

# 2102440 Introduction to Microprocessors

## Chapter 9 8255 8-bit Programmable Peripheral Interface

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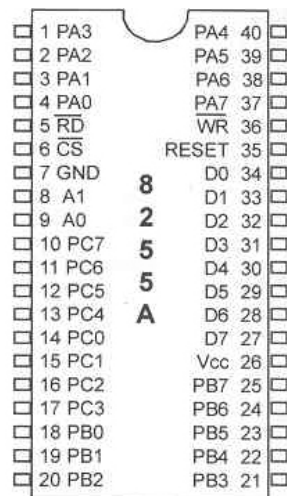
## Topics

- Interfacing with 8086/8088
- Three modes of operation
  - Mode 0
  - Mode 1
  - Mode 2
- Status word
- Interfacing with 8086 data bus
- Applications

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## 8255 PPI Chip



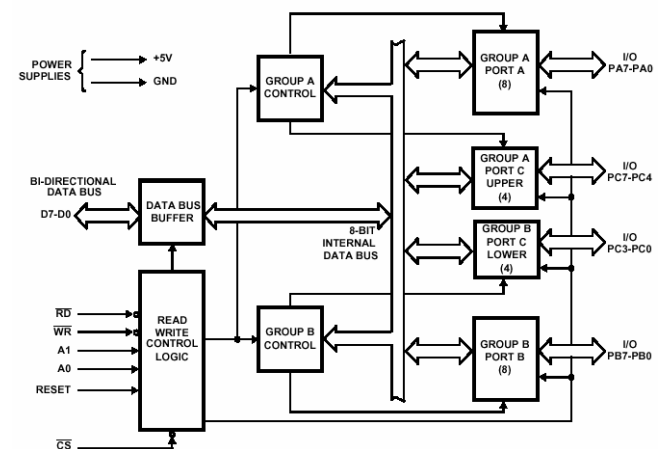
The 8255 Programmable Peripheral Interface (PPI)

- It is one of the most widely used I/O chips.
- It has three separately accessible ports: A, B, and C
- The individual ports can be programmed to be input or output.
- Port A (PA0-PA7) -> all inputs or all outputs.
- Port B (PB0-PB7) -> all inputs or all outputs.
- Port C (PC0-PC7) -> all inputs or all outputs or can be programmed individually.
  - CU : upper bits (PC4-PC7)
  - CL : lower bits (PC0-PC3)

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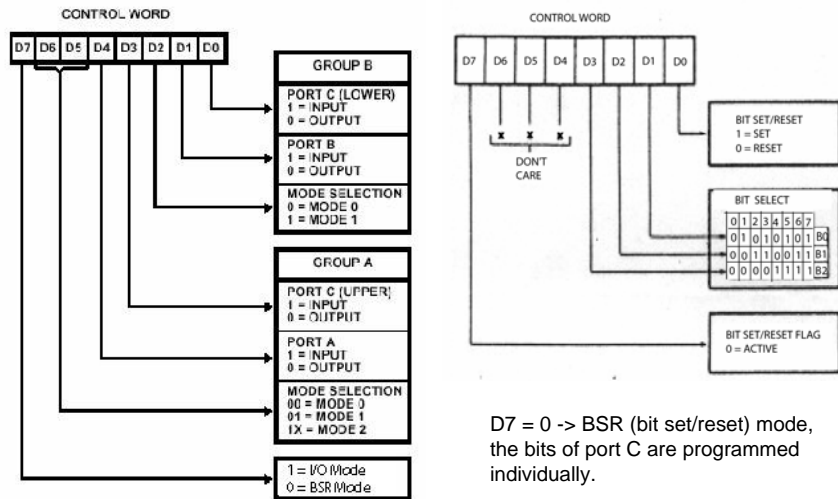
## Block Diagram of the 8255



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## I/O Mode of the 8255



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## 8255 Port Selection

$\overline{CS}$	A1	A0	Selects
0	0	0	Port A
0	0	1	Port B
0	1	0	Port C
0	1	1	Control register
1	x	x	8255 is not selected

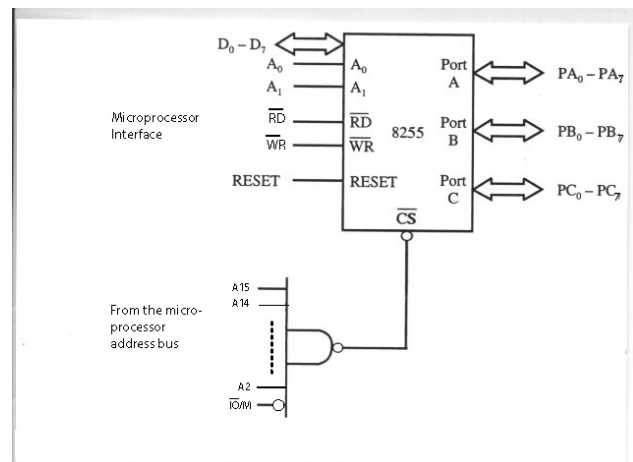
CS (chip select) : select the entire chip

A0 and A1 : select the specific port with the 8255.

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## Addressing 8255



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## Mode Selection of the 8255

- Ports A, B, and C are used for I/O data.
- The control register is programmed to select the operation mode of the three ports A, B, and C.
  - Mode 0 : simple I/O mode
    - Any of the ports A, B, CL and CU can be programmed as input or output.
    - No control of individual bits (all bits are out or all bits are in)
  - Mode 1 : Ports A and B can be used as input or output ports with handshaking.
  - Mode 2 : Port A can be used as bidirectional I/O port with handshaking.

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## Input/Output Data Transfers

- Data transfers can be Byte-wide or word-wide.
- The accessed I/O port is selected by an I/O address.
- The I/O address is specified as part of the I/O instruction.
- The 8086 I/O addresses are output on address/data bus lines AD0-AD15.
- The logic levels of signals A0 and  $\overline{\text{BHE}}$  determine whether data are I/O for an odd-addressed byte-wide port, even-addressed byte-wide port, or word-wide port.

## Input/Output Instructions

Mnemonic	Meaning	Format	Operation
IN	Input direct Input indirect (variable)	IN ACC, Port IN ACC, DX	ACC ← [Port] ; ACC = AL or AX ACC ← [DX]
OUT	Output direct Output indirect (variable)	OUT Port, ACC OUT DX, ACC	[Port] ← ACC [DX] ← ACC

*Direct:* port address is specified directly and cannot be larger than FFH.

Ex. IN AL, 99H ; bring a byte into AL from port 99H

OUT 34H, AX ; send out a word from AX to port addresses 34H -35H

*Register indirect:* the port address is kept by the DX register. Therefore, it can be as high as FFFFH.

Ex. MOV DX, 64B1H ; DX = 64B1H

OUT DX, AX ; send out a word from AX to port address pointed to DX.  
; The byte from AL goes to port 64B1H and byte from AH  
; goes to port 64B2H

## 8255 Control Word (I)

- Ex. Find the control word if PA = out, PB = in, PC0 – PC3 = in, and PC4-PC7 = out.
  - Control word =  $1000\ 0011_2 = 83\text{H}$
- Ex. Program the 8255 to get data from port B and send it to port A. In addition, data from PCL is sent out to the PCU. Use port addresses of 300H-3003H for the 8255 chip.

## 8255 Example code (I)

```

B8255C EQU 300H ; Base address of 8255 chip
CNTL EQU 83H ; PA = out, PB = in, PCL = in, PCU = out

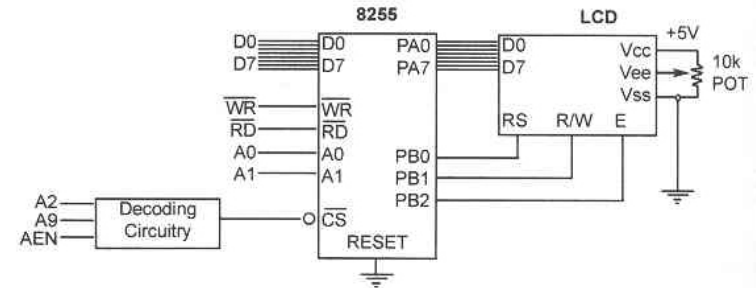
MOV DX, B8255C+3 ; load control reg. address (300H+3 = 303H)
MOV AL, CNTL ; load control byte
OUT DX, AL ; send it to control register
MOV DX, B8255C+1 ; load PB address
IN AL, DX ; get the data from PB
MOV DX, B8255C ; load PA address
OUT DX, AL ; send it to PA
MOV DX, B8255C+2 ; load PC address
IN AL, DX ; get the bits from PCL
AND AL, 0FH ; mask the upper bits
ROL AL, 1 ; shift the bits
ROL AL, 1 ; to upper position
ROL AL, 1
OUT DX, AL ; send it to PCU
    
```

## 8255 Example Code (II)

Ex. Show the address decoding where port A of the 8255 has an I/O address of 300H, then write a program to toggle all bits of PA continuously with a ¼ second delay. Use INT 16H to exit if there is a keypress.

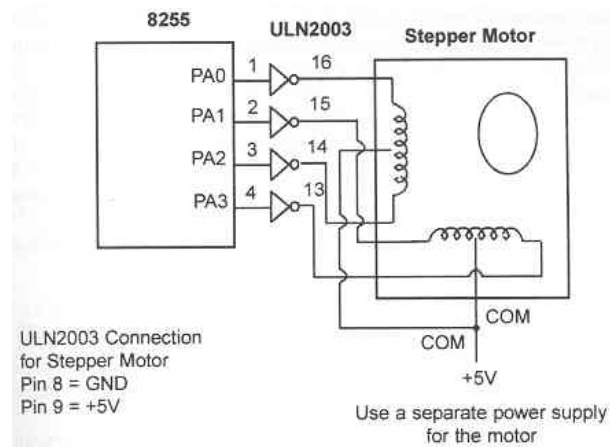
<pre> MOV DX,303H ;CONTROL REG ADDRESS MOV AL,80H ;ALL PORTS AS OUTPUT OUT DX,AL  AGAIN: MOV DX,300H MOV AL,55H OUT DX,AL CALL QSDelay ;1/4 SEC DELAY MOV AL,0AAH ;TOGGLE BIT OUT DX,AL CALL QSDelay MOV AH,01 INT 16H ;CHECK KEYPRESS JZ AGAIN ;PRESS ANY KEY TO EXIT MOV AH,4CH INT 21H ;EXIT </pre>	<pre> QSDelay PROC NEAR MOV CX,16572 ;16,572x15.085 usec=1/4 sec PUSH AX  W1: IN AL,61H AND AL,00010000B CMP AL,AH JE W1 MOV AH,AL LOOP W1 POP AX RET QSDelay ENDP </pre>
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## 8255 Connection to LCD



1. The LCD's data pins are connected to Port A of the 8255.
2. The LCD's RS pin is connected to PB0 of Port B of the 8255.
3. The LCD's R/W pin is connected to PB1 of Port B of the 8255.
4. The LCD's E pin is connected to PB2 of Port B of the 8255.
5. Both Ports A and B are configured as output ports.

## 8255 Connection to Stepper Motor



# 8-bit Analog to Digital Converter

