Unit 9 Parallel Port

Structure:

9.1 Introduction

You have seen in unit 4 that buses are used to transfer data from CPU to the peripheral devices connected to it. Port is a hardware that supports the communication between one computer to another computer and other peripheral devices. *Parallel port* is a device that is used to connect and communicate between computer and various peripherals. In parallel port, circuit for collage, decode data and control signals are virtually eliminated because it sends the entire data from computer to printer simultaneously. Though it is simple, parallel port is not free from failures as there may be cable problems, static discharge damage, or continuous hardware defects, leading to printer disconnection. Due to the inadequacy to handle faster peripherals by the conventional bidirectional port, IEEE released a standard for bidirectional parallel peripheral interface signalling method. This method is named as IEEE1284 and it is useful for bidirectional parallel communication.

In this unit you will study about pin assignment, operation of conventional parallel ports and also the advances that have taken place. You will also study the different modes of IEEE1284 and issues related to the standard.

Apart from this, the unit will discuss various troubleshooting steps that you could use to separate and rectify port problems.

Objectives:

After studying this unit you will be able to:

- Describe the operation of the parallel port
- Identify the advances in the Parallel port
- Resolve the problems through troubleshooting.
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9.2 Parallel port functioning

The parallel port interface is one of the simplest circuits in the PC. Figure 9.1 illustrates a typical bidirectional port.

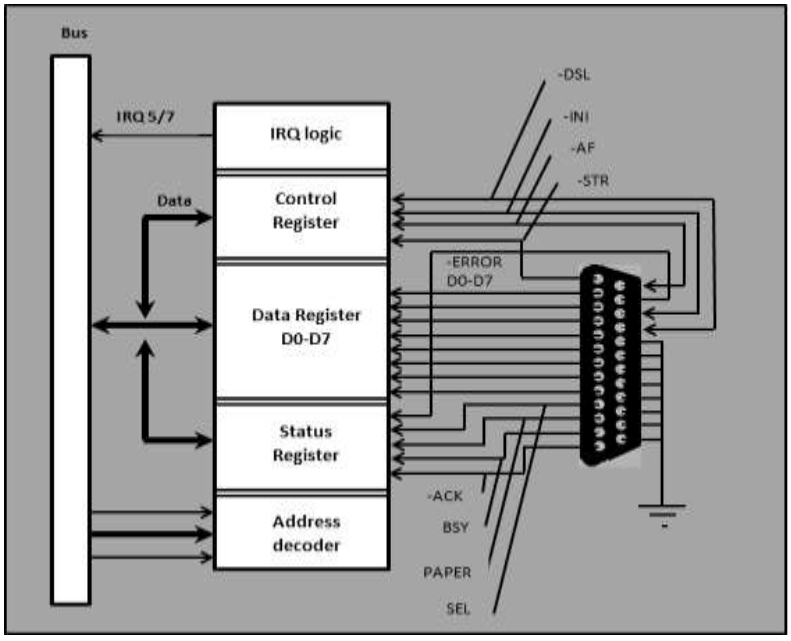

Figure 9.1: Bidirectional Port

A parallel port consists of three registers:

The data register

The control register

The status register

Address bits A0 to A9 are decoded to determine the active register among the three. –I/OR and –I/OW lines are used to determine whether the signals on the data bus are being read from or written to the specific register. Handshaking signals are bidirectional protocol used between sender and receiver to acknowledge to the sender that the data has been received. These signals are used to trigger the interrupt to request a new character.

Data register, the 'heart' of a parallel port provides registers to read and write data making it a bidirectional port. It is loaded into the system by passing a value in it to access the printer. *The bidirectional control register* is used to set condition for the CPU so that a new character can be requested and manage the behaviour of the port. For example, when the printer is ready to accept another character the control register is set to generate the interrupt. *The status register* is used to determine the status of the printer.

As you know that the conventional parallel port is implemented in a series of three registers, when one register is used to buffer the 8 data bits, the other two registers handle the handshaking signals of the port. The base address of each port corresponds to the data register. The specific port's status register is accessed through the base address with an offset value of 01h (Identifier 2) while the control register is accessed with an offset value of 02h (Identifier 3)

9.2.1 Signals and Time diagram

Signal is any time varying quantity which is generated to produce the interrupt. All signals in the parallel port are compatible with conventional signal levels. Most of the computers use 25-pin sub-miniature D-type female connector. The D-subminiature or D-sub is a common type of electrical connector used particularly in computers. In D type connector D is the prefix for the whole series that denotes the shell size (A=15 pin, B=25 pin, C=37 pin, D=50 pin, E=9 pin), followed by the actual number of pins, followed by the gender. Typical diagram of a 25-pin sub miniature is shown in the figure 9.2. At the printer device the parallel connection uses 36-pin connector. This 36-pin connector is called as Centronics type connector.

Centronics mode is one of the conventional methods of transferring data to the printer in which it does not have handshaking mechanism. The exact reasoning is not clear since 11-pins of the Centronics connector will remain unused. The data sent by the sub miniature D-type connector is to responded by Centronics connector as soon as possible because the data will not reside in the connector for longer time. There are three types of signals - Data signals, handshaking signals and ground signals. The following section describes each signal in detail.

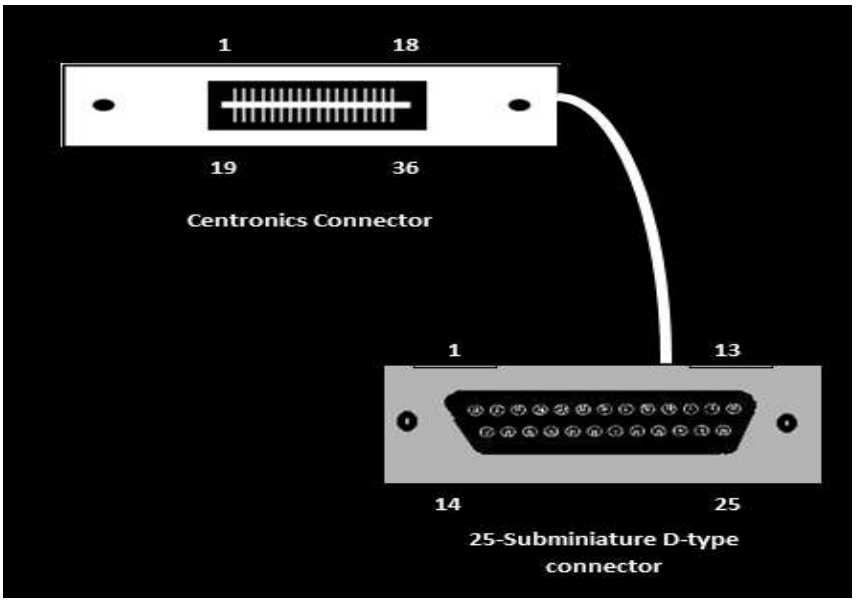

Figure 9.2: A typical Parallel port cable assembly

Data signals are the conductors that carry information from the parallel port to or from the printer or other peripheral. There are eight data lines (D0 to D7). These lines are located from pin 2 to pin 9. The pin 1 and pin 0 are occupied by ground signals. *Handshaking signals* are bidirectional protocol used between sender and receiver to acknowledge to the sender that the data has been received. *Ground signal*s are used to reduce the noise effects in the signal. They also provide common electrical reference between the computer and peripheral*. –Initialize signal* (-INI) is initialized to ensure that the printer starts. It is active low so that the printer will apply logic 0 to initiate the start. The *Select signal* (SEL) is used to inform the

computer that the component is ready to receive the data. It is active high so that the logic 1 indicates that the printer is online and ready.

The computer will know that it does not have to send data when the printer select signal is logic 0 since it is not ready. In order to verify whether the data is ready on the parallel port signal –*Strobe Signal* (-STR) is used. It is used to accept the data from the peripheral and store it on the printer's internal buffer for processing. In order to delay the computer from sending the data until the printer is ready *Busy signal* (BSY) is used. When a strobe signal is received by the peripheral, it drives the busy signal to logic 1. This remains at logic 1 until the printer is ready for next byte. Busy signals can indeterminately delay the computer when peripheral error occurs. For example, whenever the paper gets stuck in the printer or paper is exhausted or ribbon is jammed, it remains at logic 1 for a long time. Whenever the printer has to communicate to the computer that it is ready to receive another character it uses Acknowledge signal (ACK) which is active low signal.

9.2.2 Port operation

Printer is placed online by parallel data transfer. Initially busy signal must be logic 0, strobe signal and acknowledge signal must be logic 1. This is the indication that the printer is ready to accept one byte of data. When the printing is initiated, it checks the status of the printer setting and the CPU polls the desired LPT (Line print terminal) port. LPT is the original form and still commonly used as parallel port interface. If the status shows ready then a byte of data is written to the data register and passed to the peripheral.

Data must be valid for at least 0.5 µS (microsecond) before the strobe signal is set to logic 0. Printer responds with the Busy signal by returning a logic one. This changes the status of the port. The strobe pulse must lasts for at least 1.0µS. Data must be held at least 0.5 µS after the strobe signal is passed. This timing indicates that it has enough time to receive data. It is the minimum requirement of the connector that the data must be valid for minimum of 0.5 µS below which is the time not sufficient enough to receive the data. Computer stops sending data now since the Busy signal is logic 1 and previous data is still being processed. Timing diagrams are the artefacts that are used to explore the behaviours of one or more objects throughout a given period of time.

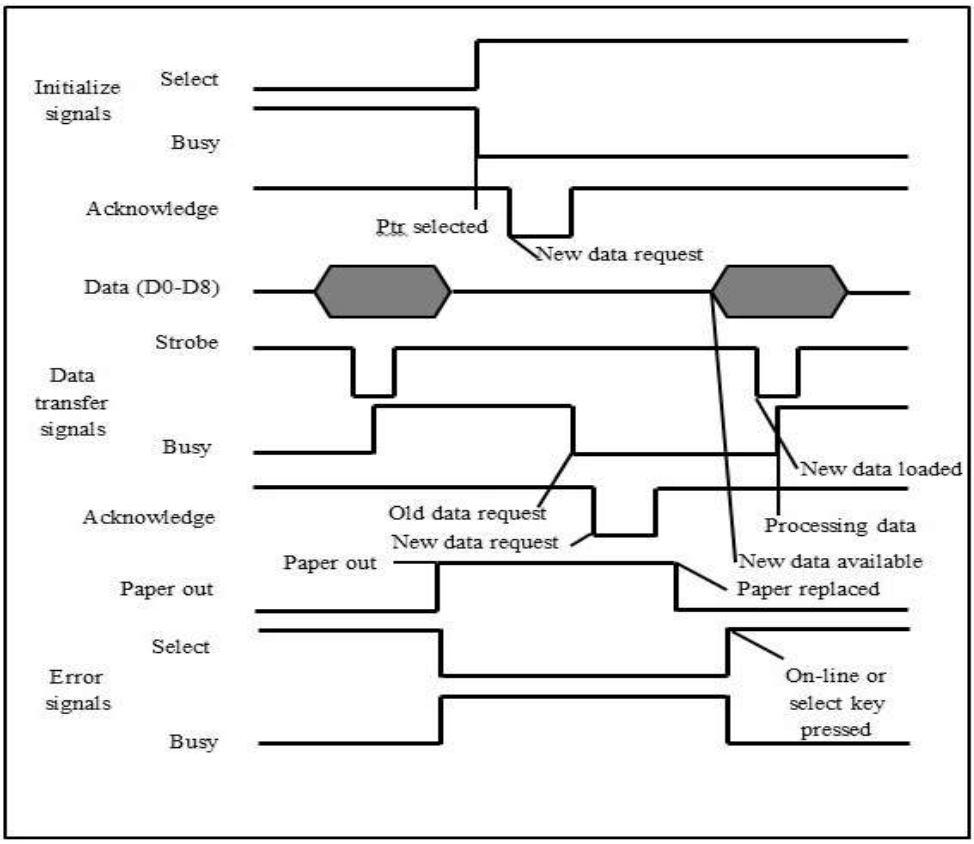

Figure 9.3: Typical timing diagram of a parallel port

Busy signal is set to logic 0 after the data byte is processed by the printer. Acknowledge signal with logic 1 is sent to the computer indicating that it is ready to receive the data. This is shown in the timing diagram in figure 9.3 which illustrates this theory. The printer sets busy signal high when it is processing a character after the select signal in the initialise mode. Once the busy signal is low that means when the printing of a character is done, it set the acknowledge signal high and request the printer for new data to send.

In the mode of printing, after the printer line receives a character for printing request, the character bits are put on the data line. Busy signal is tested repeatedly until it is found to be low, then the strobe signal is sent. The printer set busy signals high when the character data have been latched and sets it low again when the character has been processed. Once the busy signal is low the acknowledge signal is set high indicating the new data request. In the diagram you can find the three major types of signals

responsible for the complete processing of printing a series of character they are initialise signals, data transfer signals and error signals. Once the acknowledge signal is set high in the data transfer signal a new data can come on the data line that is represented by new data available label in the data signal.

Suppose if the printer container has exhausted with paper or paper is struck the error signal indicates the paper out by selecting the paper out signal high. This paper out signal remains high until the paper is replaced or paper is loaded. Once the paper is loaded the paper out signal is set to low and select signal sends the data to the printer. Once a select signal is low the busy signal in the error mode will be high indicating the process of printing.

In diagram 9.3, one complete cycle can take a bit over 1mS (millisecond).

Advanced Parallel port

It is very easy to understand the appeal of a parallel port because you just need to plug into the 25-pin D-type connector and it is ready to run. It works on the concept of plug and play. The parallel port has evolved to improved modes which are of different types like unidirectional port, “Type 1” bidirectional port, and “Type 3” bidirectional port.

Unidirectional ports: this mode was used in earlier parallel port. As the name indicates this port is used to send data from the PC to the printer device. For most of the general purpose computers unidirectional port was enough for communication.

“Type 1” bidirectional ports: Bidirectional ports were used to send and receive data from computer to printer and vice-versa. Though the bidirectional port is not faster than unidirectional port it came into existence because of its ability to send data back to the PC which made the use of the parallel port to connect to other peripherals besides printers.

“Type 3” bidirectional ports: This mode attempted to increase the throughput of the parallel port by using Direct Memory access (DMA) techniques. This approach allowed the CPU to define a block of memory to be sent. A DMA controller takes over control from the CPU and sends and receives the data without the intervention of CPU which results in faster data transfers. This port removed the problem of slower performance of bidirectional port due to the intervention of CPU for the transfer of data.

9.2.3 IEEE 1284 Modes

By the end of 1980s it was clear that the conventional bidirectional ports were not adequate to handle faster peripherals. Therefore, a group of major PC manufacturers formed the Network Printing Alliance (NPA) which attempted to develop a new architecture. Later IEEE joined with NPA and released a standard for bidirectional parallel peripheral interface signalling method which was named as IEEE standard 1284.

The IEEE 1284 standard is a standard set by IEEE and NPA for connecting a computer to peripheral devices over a parallel physical and electrical interface. IEEE allows data to flow in one direction, from computer to peripheral as well as it supports bi-directional data flow.

IEEE 1284 specifies 5 standard modes of operation in it, each of them specifying the data transfer from either printer to computer, computer to printer or bidirectional flow. The five modes are:

Compatibility mode: This mode is used to define the basic protocol used in the computers to transfer data from computer to printer. It is also called as Centronics mode. It was mainly designed to serve the dot matrix and older laser printers. In this mode, data is kept on the data signal and status is checked for errors and busy signals. When this is clear strobe signal is initiated to send the data to the printer. In this mode it carries data rate up to 150 bytes/second at 6 meter or 20 ft. with an AB-cable or up to 150 kbps at 10 meter or 32.8 ft. with a CC-cable (composite connector which is used to connect newer peripherals, wiring between the connectors in a cable and connecting the board to the parallel port of the PC). The drawback of this mode is that there is a serious problem in communicating with LAN (Local Area Network) adapters, removable disk drives and the newest generation of laser printers.

Nibble mode: this mode allows reverse data transfer to the computer. Combining with compatibility mode it can create bidirectional data transfer line. As nibble is half byte (4 bits) of the data units nibble mode is capable of sending 2 nibble of data from peripheral to the computer in two data transfer cycles. Nibble mode is best suited for printers and can operate on all PCs that have a parallel port. It does not have much effect on low bandwidth but may not support it when used with other bidirectional devices other than

printers. This mode carries data rate up to 50 kbps at 6 meter or 20 ft. with a CC-cable which can be increased to up to 150 kbps at 10 meter or 32.6 ft.

Byte mode: this mode requires software drivers to disable the drivers that control the data signals so that data can be sent from the printer to the computer. The data is sent at the same speed as sent from the computer to the printer. This mode is able to send one byte (8 bits) of data transfer and when combined with compatibility mode can create bidirectional data transfer line. It carries data rate up to 500 kbps at 10 meter or 32.8 ft. with CC-cables.

ECP mode: Extended Capability Port mode is an advanced mode for communication between printers and scanners which allows data compression for images and FIFO facility for items in queue. ECP provides high performance bidirectional path between computer and the peripheral. And supports data rates up to 2 to 4 MB per second. The features of ECP mode are:

Run length encoding (RLE) data compression for host system's LPT port.

FIFO buffers for both forward and backward channels.

Feature of channel addressing is used for multifunction logical devices within a single physical device such as printer/fax/modem devices. For example, In a printer/fax/modem device, where a single parallel port is connected to a peripheral device using channel address software driver of ECP mode, you can assign a new channel to the modem while the printer is still busy in printing a high resolution image.

This mode carries data rate up to 500 kbps at 1 Mbps at 6 meter or 20ft. or 10 meter or 32.8 ft. with CC-cables.

EPP mode: Enhanced Parallel Port mode was designed to provide a high-performance parallel interface which could be used with the standard interface. The EPP mode uses one ISA I/O cycle that transfers data between the computer and the peripheral devices. This allows data transfer rate at the speed of 500 KB to 2MB per second, depending on the speed of the slowest interface. The EPP mode is bi-directional. and suitable for network adapters, data acquisition, portable hard drives, and other devices that need speed.

It uses single instruction to transfer data to or from the PC. Moreover, the EPP protocol provides a high degree of coupling between the peripheral driver and the peripheral devices.

IEEE issues

While IEEE might be appealing, there are some serious considerations to be kept in mind while dealing with it. You must specifically ensure that you have IEEE 1284 complaint parallel port, cable and peripheral devices like printer, tape drives, hard drive and so on. The main problem in using IEEE port is using the specific printer cable with older dot matrix printer. To benefit from IEEE you must have at least IEEE 1284 cable and a device with significant memory capacity such as a laser printer.

The computer must be able to determine the features of the peripheral that is connected to it so that it can choose the mode of standard. Therefore, a method called *negotiation* was developed to determine these factors. Negotiation is a series of events that exists on the parallel port interface and used to determine the requirement of type of mode for the device. For older device compatibility, mode is selected for operation as it does not respond to negotiation.

Self Assessment Questions

1. _____ is a device that is used to connect and communicated between computer and printer.
2. Data registers are called as _____.
3. _____ is any time varying quantity which is generated to produce the interrupt.
4. IEEE joined with _____ released a standard for bidirectional parallel port.

9.3 Troubleshooting

Though the parallel port is a very simple device it can throw some huge challenges. Although the easiest way would be to replace a port whenever there is a problem in it, the following tips might help you to detect any problem in the mother port before you do so. There are three options before you:

South Bridge chip that supports the parallel port can be replaced. Though this can be economical it is not common practical solution.

Set the jumpers to disable the faulty parallel port and install a multi expansion I/O slot to take its place. This offers a cheap, fast fix for a defective parallel port.

Motherboard can be replaced. This is a simple but very expensive option. This is the last solution for any technician when the parallel port is defective.

9.3.1 Preventing parallel port trouble

Though the parallel port is very a simple device it is important for you to address some common issues that manifest themselves regularly. The following points could be considered before identifying the problem:

Cable: As a cheap or damaged cable can cause serious problem it is essential that you ensure that the cable length is less than 6 ft. When you suspect a cable problem try connecting a different cable or a good known cable. In most cases using the IEEE 1284 cable will solve the problem.

Port mode: you need to choose a right mode for the right device. Not all the parallel ports operate well on ECP or EPP modes. In case of defects or problems in the printer try changing the mode to compatibility mode or any standard mode in the CMOS setup. In high end devices you need to specify the setting as ECP or EPP to get full functionality of the port.

Hardware conflicts: It is very common to have a conflict if the system uses second LPT port (LPT2) for IRQ5 because it is mostly used up by sound boards. The line print terminal (LPT) was designed to operate text printer. If you have two or more LPT ports in the system, then you need to configure the sound boards to use another IRQ or to remove the sound board entirely.

Printer driver conflicts: This problem is common when you use certain parallel port devices such as Iomega Zip drives, SyQuest SyJet drives etc. The parallel port receives the special reserved non printable characters by these drives. This signals the drive that the next data is for the drive and not for the printer. This situation can cause conflicts between the drivers and each unit might appear like a defective system. Therefore, by using one LPT port for the parallel port drive and another LPT port for the printer will resolve the above mentioned conflict.

Printer monitoring software: printer monitoring may also cause conflict in drivers. Some printers have status drivers that monitor the printer status. When such printers are connected to the pass-through port of the parallel port, they may disable the printer monitoring drive and also corrupt the data resulting in system problem. Therefore, you should disable the status communication which does not affect the printing.

9.3.2 Configuration of parallel port device under Windows

There are some common issues that arise while configuring the parallel port device under Windows which are categorized as follows:

Cabling problems: suitable cable must be used for the parallel port and the device. Try to connect the device directly to the parallel port if you have switch box or pass-through type of connector between the port and the device. You could also try to accommodate the additional device if you have any other peripherals device other than printer by setting up the additional parallel port on your computer.

Port disabled: check the status of the parallel port by rebooting the PC and selecting the CMOS setup. LPT port must be enabled and particular IRQ must be assigned to the port. For example IRQ7 for LPT 1 or IRQ 5 for LPT 2. In the Bios listing IRQ5 is available and the default IRQ is used for sound card. If the sound card is not used the network card and LP2 are often set to the IRQ5 as it support the secondary parallel port devices. IRQ7 is typically for primary parallel port. If the parallel port is not used then IRQ7 can be assigned to another LPT1 device or any primary device.

Port configured improperly: In CMOS setup, check the parallel port mode to ensure that compatibility mode or standard mode is set for basic printers and high end printers which may need ECP or EPP mode to function properly.

Disable any status monitors: you need to disable any status monitoring software on the system. Also, Windows startup folder needs to be checked during the boot time. You need to disable real-mode software by remarking out the offending command line in CONFIG.SYS or AUTOEXEC.BAT.

Wrong mode set for parallel port device: you should ensure that the printer is not set to plug-and-play mode.

Check and correct any IRQ conflicts: Check and correct IRQ conflicts. You need to verify that a particular IRQ allocated to a parallel port is not used by any other device. This kind of setting is a problem with sound board and IRQ 5. You need to remove or reconfigure the device which has conflicts. For example, consider a SyQuest drive. If you have no SCSI controllers listed, then it indicates that a SyQuest Windows driver is prevented from loading, indicating an IRQ conflict.

Check and remove any similar device drivers: whenever you upgrade a parallel port device ensure that the older driver is removed so that there is no interference with the new device drivers. For example, if you have upgraded your Windows with SyQuest Windows's parallel port drivers and another removable media device such as tape backup running a device drive on older Windows, this will compete with the newer drive and prevent the SyQuest drive from installing properly under Windows. In that case you need to remove or uninstall any device drivers or software related to old parallel port device and then reinstall the new device drivers.

Activity 1:
How will you troubleshoot when you hear a beep code or see a POST error indicating a parallel port?
Hint: Refer the concept of symptom of parallel port in the book on troubleshooting, maintaining, and repairing PCs by S. J. Bigelow

Self Assessment Questions

5. State whether the following statements are true or false.
   a. There will be serious problem in the port if you use a cheap cable.
   b. You should enable the status monitor software when there is a problem in the port.
6. ECP stands for _____.

9.4 Summary

Parallel port is a device which is used to connect and communicate between computer and other peripheral devices. Parallel port interface is one of the simplest and straight forward circuits in the PC. It consists of three registers which perform specific functions: they are data register, status register and control register.

While accessing the printer, the system CPU loads the port data register with the value to be passed. In this unit you studied the different types of signals which are responsible for transferring the data from the computer to the peripheral device which is mostly a printer. You also discussed the operation of the parallel port with the help of different kinds if signals which have been represented with the help of parallel port timing diagram. Apart from these, a comparison between the various parallel port modes such as unidirectional port and bidirectional ports were made in this unit.

You have not only come to know the standard used in new peripheral device and its different mode components but also discussed how to prevent the parallel port from experiencing any problem, but if problems to occur then how to troubleshoot in the Windows configuration.

9.5 Glossary

Term	Description
LPT port	Line print terminal is the original form and still commonly used as parallel port interface
Centronics mode	This is one of the conventional methods of transferring data to the printer in which it does not have handshaking mechanism. therefore we need to react fast to the data send by the host
Handshaking signals	They are bidirectional protocol used between sender and receiver to acknowledge the sender that the data is received
Nibble	One nibble is equal to 4 bits or half byte
Byte	One byte is equal to 8 bits or double the nibble
D-type female connector	The D-subminiature or D-sub is a common type of electrical connector used particularly in computers. In D type connector D is the prefix for the whole series that denotes the shell size (A=15 pin, B=25 pin, C=37 pin, D=50 pin, E=9 pin), followed by the actual number of pins, followed by the gender.

9.6 Terminal Questions

1. Explain the operation of the parallel port in detail.
2. Differentiate between different nodes of IEEE 1284 standard.

3. How will you resolve the problem of Windows configuration through troubleshooting?

9.7 Answers

Self Assessment Questions

1. Parallel Port
2. Bidirectional
3. Signal
4. NPA
5. a) True
   b) False
6. Extend Capability Port

Terminal Questions

1. Refer sec 9.2.2 Port Operation
2. Refer sec 9.2.3 IEEE 1284 modes
3. Refer sec 9.3 Troubleshooting

References:

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