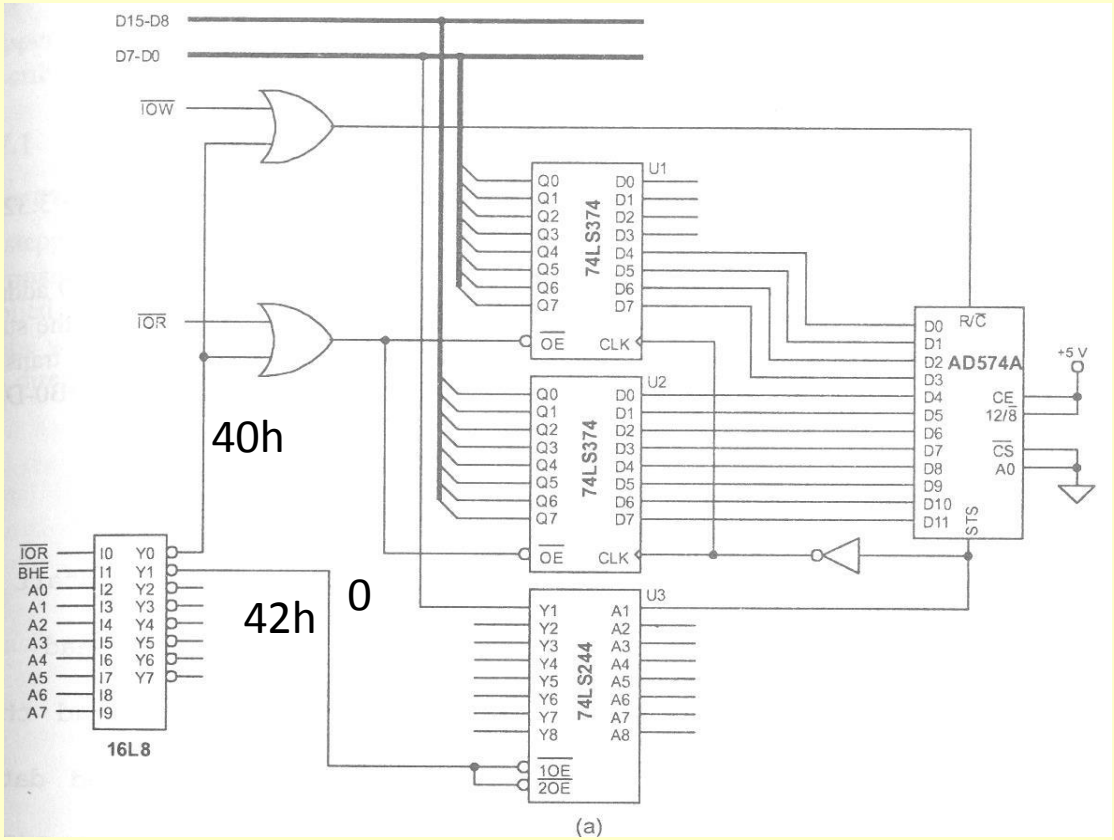
INPUTS		OUTPUT
$1\overline{G}$, $2\overline{G}$	D	
L	L	L
L	H	H
H	X	(Z)

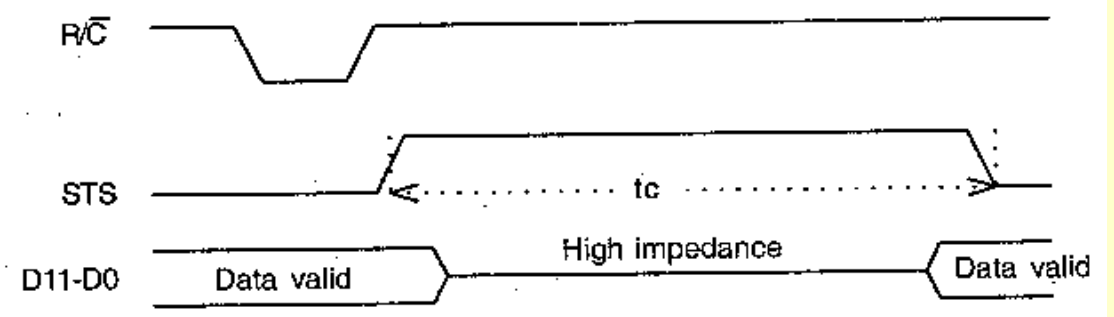




1. Stand-alone configuration

```
ST_C      EQU      40h
DATA_P    equ      40h
STATUS_P  EQU      42H
SAMPLES   DW       4000   DUP(0)
……..
          mov      cx,4000    ; 4000
          mov      si,offset SAMPLES
next:     out      ST_C,ax
Et1:      in       al,STATUS_P
          ror      al,1       ;D0>>C
          jc       et1        ;STS=1 sar
          in       ax,DATA_P  ;STS=0
          push     cx
          mov      cl,4
          shr      ax,cl
          mov      [si],ax
          inc      si
          inc      si
          pop      cx
          loop     next
          ……
```





AH		AL	
Cifra H	Cifra M	Cifra L	X

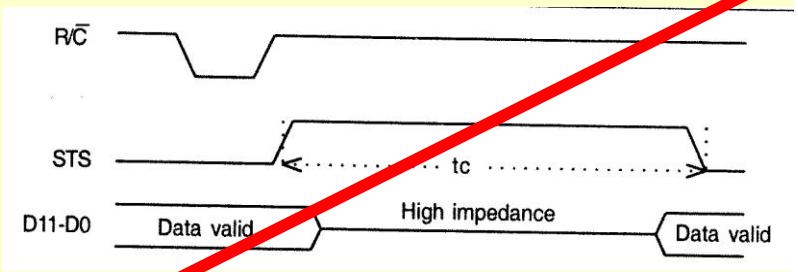
CE	CS	R/C	12/8	A_0	OPERATION
1	0	↓	X	0	Initiate 12-bit conversion

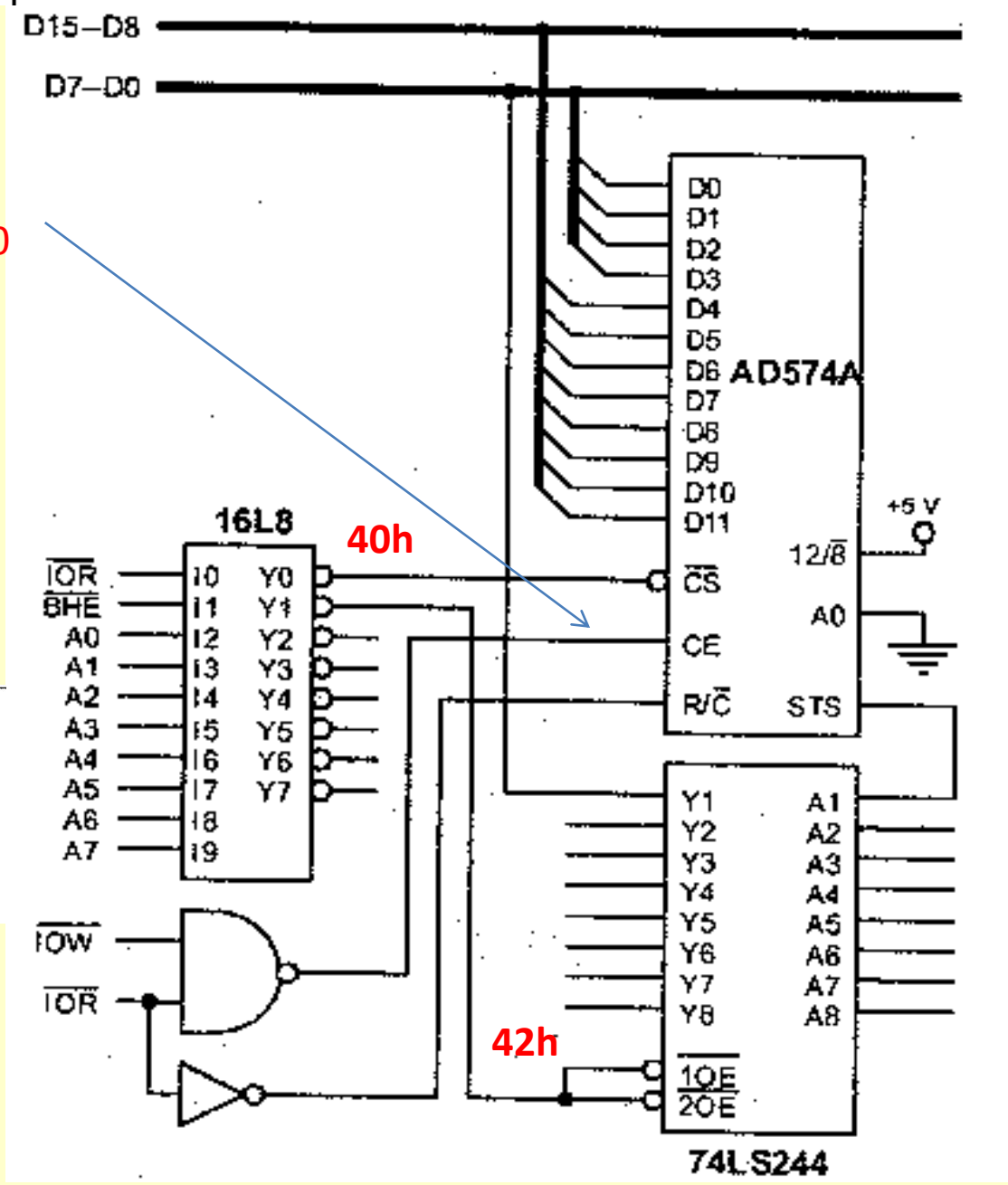
CE	$\overline{CS}$	R/$\overline{C}$	12/$\overline{8}$	A_0	OPERATION
⇑	0	0	X	0	Initiate 12-bit conversion

START_Conversie - OUT 40h,AX
/CS=0, A0=0, CE=IOW=L^H, R/C=//IOR=0

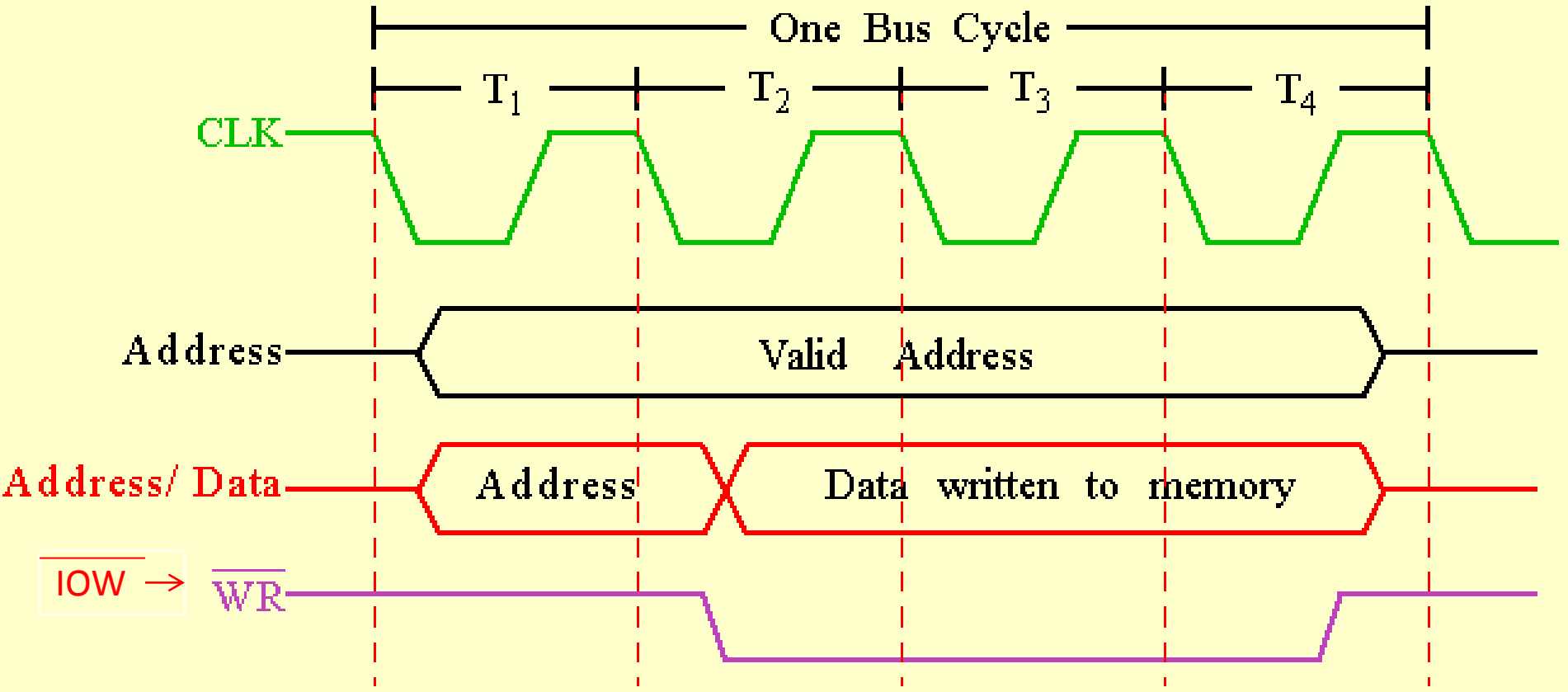
Read IN AX, 40h
/CS=0, R/C=//IOR=1, CE=1, A0=0, IOR=0

Vezi slide 7.

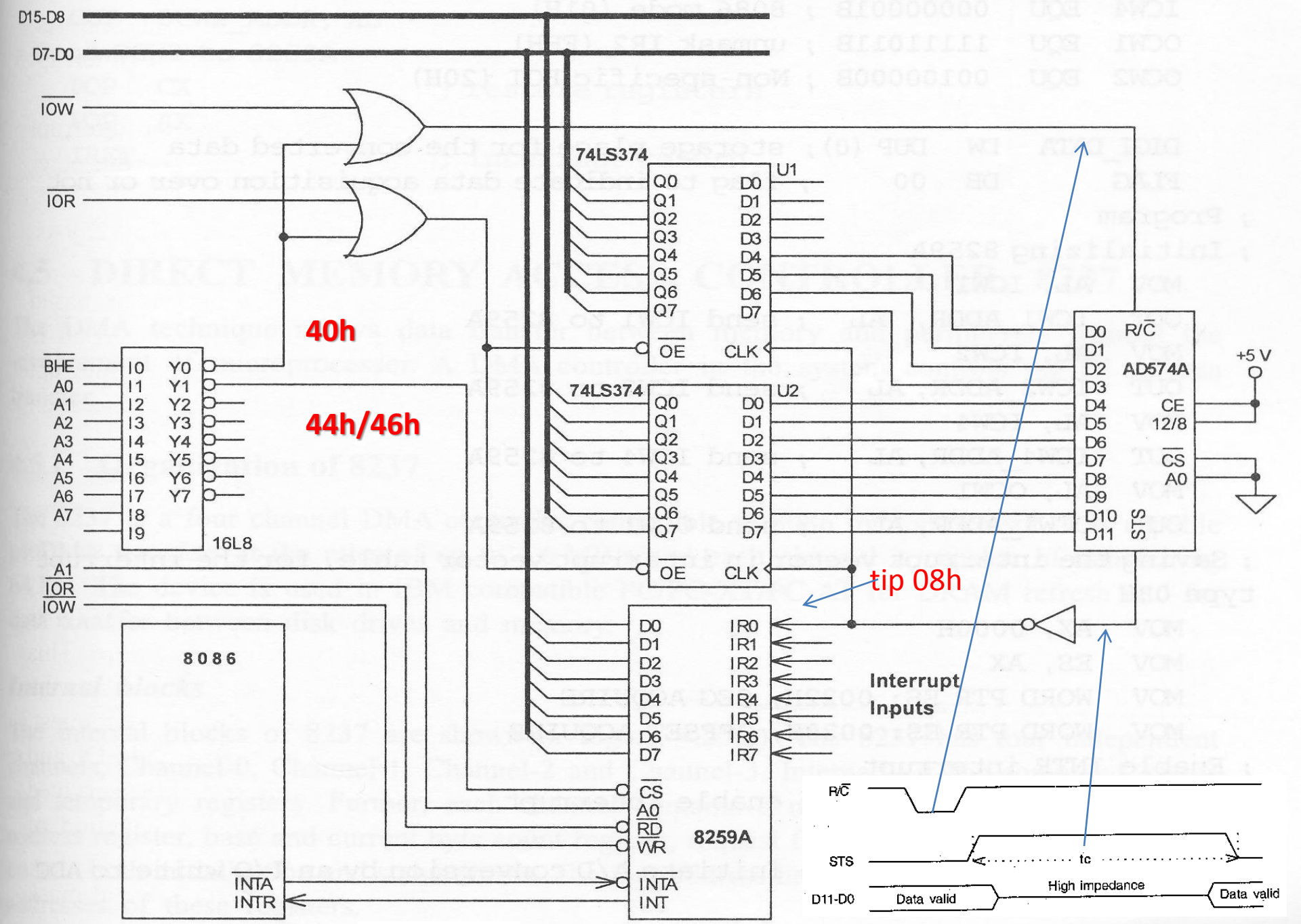




2. Direct connection



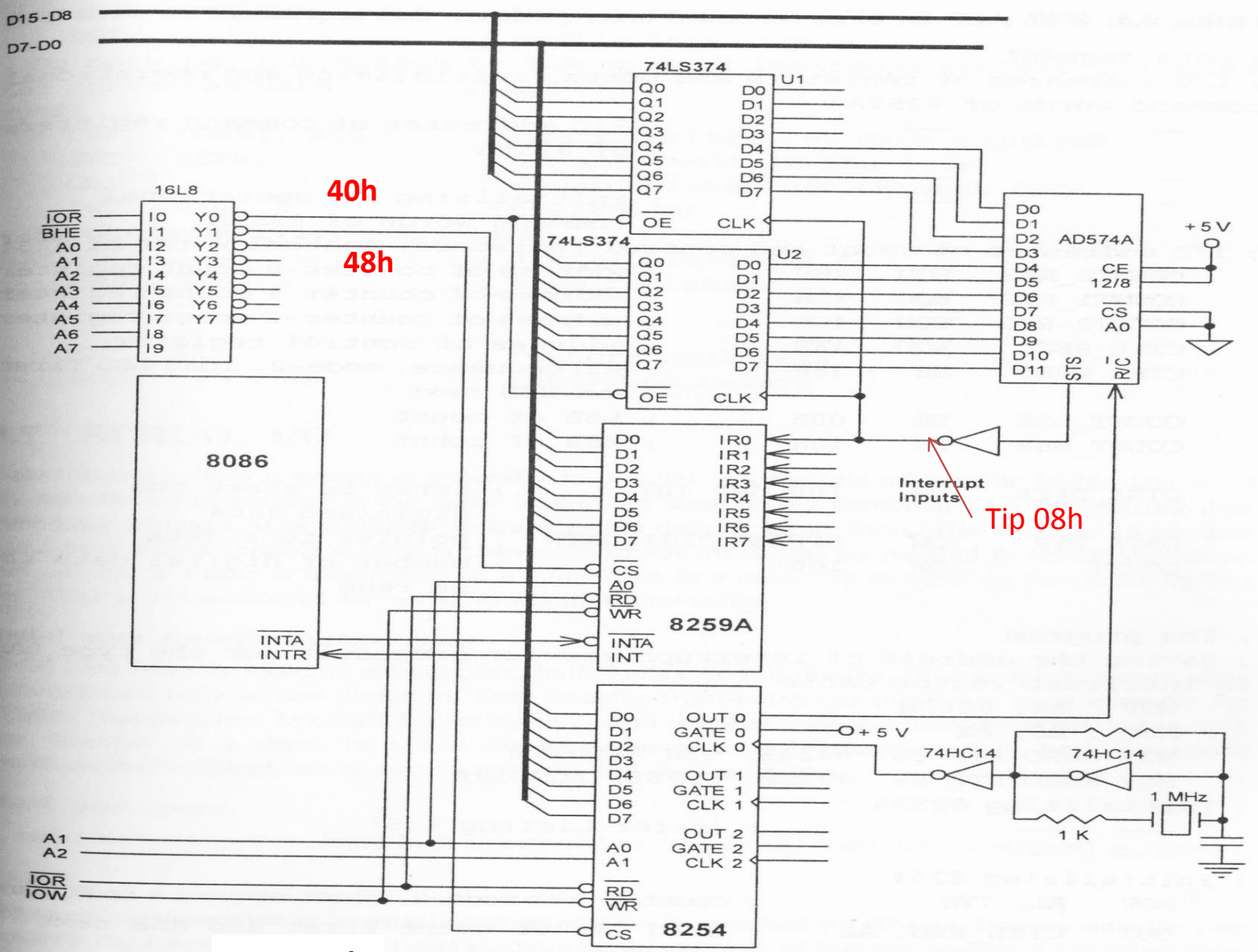
Simplified 8086 Write Bus Cycle



3. Interrupt driven data acquisition.

```
ST_C      EQU       40h
DATA_P    equ       40h
SAMPLES             DW        4000   DUP(0)
FLAG      DB        0
……..
;initializing 8259A
……..
;saving interrupt vector in IVT type 08h
              mov ax,0
              mov es,ax
              mov wordptr es:22h ; seg ACQ
              mov wordptr es:20h ; offset ACQ
              sti          ;IF=1
              mov cx,4000
              mov si,offset SAMPLES
Et0:          out ST_C,ax   ;start conversion
Et1:          cmp  FLAG,0
              jz  et1
              mov FLAG,0
              add  si,2
              Loop et0
……..
```

```
ACQ PROC FAR
        Push ax
        Push cx
        In ax,DATA_P
        Mov cx,4
        Shr ax,cl
        Mov [si],ax
        Inc FLAG
        Sti   ;IF=1
        ;EOI if necesary
        Pop cx
        Pop ax
        IRET
ACQ   ENDP
```



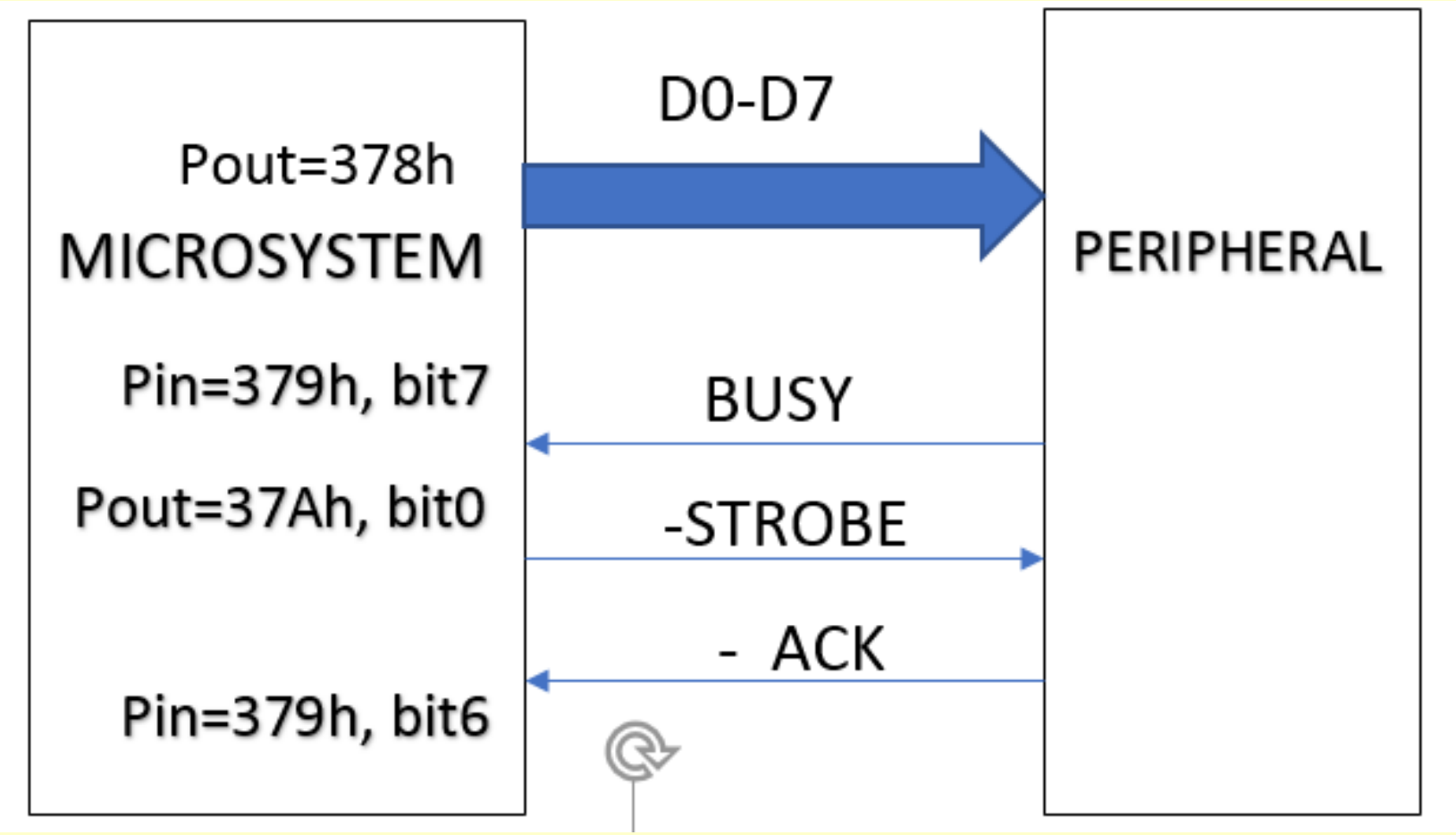
4. Timer controlled interrupt driven data acquisition.

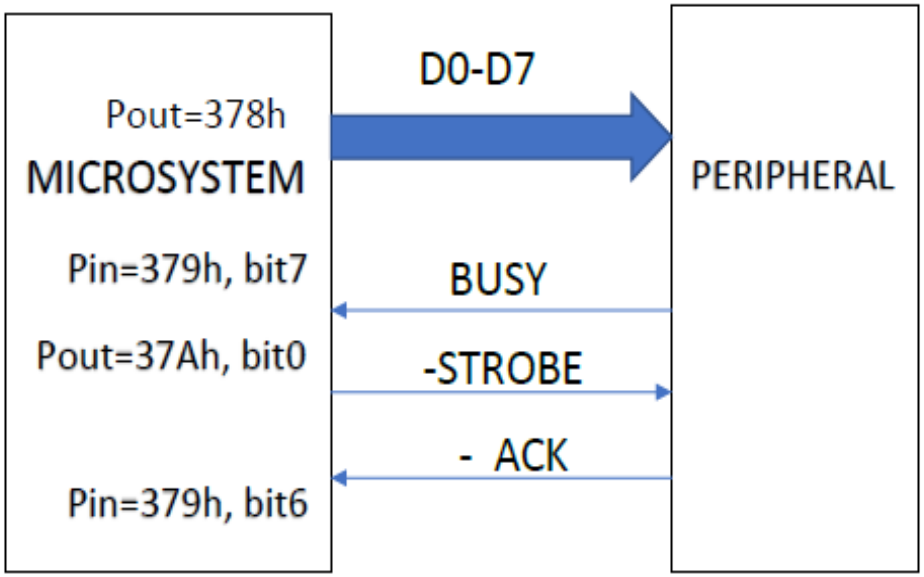
```
C0          EQU         48h
CTRL        EQU         4Eh
CTRLW       EQU         35h ;00110101B
CDIV        DW          1000
DATA_P      equ         40h
SAMPLES     DW          4000   DUP(0)
COUNT       DW          4000
……..
;initializing 8259A
;saving interrupt vector in IVT type 08h
                mov ax,0
                mov es,ax
                mov wordptr es:22h ; seg ACQ
                mov wordptr es:20h ; offset ACQ
                mov al, CTRLW       ;TIMER
                out  CTRL,al
                mov  ax,CDIV
                out C0,al
                mov al,ah
                out C0,al
                sti             ;IF=1
                mov si,offset SAMPLES
et0:            cmp COUNT,0
                jnz et0
                cli   ……..
```

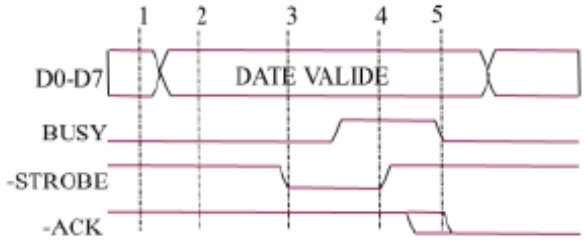
```
ACQ PROC FAR
        Push ax
        In ax,DATA_P
        Mov cx,4
        Shr ax,cl
        Mov [si],ax
        Dec COUNT
        Inc si
        Inc si
        Sti    ;IF=1
        ;EOI if necesary
        Pop ax
        IRET
ACQ   ENDP
```

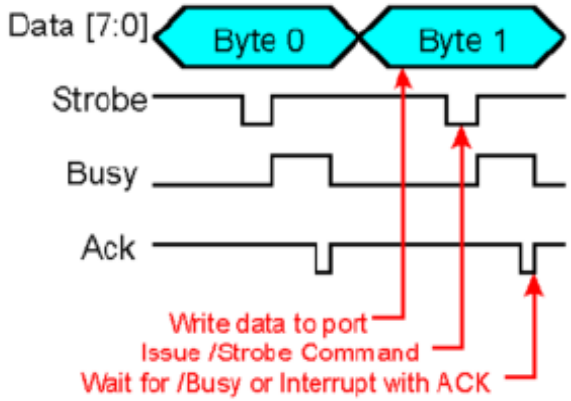
5. Modificati schema astfel ca achizitia esantioanelor sa se faca prin DMA.
Scrieti secventele de program care stau la baza functionarii schemei (programare DMAC, generare start conversie, ...)

6. Un periferic e conectat la un microsistem cu procesor pe porturile ca in figura de mai jos. Schimbul de date intre periferic si sistem se face conform protocolului Centronics, vezi diagrama. Se cere sa se scrie secventa de program care transfera 100 de octeti de date din : BUF DB 100 DUP(?).









1. Se verifică dacă semnalul de BUSY, din registrul de stare este inactiv (1)
2. Se scrie registrul de date (2)
3. Dacă BUSY nu este activ, se activează -STROBE din reg. de control (3)
4. Când semnalul BUSY este activat, se dezactivează semnalul –STROBE (4)
5. Când semnalul –ACK devine activ se confirmă PC-ului că s-a făcut preluarea octetului de către imprimantă (5)

```
BUF   DB   100DUP(?)
PDATA EQU  378H
PCON EQU   37AH
PSTARE EQU 379H
……..
MOV SI,OFFSET BUF
MOV CX,100
MOV AL,1
OUT PCON,AL  ;STROBE=1
ET1: IN AL,PSTARE
TEST AL,80H     ;BUSY=0?
JNZ ET1
MOV AL,[SI]  ; DATE>>PORT
OUT PDATA,AL
XOR AL,AL
OUT PCON,AL ; STROBE=0
ET2: IN AL,PSTARE
TEST AL,80H ; BUSY=0?
JZ ET2
MOV AL,1  ;  if BUSY=1
OUT PCON, AL ;STROBE=1
ET3: IN AL,PSTARE ;
TEST AL,40H ; ACK=0?
JNZ ET3   ; IF ACK=1 Jump
ET4: IN AL, PSTARE ;test BUSY=1
TEST AL,80H
JZ ET4  ; ; IF BUSY=1 Jump
INC SI
LOOP ET1
……..
```