

Peripheral Interface Device 8155 (I/O Interface & Timer)

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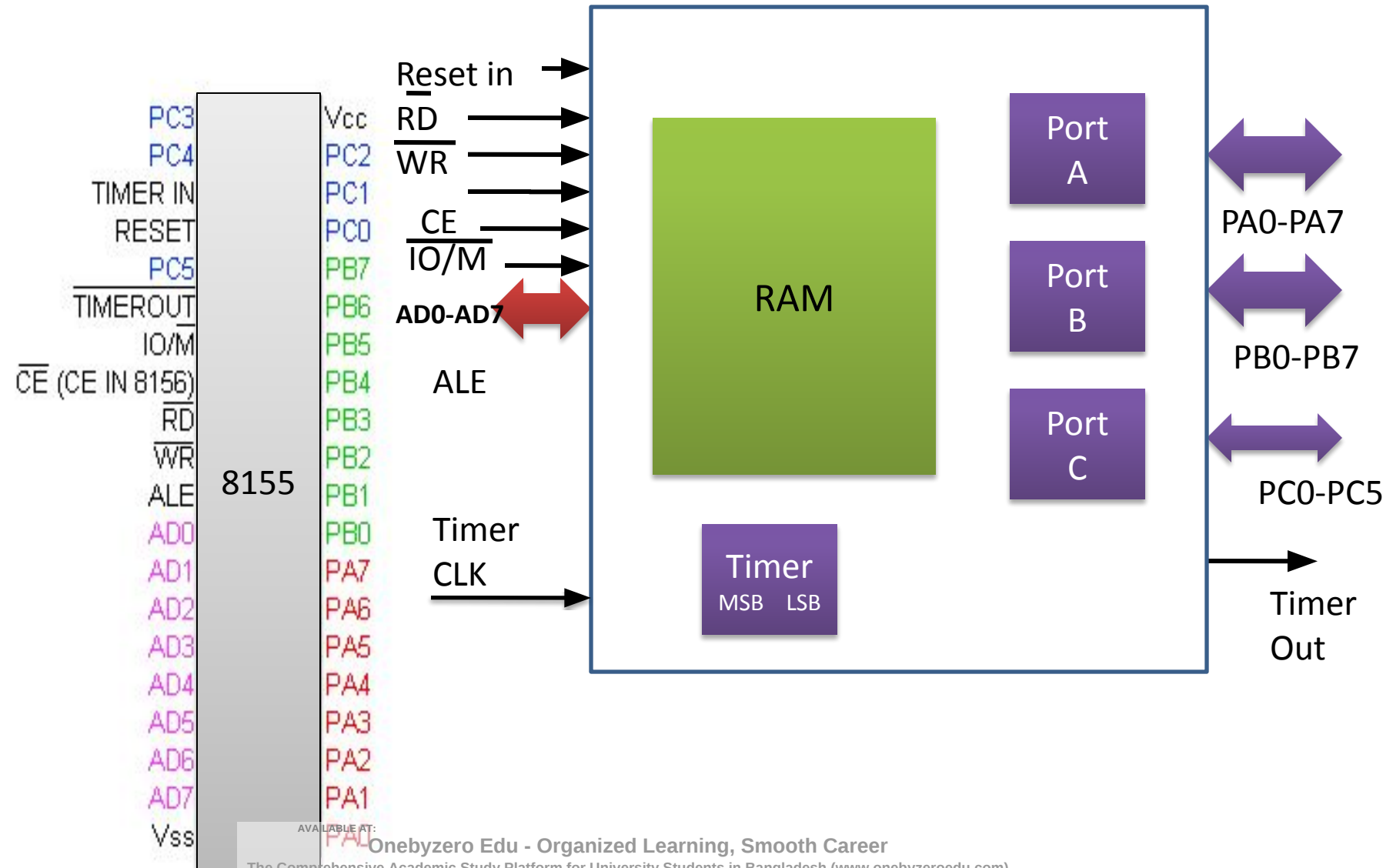
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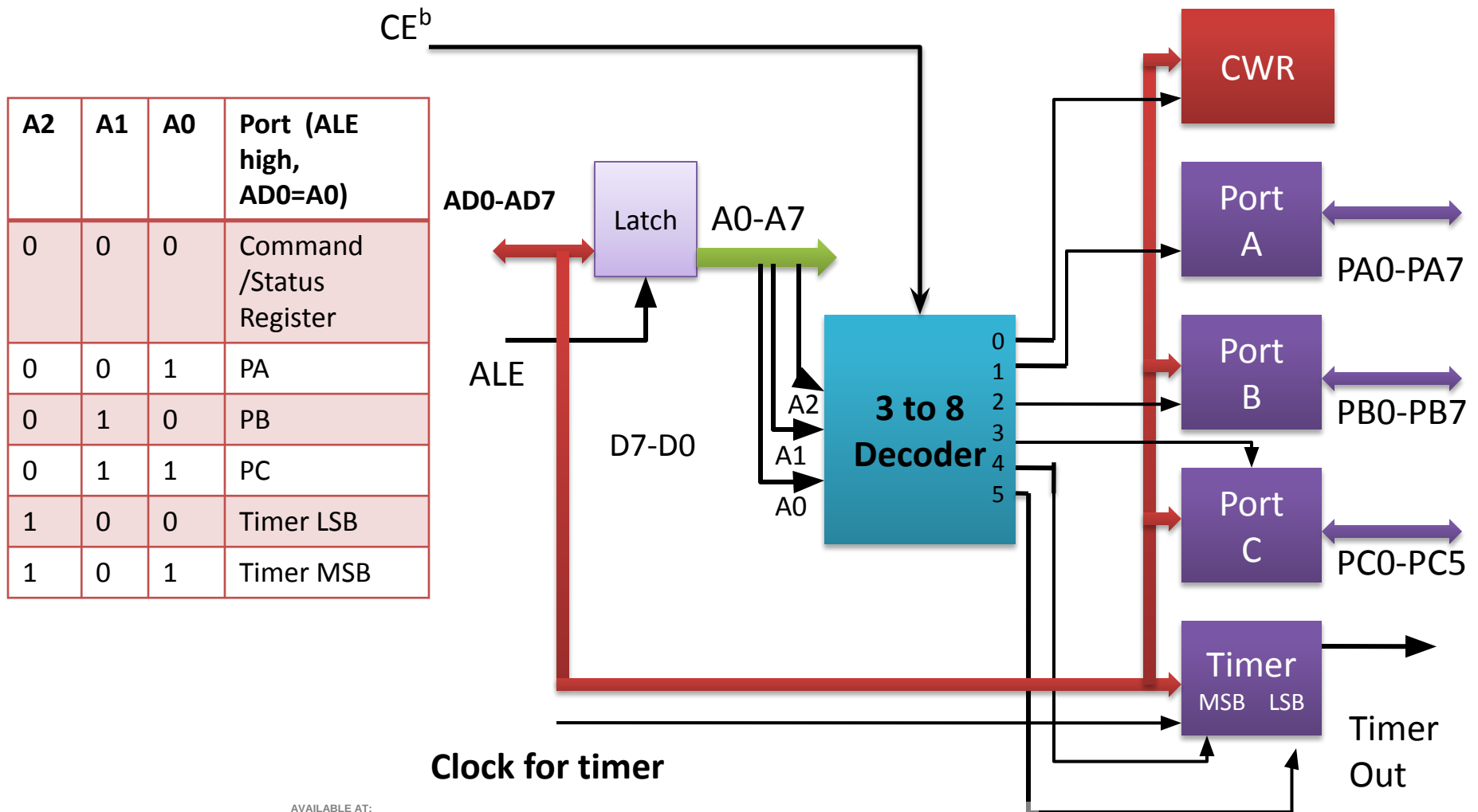
Outline

- Review
 - Programmable Interface device 8155
 - Block diagram, Address Calculation diagram
 - Interfacing LED using 8155
- 8155 Timer
 - Modes of timer
 - Square wave generation using 8155 interfaced timer
- 8155 Handshake & Interrupt mode
- Interfacing A/D Converter using Handshake mode using 8155

8155 Block Diagram



Expanded Block Diagram

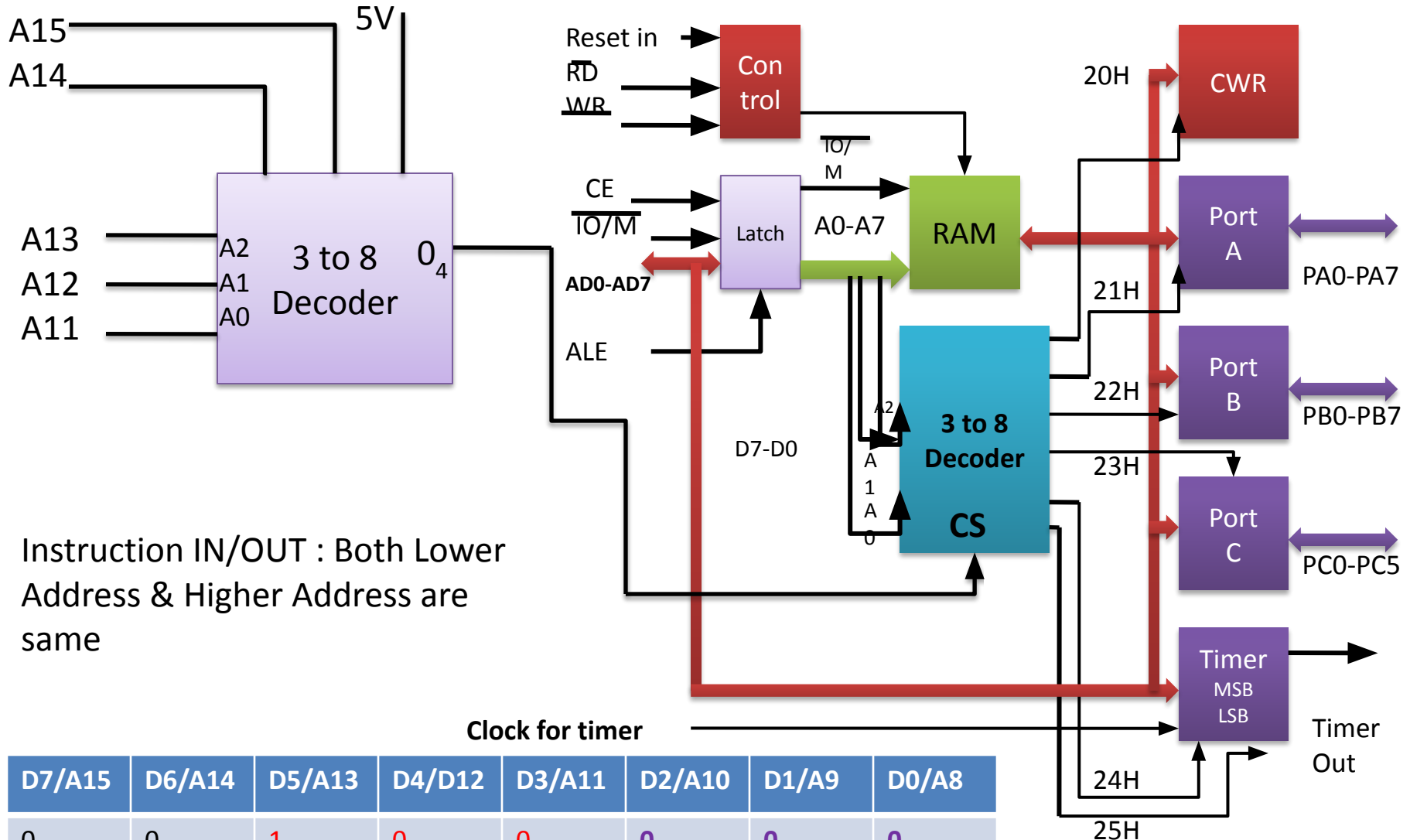


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Calculate Address of Port of 8155



Clock for timer

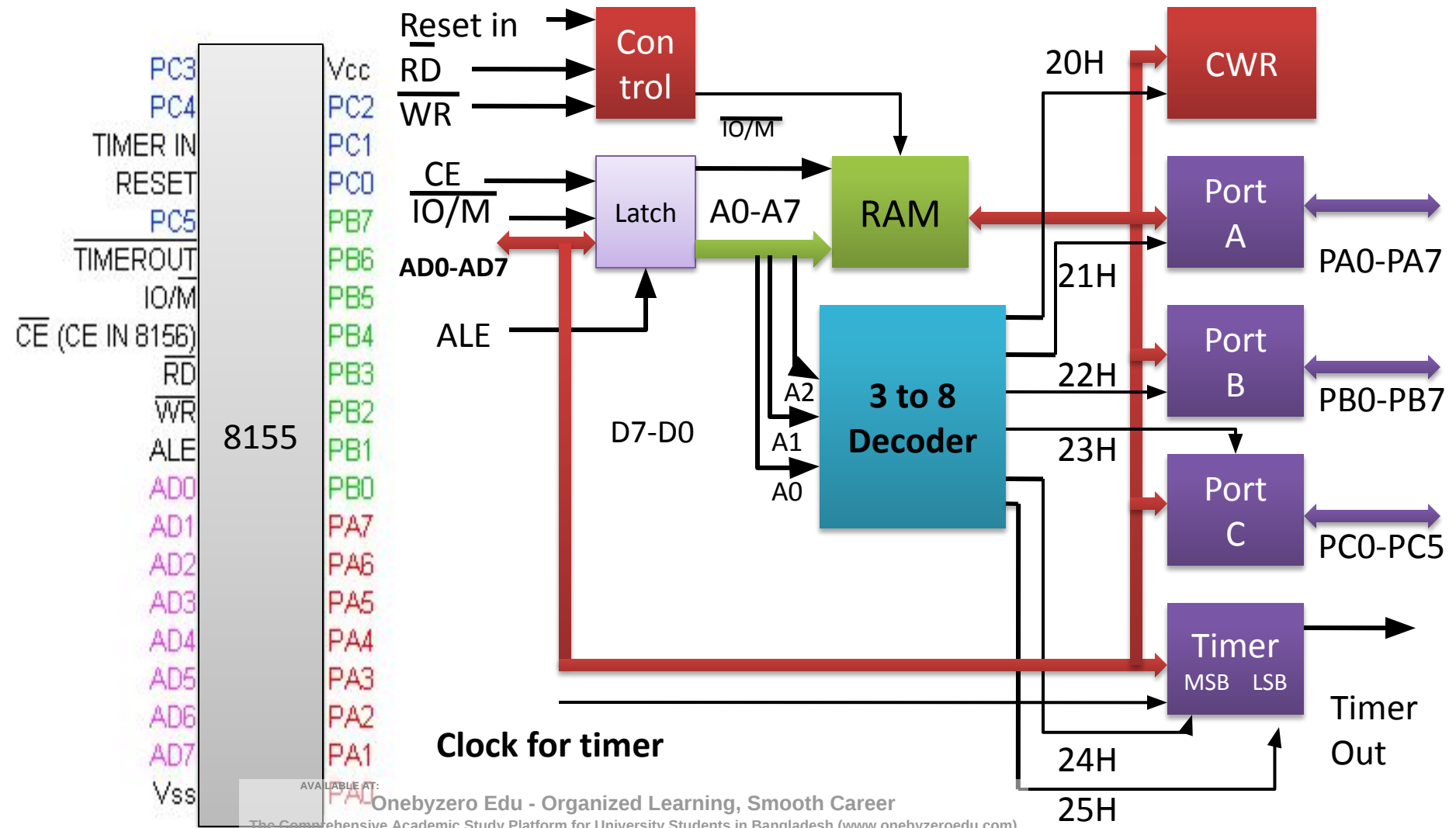
D7/A15	D6/A14	D5/A13	D4/D12	D3/A11	D2/A10	D1/A9	D0/A8
0	0	1	0	0	0	0	0

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8155 Block Diagram



Control word (command reg) format

D7	D6	D5	D4	D3	D2	D1	D0
Timer Command		IEB	IEA	PC		PB	PA

- D0, D1: mode for PA and PB, 0=IN, 1=OUT
- D2, D3: mode for PC
- D4, D5: interrupt EN for PA and PB, 0=disable 1=enable
- D6, D7: Timer command:
 - 00: No effect
 - 01: Stop if running else no effect
 - 10: Stop after terminal count (TC) if running, else no effect
 - 11: Start if not running, reload at TC if running.

- Port C bits
(D2, D3)

ALT	D3	D2	PC5	PC4	PC3	PC2	PC1	PC0
1	0	0	IN	IN	IN	IN	IN	IN
2	0	1	OUT	OUT	OUT	OUT	OUT	OUT
3	1	0	OUT	OUT	OUT	STB _A	BF _A	INTR _A
4	1	1	STB _B	BF _B	INTR _B	STB _A	BF _A	INTR _A

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8155 Decode Registers

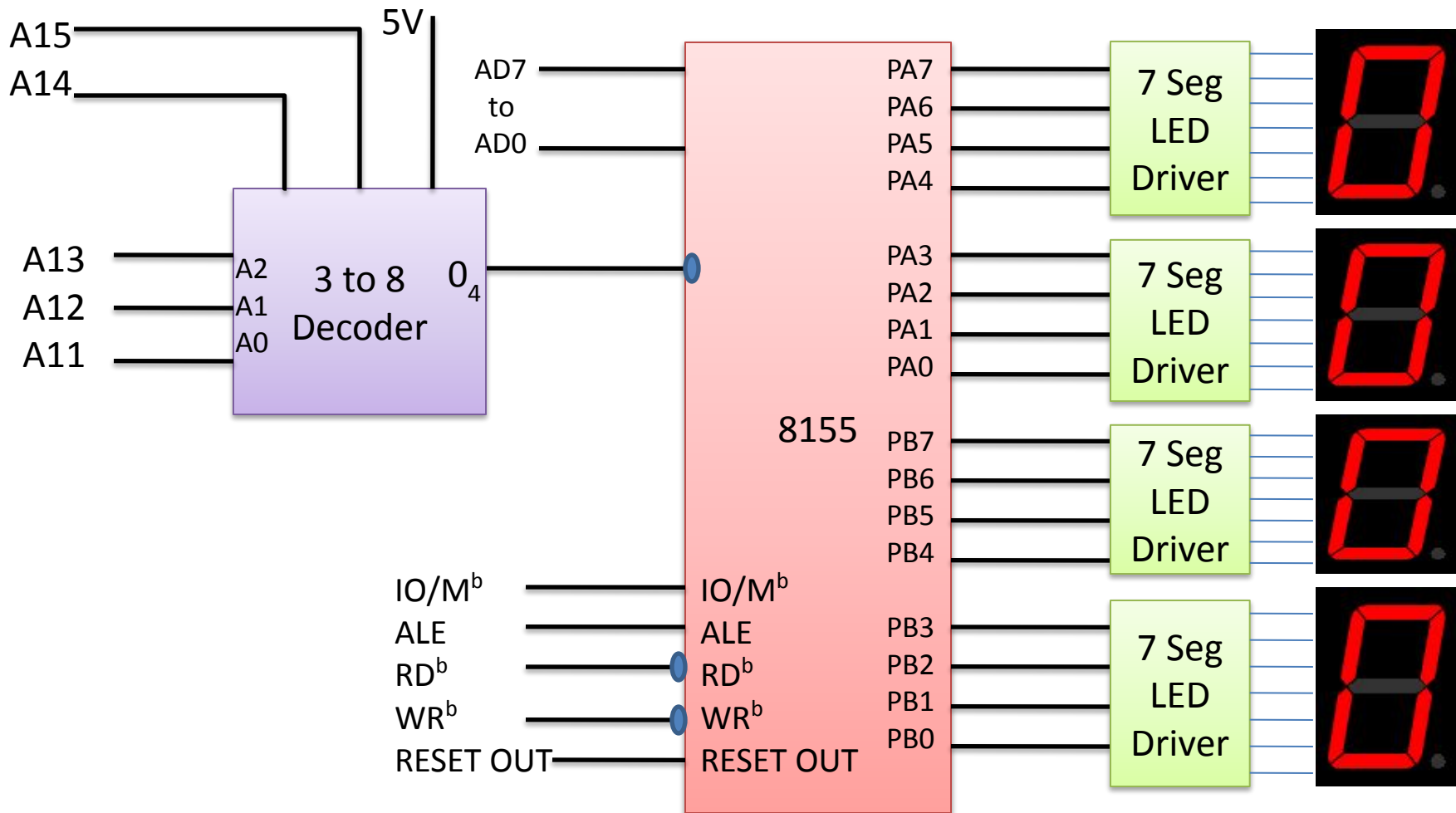
- Registers

A2	A1	A0	Port (ALE high, AD0=A0)
0	0	0	Command/Status Register
0	0	1	PA
0	1	0	PB
0	1	1	PC
1	0	0	Timer LSB
1	0	1	Timer MSB

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Interfacing 7 Segment LEDs to output port using 8155



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Interfacing LEDs Cntd..

- Port Address
 - Control Register=20H, Port A= 21H, Port B= 22H
- Control word:

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	0	0	1	1
Timer		Not Applicable		Use for Port C		Port B Output	Port A Output

- Program
 - MVI A,03 ; initialize Port A &B for O/P
 - OUT 20H
 - MVI A, BYTE1 ; Display BYTE1 at port A
 - OUT 21H
 - MVI A, BYTE2 ; Display BYTE2 at port B
 - OUT 22H

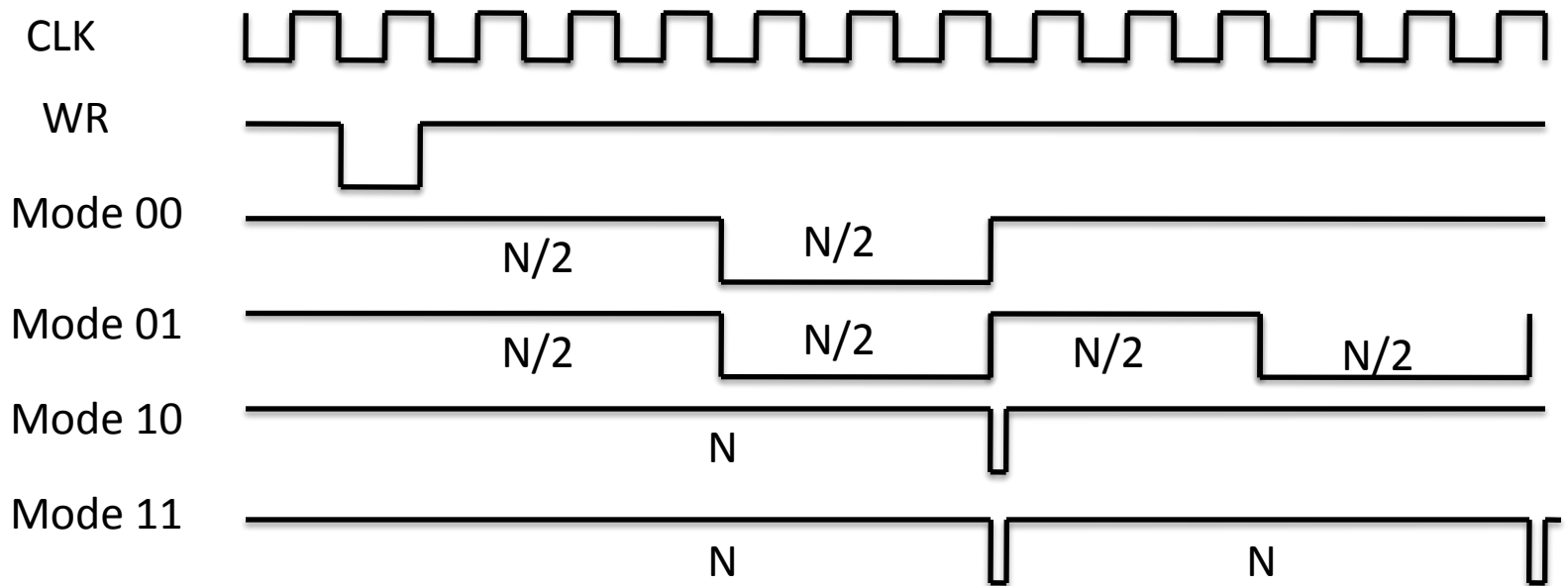
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8155: Timers

MSB							
M2	M1	T13	T12	T11	T10	T9	T8
LSB							
T7	T6	T5	T4	T3	T2	T1	T0

- M2, M1: mode bits:
 - 00: Single square wave of wavelength $TC/2$ ($TC/2, TC/2$ if TC even; $[TC+1/2], [TC-1/2]$ if TC odd)
 - 01: Square waves of wavelength TC ($TC/2, TC/2$ if TC even; $[TC+1/2], [TC-1/2]$ if TC odd)
 - 10: Single pulse *on* the TC'th clock pulse
 - 11: Single pulse *on* every TC'th clock pulse.

8155: Timer Modes Output



- 00: Single square wave of wavelength $TC/2$ ($TC/2, TC/2$ if TC even; $[TC+1/2], [TC-1/2]$ if TC odd)
- 01: Square waves of wavelength TC ($TC/2, TC/2$ if TC even; $[TC+1/2], [TC-1/2]$ if TC odd)
- 10: Single pulse *on* the TC 'th clock pulse
- 11: Single pulse *on every* TC 'th clock pulse.

Designing of Square Wave Generator Using 8155

- Design a square wave with pulse width 100μS
- Mode 1
- Clock Frequency 3 MHZ

Timer count: Pulse Period/Clock period
$$= 200 \times 10^{-6} / 330 \times 10^{-9} = 606$$
$$= 25E H$$
$$= 02 \text{ (MSB)}, 5E \text{ (LSB)}$$

Square Wave Generator Cntd..

- Timer port address: LSB 24H & MSB 25H
- Mode 1; M1=0, M2=1
 - M1 M2 T13 T12 T11 T10 T8 T7
 - 0 1 0 0 0 0 1 0 == (42H)
- Control word: (C0H)

D7	D6	D5	D4	D3	D2	D1	D0
Timer Command		IEB	IEA	PC		PB	PA
1	1	0	0	0	0	0	0

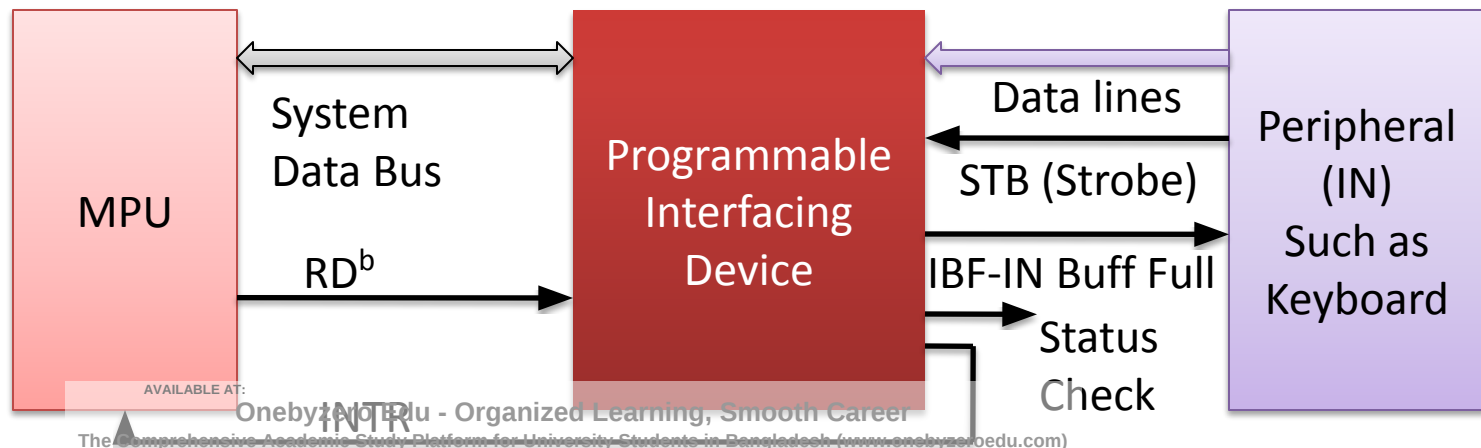
- Instructions to set counter & square wave generation

```
MVI    A, 5E    ; LSB of count
OUT 24H ; Load LSB of timer Register
MVI A, 42H    ; MSB count with Mode 1
MVI 25H ; Load MSB of timer Register
MVI A, C3H    ; Load the control word for register
OUT 20H ; Trigger the counter by loading to Ctrl word to ctrl Reg
```

Programmable device :

Data Input with Handshake signal

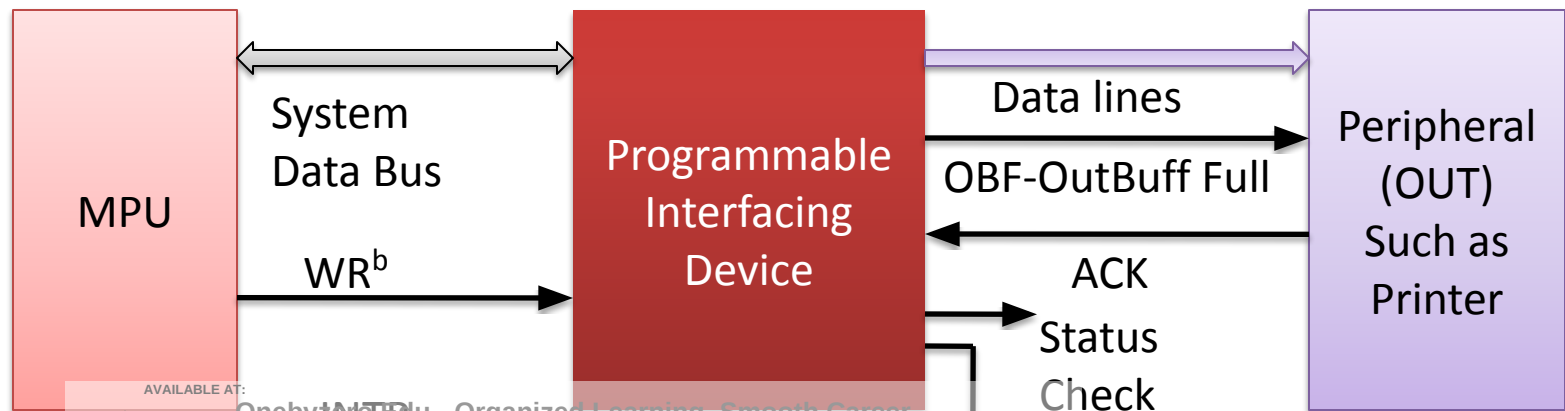
- Two Handshake signal (STB, IBF)
- Steps in data input from IN device using 8155
 - Peripheral put data in data line & send handshake signal STB
 - Device inform Peripheral that IN port is full, don't send next byte until read by IBF signal
 - Either MPU check status or Device interrupt to MPU for Reading data from Device



Programmable device :

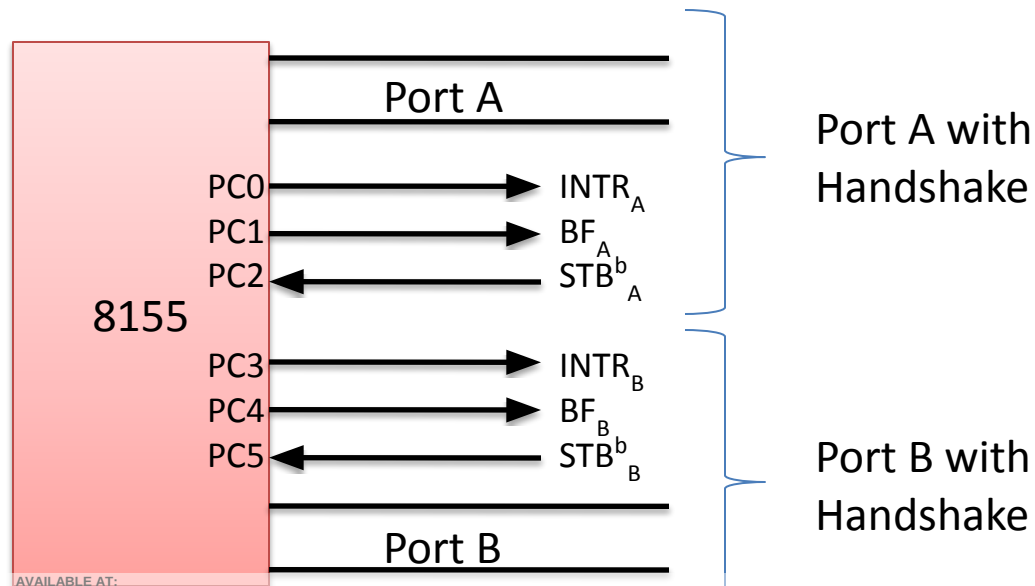
Data output with Handshake signal

- MPU writes byte to the out port of Device by sending WR^b signal
- Device inform the peripheral by sending handshake OBF, that a byte on the way
- Peripheral ACK the byte by signal to device
- Device Interrupt the MPU to ask to next byte or MPU check the status of Device



8155 I/O in Handshake Mode

- Port A and B: configured in Handshake mode
- Port A uses PC0, PC1, PC2 of Port C
- Port B uses PC3, PC4, PC5 of Port C



8155: Handshake mode

- Control signals
 - STB^b (Strobe input):
 - BF (Buffer Full):
 - INTR (INTerrupt Request): Rising edge of STB^b if INTE = 1
 - INTE (INTerrupt Enable): D4 and D5 for Port A & B
- Input, Output : As discussed earlier
- Status word:
 - MPU check the status Reg of port or timer
 - Control register & Status register have same port
 - Differentiated by RD^b and WR^b signals

Designing Interfacing Ckt Using 8155 to Read & Display from ADC to LEDs

- Set up Port A in the handshake mode to read data from A/D Converter
- Setup port B as output port to display data at seven segment LEDs
- Use line PC3 from port C to initiate a conversion
- Use the 8155 Timer to record conversation time

Control, Status & Timer

- Control word

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	0	1	1	0
Timer		NA (INTR not used)		Use for Port C		Port B OUT to LED	Port A IN from DAC

06H

CH=O/P
CL=Handshake
Mode

- Status word

D7	D6	D5	D4	D3	D2	D1	D0
No	X	X	X	X	X	BFa	X
USE	Timer	INTEb	BFb	INTRb	INTAa	BFa	INTRa

Read the Data
Mask with 02H

- Timer (with effecting other I/O assignment)

- Start timer
- Stop timer

1	1	0	0	0	1	1	0
0	1	0	0	0	1	1	0

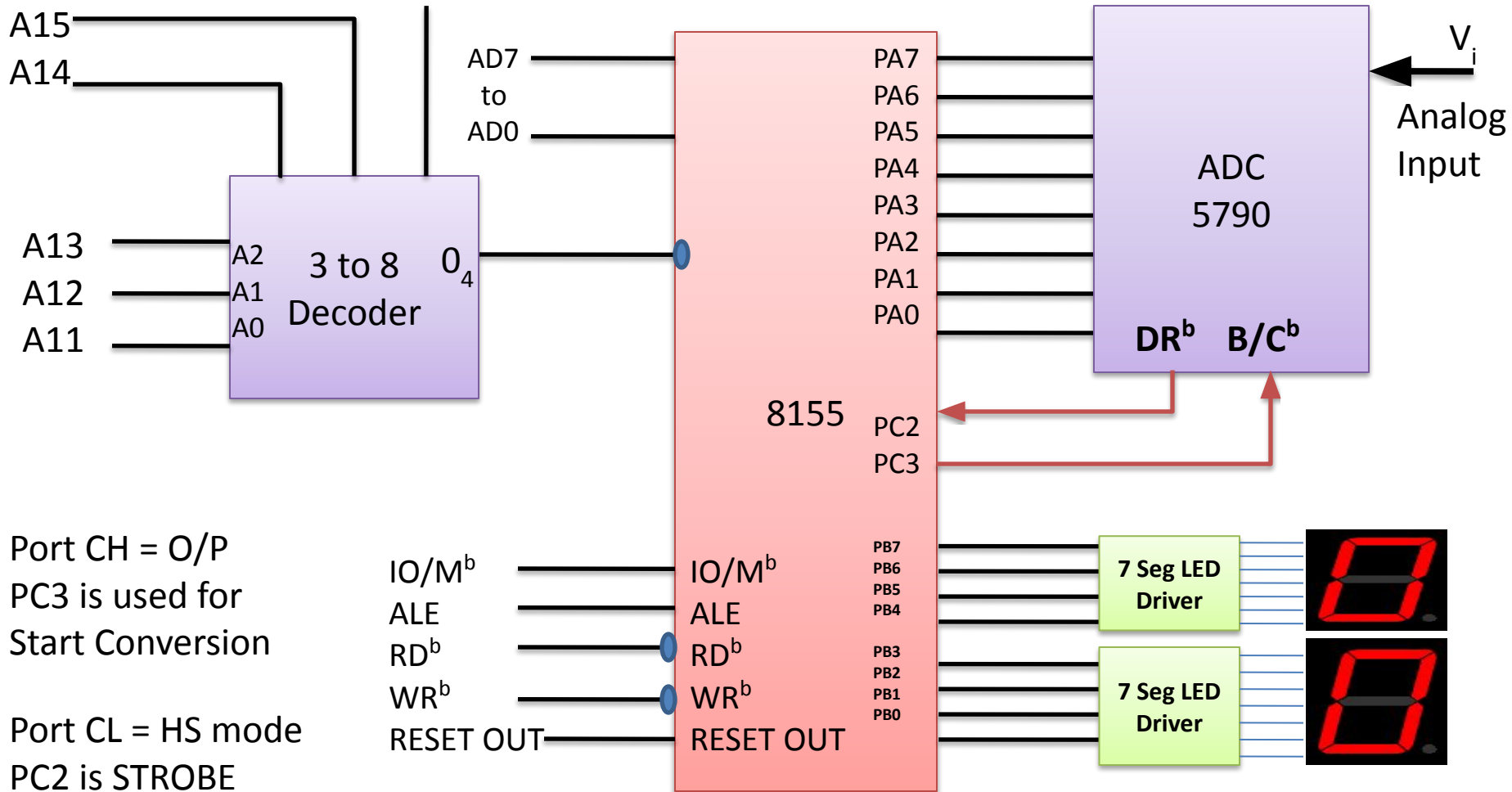
C6H

46H

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Interface Diagram



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Interfacing Program

```
MVI    A,06H    ;Control word for I/O port
OUT    20H ; Set up port as specified
MVI    A,00H    ; Load 0000H in Timer Reg
OUT    24H
OUT    25H
```

```
MVI    A,08H    ;Byte to set PC3=1
OUT    23H ;Send start pulse
MVI    A,C6H    ;Control word to start timer
MVI    20H ; Start timer
MVI    A,00H    ;Byte to set PC3=0
OUT    23H ;Start conversion
```

```
ST:IN 20H    ; Read Status Register
ANI  02H ;Check Status of DRb
JZ  ST      ; If BFa=0 wait in
```

```
MVI A,46H ; Byte to stop Counter
OUT 20H ;Stop Counter
```

```
IN  21H    ; Read A/D output
OUT 22H ;Display data at port B (LEDs)
```

```
INT 24H ; Read LSB of Timer
MOV L,A
INT 25H ; Read MSB of Timer
ANI 3FH ;Mask the mode Bit D6,D7
MOV H,A ; Save MSB timer count in H
LHLD RWM ; Store the count at
;Memory location RWM
HLT
```

Reference

- R S Gaonkar, “Microprocessor Architecture”, Chapter 14

Thanks

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