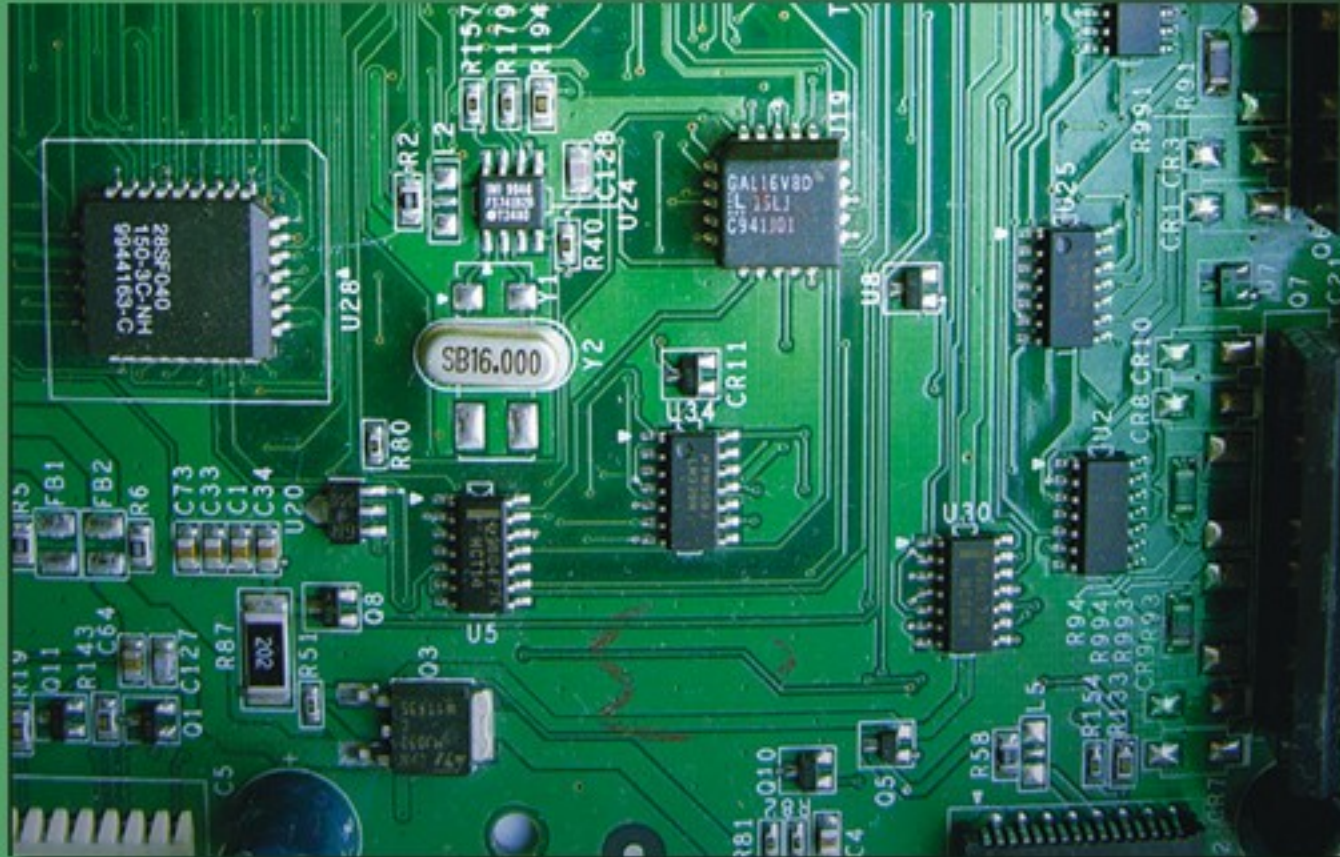# The Intel Microprocessors

8086/8088, 80186/80188, 80286, 80386, 80486 Pentium, Pentium Pro Processor, Pentium II, Pentium 4, and Core2 with 64-bit Extensions

Architecture, Programming, and Interfacing

EIGHTH EDITION

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PEARSON

Basic I/O Interface - 8255

11–3 THE PROGRAMMABLE PERIPHERAL

- 82C55 **programmable peripheral interface** (PPI) is a popular, low-cost interface component found in many applications.

- The PPI has 24 pins for I/O, programmable in groups of 12 pins and groups that operate in three distinct modes of operation.

- 82C55 can interface any TTL-compatible I/O device to the microprocessor.

- The 82C55 (CMOS version) requires wait states if operated with a processor using higher than an 8 MHz clock.

  - also provides at least 2.5 mA of sink (logic 0) current at each output, a maximum of 4.0 mA

- Because I/O devices are inherently slow, wait states used during I/O transfers do not impact significantly upon the speed of the system.

- The 82C55 still finds application even in the latest Core2-based computer system.

- 82C55 is used for interface to the keyboard and parallel printer port in many PCs.
  - found as a function within an interfacing chip set
  - also controls the timer and reads data from the keyboard interface
- An experimentation board is available that plugs into the parallel port of a PC, to allow access to an 8255 located on the board.
- The 8255 is programmed in either assembly language or Visual C++ through drivers available with the board.

Basic Description of the 82C55

- Fig 11–18 shows pin-outs of the 82C55 in DIP and surface mount (flat pack) format.

- The three I/O ports (labeled A, B, and C) are programmed as groups.

  - group A connections consist of port A (PA_7–PA_0) and the upper half of port C (PC_7–PC_4)

  - group B consists of port B (PB_7–PB_0) and the lower half of port C (PC_3–PC_0)

- 82C55 is selected by its CS pin for programming and reading/writing to a port.

Figure 11–18 The pin-out of the 82C55 peripheral interface adapter (PPI).
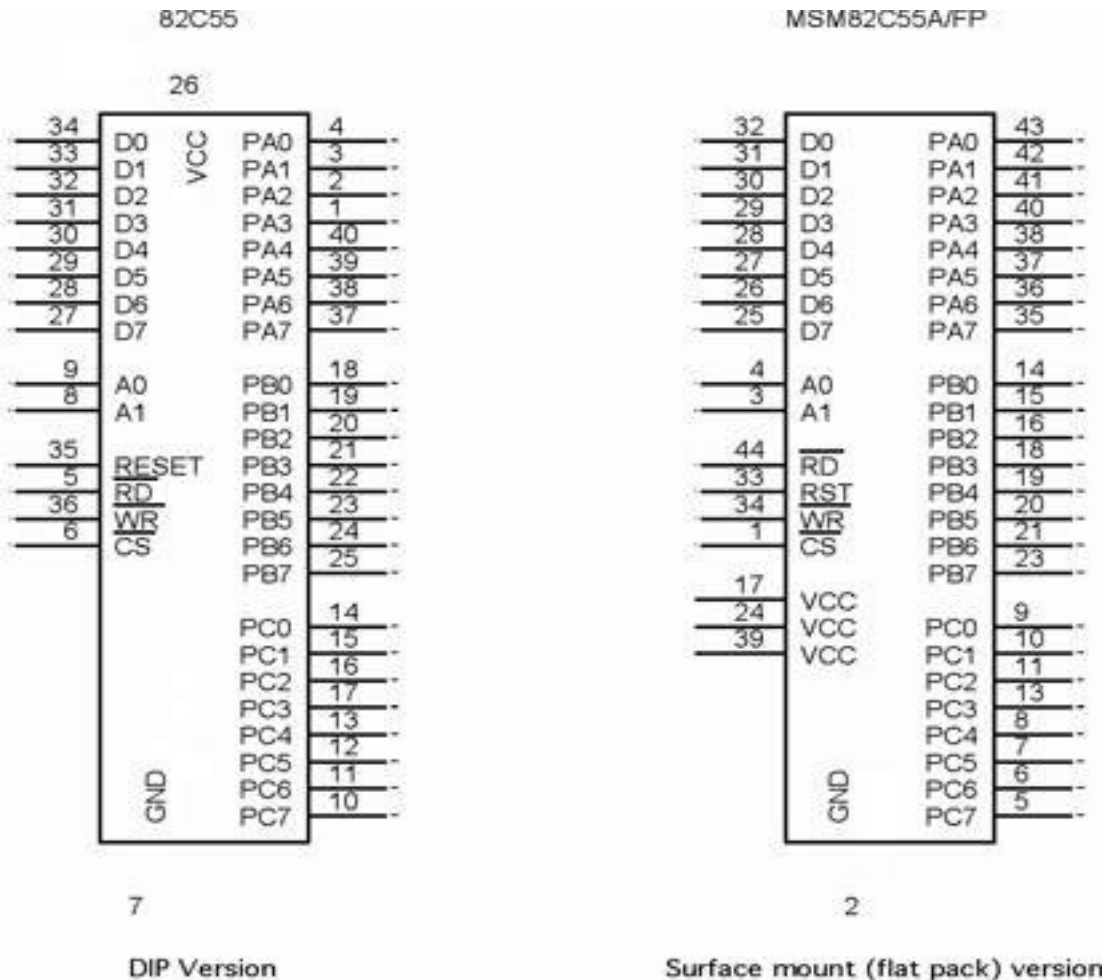
- Table 11–2 shows I/O port assignments used for programming and access to the I/O ports.

- In the PC, a pair of 82C55s, or equivalents, are decoded at I/O ports 60H–63H and also
at ports 378H–37BH.

- The 82C55 is a fairly simple device to interface to the microprocessor and program.

- For 82C55 to be read or written, the $\overline{CS}$ input must be logic 0 and the correct I/O address must be applied to the A_1 and A_0 pins.

- Remaining port address pins are *don't cares*.

- Fig 11–19 shows an 82C55 connected to the 80386SX so it functions at 8-bit addresses C0H (port A), C2H (port B), C4H (port C), and C6H (command register).
  - this interface uses the low bank of the I/O map
- All 82C55 pins are direct connections to the 80386SX, except the CS pin. The pin is decoded/selected by a 74ALS138 decoder.
- A RESET to 82C55 sets up all ports as simple input ports using mode 0 operation.
  - initializes the device when the processor is reset

Figure 11–19 The 82C55 interfaced to the low bank of the 80386SX microprocessor.
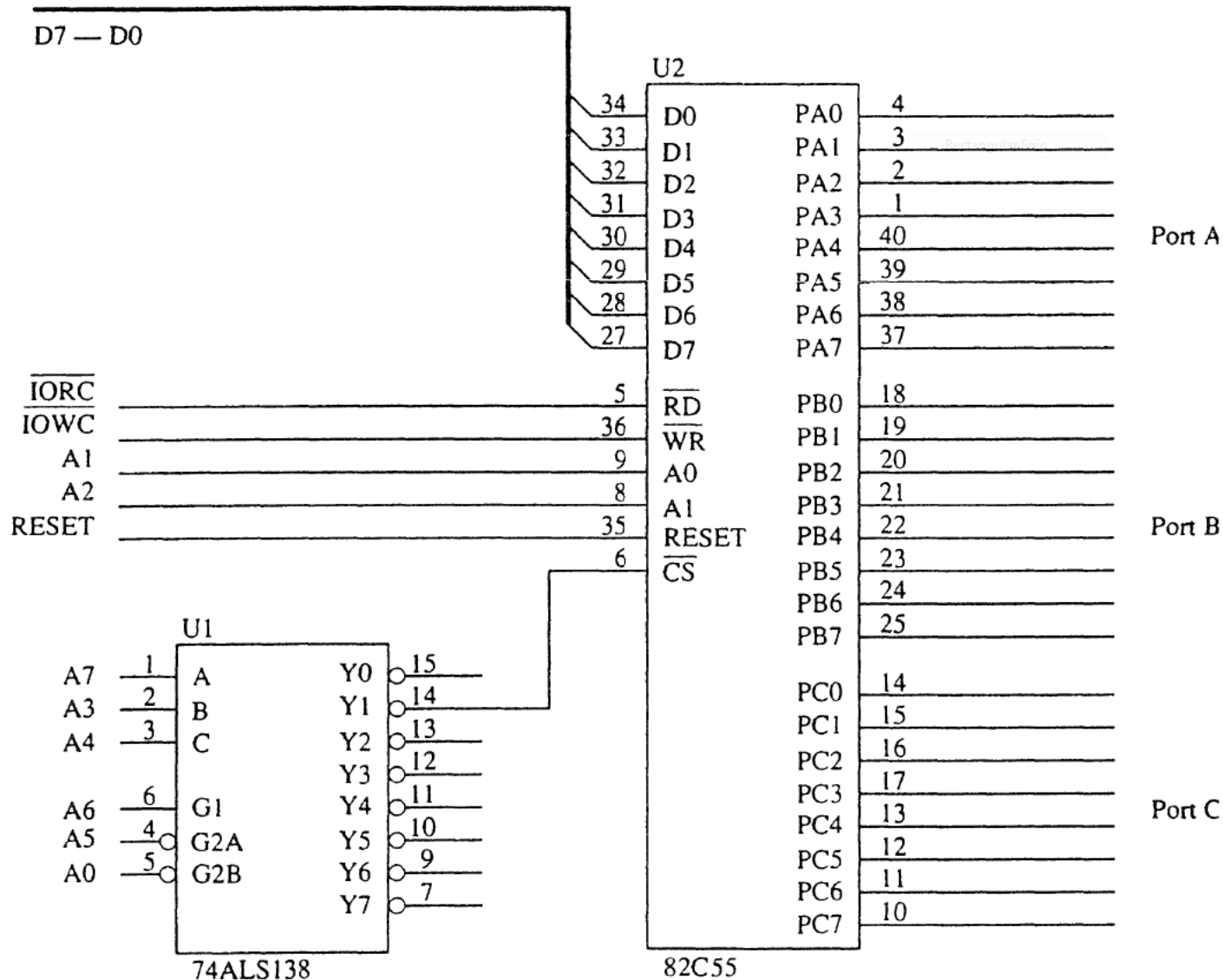
- After a RESET, no other commands are needed, as long as it is used as an input device for all three ports.

- 82C55 is interfaced to the PC at port addresses 60H–63H for keyboard control.

  - also for controlling the speaker, timer, and other internal devices such as memory expansion

- It is also used for the parallel printer port at I/O ports 378H–37BH.

Programming the 82C55

- **82C55 is programmed through two internal command registers** shown in Figure 11–20.

- Bit position 7 selects either command byte A or command byte B.

  - command byte A programs functions of group A and B

  - byte B sets (1) or resets (0) bits of port C only if the 82C55 is programmed in mode 1 or 2

Group B (port B and the lower part of port C) are programmed as input or output pins.

Figure 11–20 The command byte of the command register in the 82C55. (a) Programs ports A, B, and C. (b) Sets


(a)

Command byte B
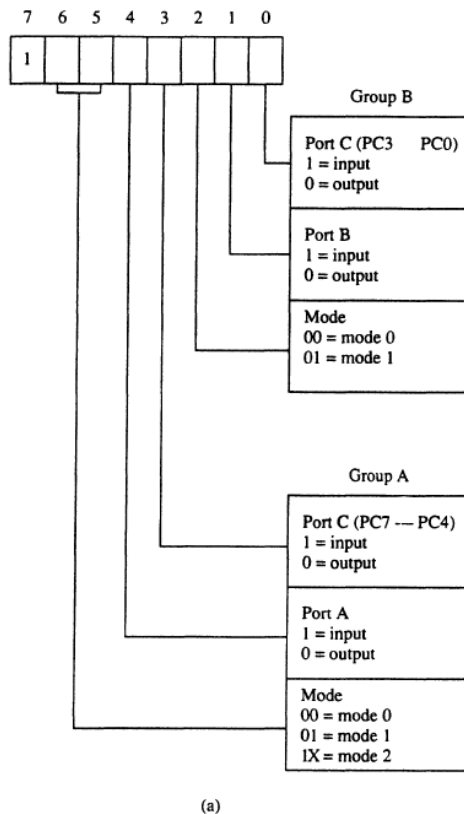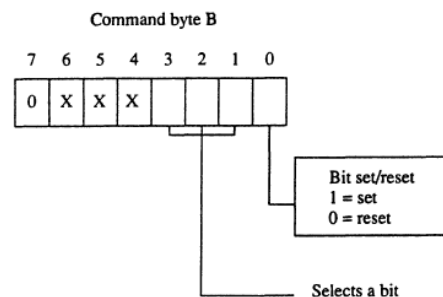
- group B operates in mode 0 or mode 1
- mode 0 is basic input/output mode that allows the pins of group B to be programmed as simple input and latched output connections
- Mode 1 operation is the strobed operation for group B connections
- data are transferred through port B
- handshaking signals are provided by port C

- Group A (port A and the upper part of port C) are programmed as input or output pins.
- Group A can operate in modes 0, 1, and 2.
  - mode 2 operation is a bidirectional mode of operation for port A
- If a 0 is placed in bit position 7 of the command byte, command byte B is selected
- This allows any bit of port C to be set (1) or reset (0), if the 82C55 is operated in either mode 1 or 2.
  - otherwise, this byte is not used for programming

Mode 0 Operation

- Mode 0 operation causes 82C55 to function:
    - as a buffered input device
    - as a latched output device
- Fig 11–21 shows 82C55 connected to a set of eight seven-segment LED displays.
- These are standard LEDs.
    - the interface can be modified with a change in resistor values for an organic LED (OLED) display or high-brightness LEDs

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Figure 11–21 An 8-digit LED display interfaced to the 8088 microprocessor through an 82C55 PIA.
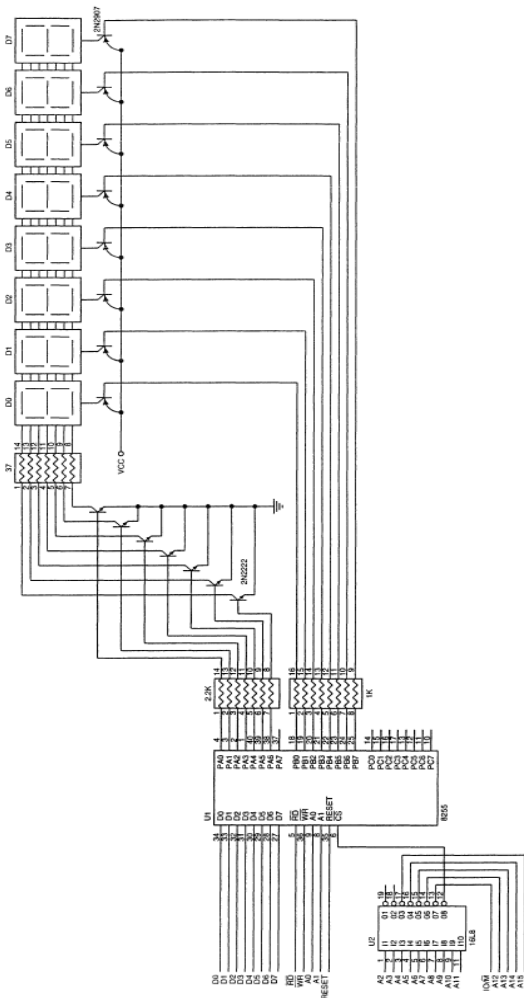
- ports A & B are programmed as (mode 0) simple latched output ports
- port A provides segment data inputs port B provides a means of selecting one display position at a time for multiplexing the displays
- the 82C55 is interfaced to an 8088 through a PLD so it functions at I/O port numbers 0700H–0703H
- PLD decodes the I/O address and develops the write strobe for the WR pin of the 82C55

- Resistor values in Fig 11–21 are chosen so the segment current is 80 mA.

  - required to produce average 10 mA current
    per segment as the displays are multiplexed

- A six-digit display uses a segment current of 60 mA for an average of 10 mA per segment.

- Peak anode current in an eight-digit display
  is 560 mA (seven segments $\times$ 80 mA).

  - average anode current is 80 mA

- In a six-digit display, peak current would be 420 mA (seven segments $\times$ 60 mA).

- In this display, the segment load resistor passes 80 mA current and has approximately 3.0 V across it.
- The value of the resistor is 3.0 V ÷ 180 mA = 37.5 Ohm. The closest standard resistor value of 39 Ohm is used in Fig11–21.
- Programming the 82C55 is accomplished by the short sequence of instructions listed in Example 11–9.
- Ports A and B are programmed as outputs.