

PC Interfacing

Fourth Level

Lecture TWO

Parallel (Centronic) Port Interface

Goals:

Up-on completing this lecture, the student should be able to:

- 1- Identify the main concept of PC-interfacing.**
- 2- Identify the Parallel port and its principle of operation**
- 3- Design interfacing circuits using the 3 groups of pins in the parallel port.**

1. Introduction:-

The Centronic, RS232 and game ports are the most common I/O ports that a modern computer has. Some notebook computers may not have a game port, but the Centronic and the RS232 ports are the universal features of all types of computers.

Originally, these ports were designed for specific applications. Centronic ports are used for connecting computers to printers; RS232 ports for connecting printers, modems and mice; and game ports for connecting joysticks. They can also be used for other interfacing applications. Peripheral devices designed for these ports not only provide the easiest way of connection to computers but also offer a universal hardware solution for all computers. Therefore, it would be very useful to understand how these ports work and how to make the best use of them.

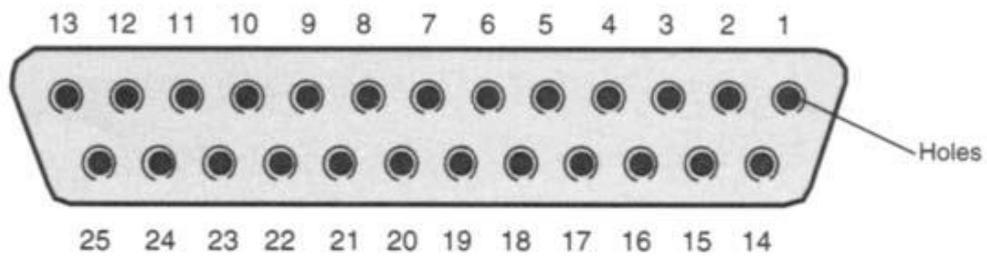
2. The Centronic Port :-

The Centronic port, also known as the printer port or the parallel port, is an industrial standard interface designed for connecting printers to a computer. A computer at least has one such a port installed. The port may come with the computer's mother-boards or with plug-in I/O cards. Adding more Centronic ports is easy and inexpensive. In total, four Centronic ports may be installed on a computer and they have logic names LPT1 to LPT4.

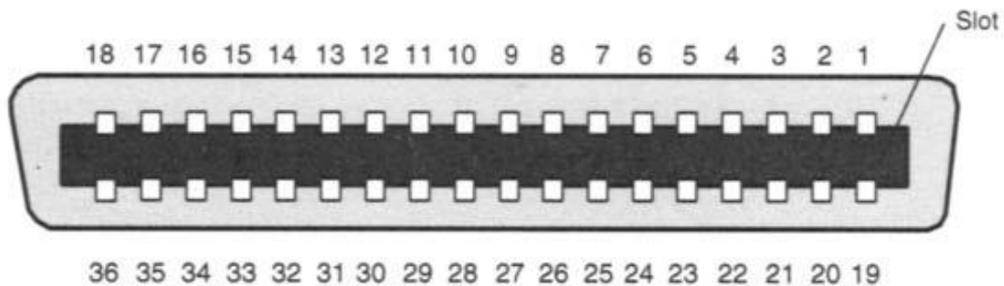
- **Mother boards have 1, adding more is easy and inexpensive using plug in I/O cards (Max.4)**
- **They have Logic name (LPT1 to LPT4)**
- **Work with distance < or= 5 meters**

3. Port connectors (Pin configuration) :-

The port connectors on a computer and on a printer are different. The one on the computer is a 25 pin D-type female connector (Figure 1.1(a)), and the latter is a 36-pin female Centronic-type connector (Figure 1.1(b)). The pin functions of the two connectors are shown in Figure 1.1. To connect a printer to a computer, a printer cable is used (Figure 1.2). The length of the cable must not exceed 5 meters. The Centronic interface is not for long distance operations.



(a) Centronic connector on a pc viewed from the back of the pc
Connector type: 25 pin female D-type



(b) Centronic connector on a printer viewed from the back of the printer
Connector type: 36 pin female Centronic-type

Pin functions of the Centronic port connectors

Connectors on		Direction (for pc)	Name	Explanations
pcs	printers			
1	1	OUTPUT	<u>STROBE</u>	low to strobe data into printer
2	2	OUTPUT	DB0	data bit 0
3	3	OUTPUT	DB1	data bit 1
4	4	OUTPUT	DB2	data bit 2
5	5	OUTPUT	DB3	data bit 3
6	6	OUTPUT	DB4	data bit 4
7	7	OUTPUT	DB5	data bit 5
8	8	OUTPUT	DB6	data bit 6
9	9	OUTPUT	DB7	data bit 7
10	10	INPUT	<u>ACK</u>	low to indicate data received, printer ready
11	11	INPUT	<u>BUSY</u>	high to indicate printer busy
12	12	INPUT	<u>PE</u>	high to indicate printer paper empty
13	13	INPUT	<u>SLCT</u>	high to indicate printer on line
14	14	OUTPUT	<u>LF/CR</u>	auto linefeed after carriage return
15	32	INPUT	<u>ERROR</u>	low to indicating printer error
16	31	OUTPUT	<u>INITIALIZE</u>	low to initialize printer
17	36	OUTPUT	<u>SLIN</u>	low to select printer
18-25	19-30 and 33 18,34		GND	twisted-pair return Ground
			Unused	
	16		Logic GND	logic ground
	17		Chasis GND	chasis ground

Fig. 1.1: Pin-out of the Centronic port connectors on computers and printers

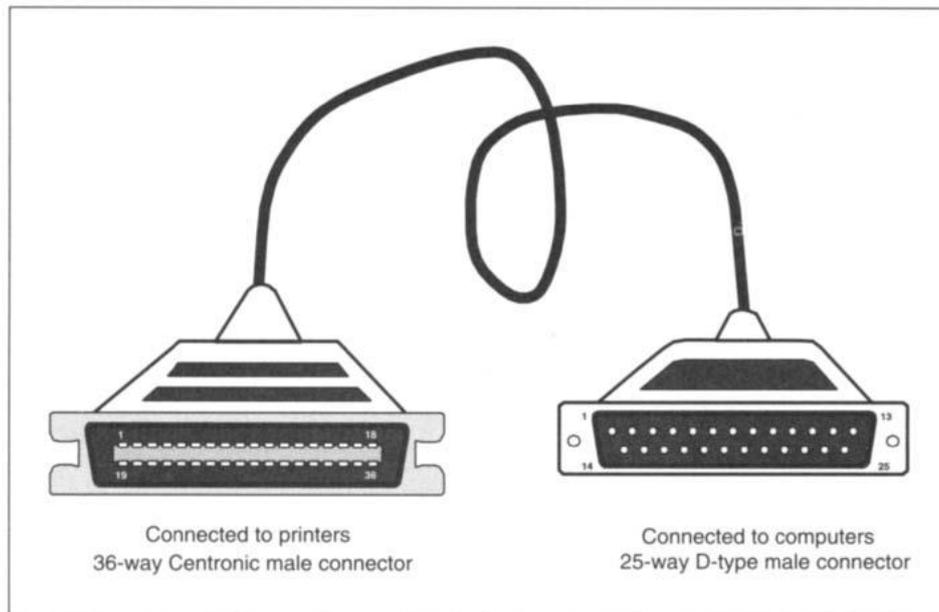


Fig. 1.2: The printer lead

4. Internal hardware organization :-

The circuit of a generic Centronic port inside a PC is shown in Figure 1.3. Eight-bit **data** is latched into IC1 by writing to a port having an address: base address+0. This operation is under the control of WRITE_DATA. The output forms **the Data group**. Data can be read into the computer from the same address via IC2 under the control of-READ_DATA. When reading data, the output from IC1 must be in high impedance state. This is achieved by making pin 1 (OUTPUT ENABLE) of IC1 high.

A 6-bit **control** is latched to IC3 by writing to base address+2. This operation is under the control of WRITE_CONTROL. Bit 0 to bit 3 are output to the port connector to form **the Control group**. Some of the lines are inverted by open-collector inverters (IC6 and IC7). All the output lines are pulled to +5V by 4k7 resistors. These bits can be read back into the computer at the same address via IC4a under the control of-READ_CONTROL. Bit 4 of the control byte enables the interrupt and bit 5 enables or disables the output of IC1. Five lines in the port connector (**the Status group**) can be read into the computer via IC4b under the control of-READ_STATUS. The address associated with this is base address +1. These inputs are pulled to +5V by 4k7 resistors and one of the lines is inverted.

In original, the output enable of IC1 is tied to ground to permanently enable the outputs. This is the unidirectional version of the Centronic port. From IBM PSI2, the output enable of IC1 is connected to bit 5 of the control register IC3 as shown in Figure 1.3 and the port becomes a bidirectional port. Each output line in the Data group is capable of sourcing 2.6 mA current with the voltage varying between 2.6 to 5V. Each can sink 24 mA. The lines in the Control group have a much smaller capacity to source and to sink current. They can only source 100 μ A and sink 8 mA current. The rate of data transfer through the Centronic port is greater than 1 Mbyte/second.

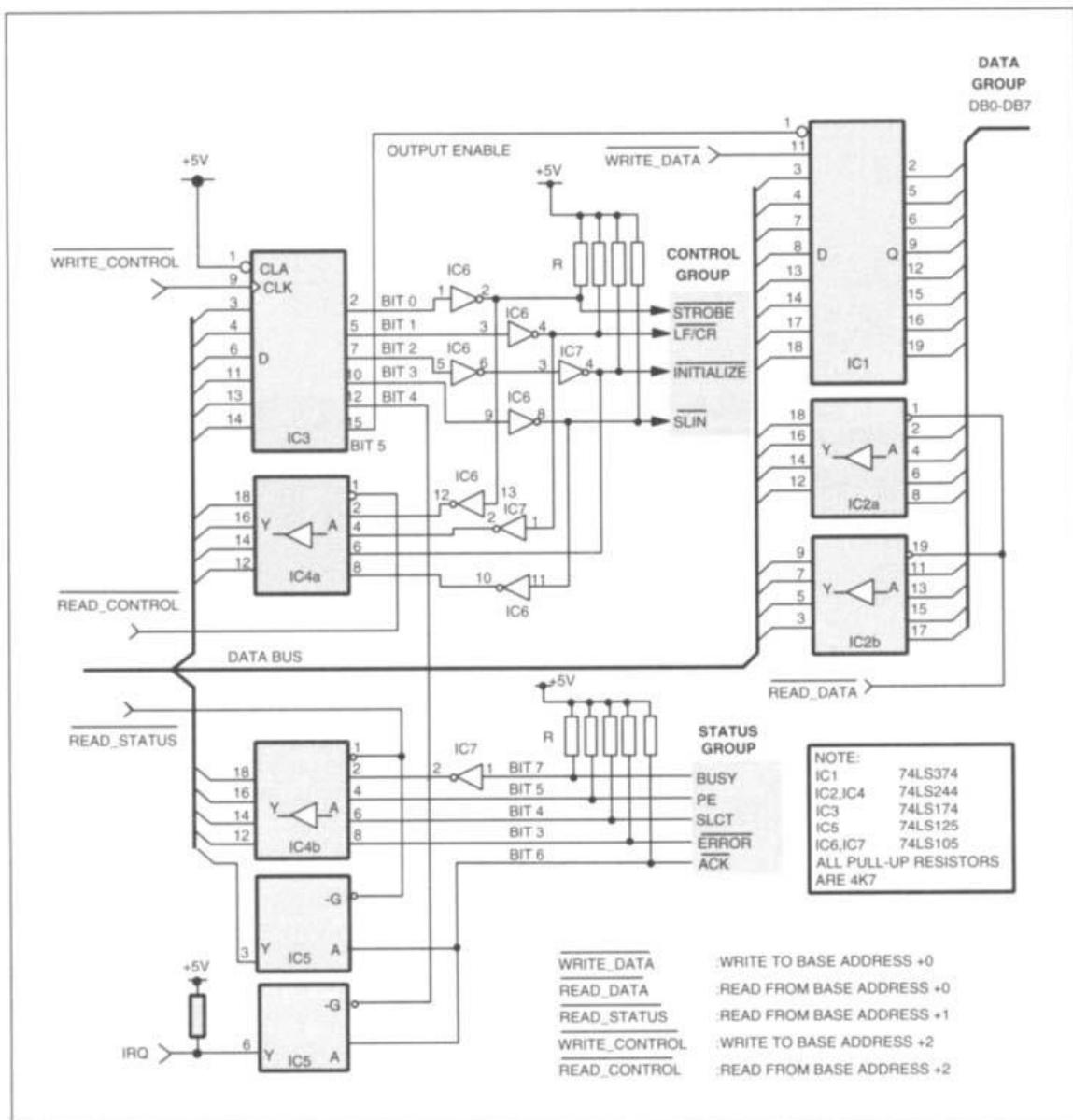


Fig. 1.3: Circuit diagram of the generic Centronic port

5. Groups (Data, Control and Status):-

The I/O lines in the port are organized into three groups, namely, the Data group, the Control and the Status group. Figure 1.4 gives the logic structure of the Centronic port.

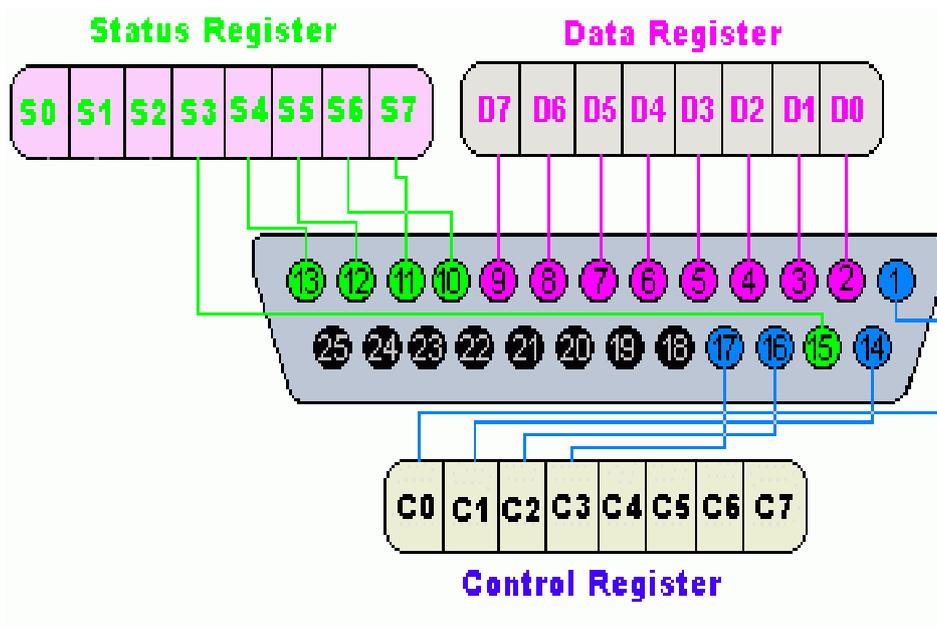
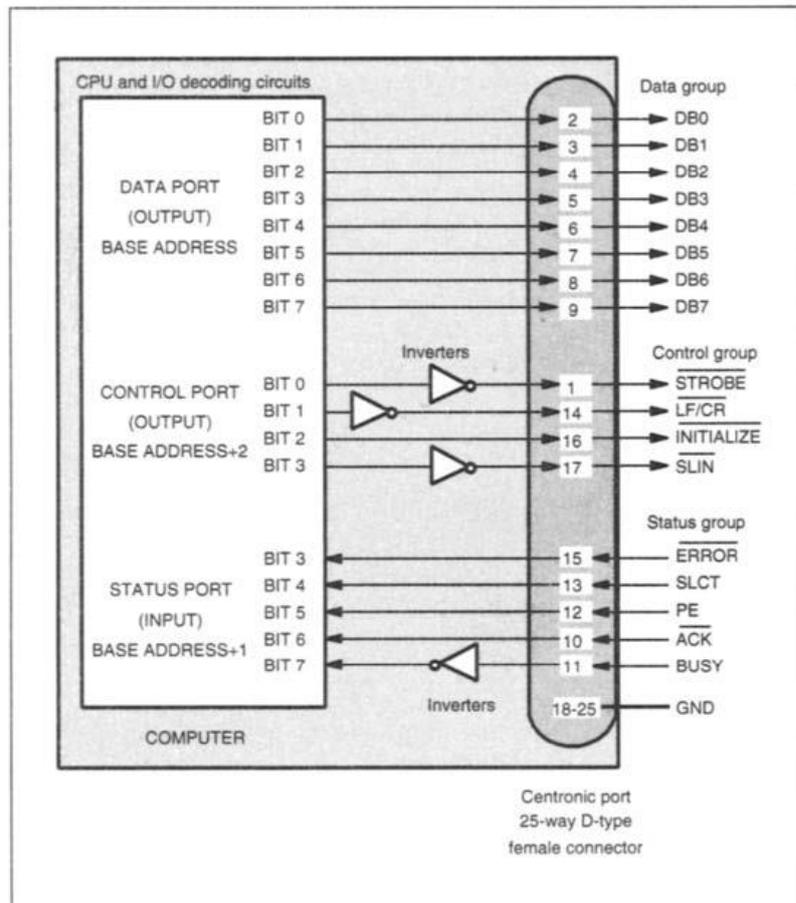


Fig. 1.3: the logic structure of the Centronic port on computers

Data group

This sends data from PCs to external devices. It has eight latched output lines and the group is associated with an 8-bit CPU port. The address is: base address.

Control group

This controls the operation of external devices. It contains four latched output lines (-STROBE, -LF/CR, -SLIN and -INITIALIZE) which are from the computer to the devices. The group is controlled by a CPU port having an address: base address+2. -STROBE, -LF/CR and -SLIN lines are inverted.-INITIALIZE is not.

Status group

The group is used by the computer to obtain the current status of external devices. It contains five lines (-ERROR, SLCT, PE,-ACK and BUSY), which are directed from external devices to the computer. It is fed into a CPU port, the address of which is: base address+1. BUSY line is inverted and the other four lines are not.

The bit functions of each I/O port are summarized in Table 1.1.

Table 1.1

Data group bits 0–7	bit 0 to bit 7
Control group	
bit 0 (-STROBE)	0=normal; 1=output of data
bit 1 (-LF/CR)	0=normal; 1=auto line feed after carriage return
bit 2 (-INITIALIZE)	0=initialize printer; 1=normal
bit 3 (-SLIN)	0=deselect printer; 1=Select printer
bit 4 (-IRQ)	0=printer interrupt disabled; 1=enabled
bit 5 (-Data I/O)	0=output data; 1=input data from data port
Status group	
bits 0–2 (UNUSED)	Unused
bit 3 (-ERROR)	0=printer error; 1=no error
bit 4 (SLCT)	0=printer not on-line; 1=printer on-line
bit 5 (PE)	0=printer has paper; 1=out of paper
bit 6 (-ACK)	0=printer acknowledges; 1=normal
bit 7 (BUSY)	0=printer busy; 1=not busy

The LPT base address

There are two ways to obtain the base address. One is to check the hardware configuration of your computer. The other is to find the addresses directly from the user's program by using the facilities provided by the computer's basic input output system (BIOS). When a computer is powered on or reset, the BIOS checks all the possible Centronic ports. If it finds one, it writes the addresses (a 2- byte word) of that port to two specific memory locations. The memory locations for LPT1 to LPT4 are listed as follows:

LPT1: 0000:0408h - 0000:0409h

LPT2: 0000:040Ah - 0000:040Bh

LPT3: 0000:040Ch - 0000:040Dh

LPT4: 0000:040Eh - 0000:040Fh

There is another useful memory location, 0000:4011h. It stores the total number of Centronic ports installed. The information is contained in bit 6 and bit 7.

bit 7=0, bit 6=0: no Centronic port installed

bit 7=0, bit 6=1: one Centronic port installed

bit 7=1, bit 6=0: two Centronic ports installed

bit 7=1, bit 6=1: three Centronic ports installed

The LPT base address

1-from the HW

2-directly from (BIOS), with memory locations are:

LPT1: 0000:0408h - 0000:0409h

LPT2: 0000:040Ah - 0000:040Bh

LPT3: 0000:040Ch - 0000:040Dh

LPT4: 0000:040Eh - 0000:040Fh

Software control

a-How to obtain the base address of LPT

-QBASIC

-TP6

-WINDOWS

b-How to Output & Input data via the LPT

1-Printer commands & BIOS interrupt routines

. QBASIC with instruction PRINT

. TP6 with instruction WRITELIN(LST)

.BIOS interrupt INT 17h

2-Direct I/O access

Summary:

- 1- There are three groups of pins in the parallel port: Data, Status, Control**
- 2- Some are pulled-up and some are inverted.**
- 3- Data is sent in parallel hence strobing and ACK should be used.**

Questions:

1- Design an interfacing cct to connect two eight bit analog to digital converters to the parallel port of a computer. Write the pseudo-code as well.

2- how to read a 12 bit data-bus on the parallel port? Design and show the pseudo-code.