Apple

Dot Matrix Printer User's Manual

Part I: Reference

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Warning

This equipment has been certified to comply with the limits for a Class B computing device, pursuant to Subpart J of Part 15 of FCC Rules. Only peripherals (computer input/output devices, terminals, printers, etc.) certified to comply with the Class B limits may be attached to this computer. Operation with non-certified peripherals is likely to result in interference to radio and TV reception.

Apple

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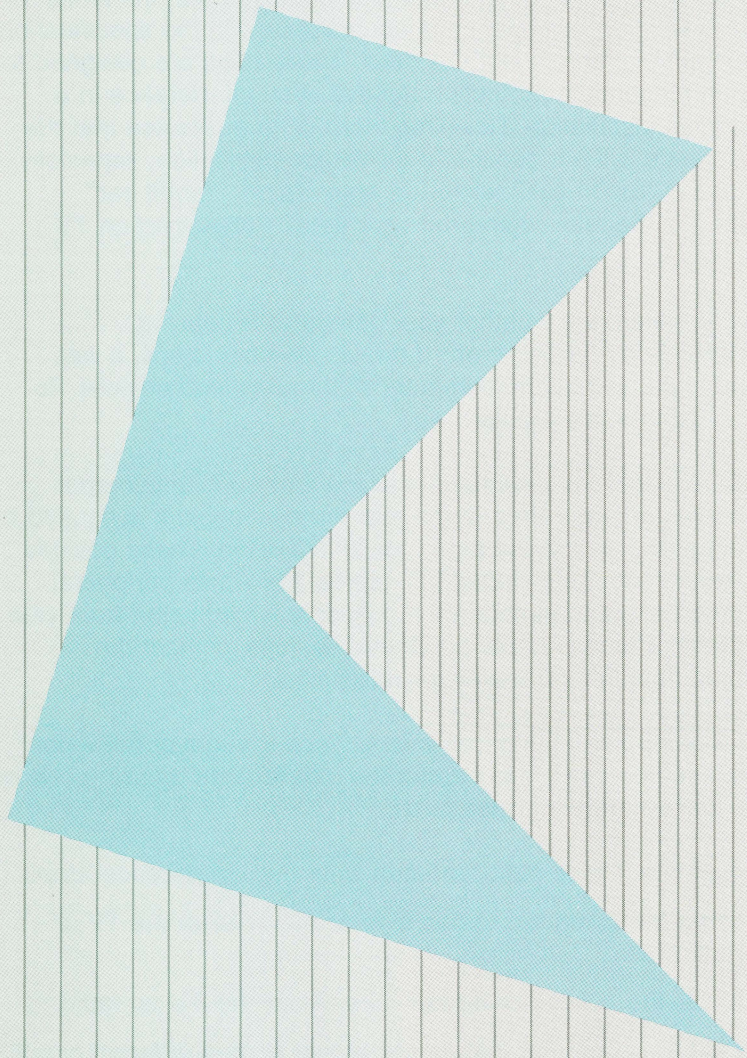
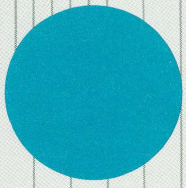
Part I: Reference





Radio and Television Interference

The equipment described in this manual generates and uses radio-frequency energy. If it is not installed and used properly, that is, in strict accordance with our instructions, it may cause interference with radio and television reception.

This equipment has been tested and complies with the limits for a Class B computing device in accordance with the specifications in Subpart J, Part 15, of FCC rules. These rules are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that the interference will not occur in a particular installation, especially if you use a "rabbit ear" television antenna. (A "rabbit ear" antenna is the telescoping-rod type usually contained on TV receivers.)

You can determine whether your computer is causing interference by turning it off. If the interference stops, it was probably caused by the computer or its peripheral devices. To further isolate the problem:

- Disconnect the peripheral devices and their input/output cables one at a time. If the interference stops, it is caused by either the peripheral device or its I/O cable. These devices usually require shielded I/O cables. For Apple peripheral devices, you can obtain the proper shielded cable from your dealer. For non-Apple peripheral devices, contact the manufacturer or dealer for assistance.

If your computer does cause interference to radio or television reception, you can try to correct the interference by using one or more of the following measures:

- Turn the TV or radio antenna until the interference stops.
- Move the computer to one side or the other of the TV or radio.
- Move the computer farther away from the TV or radio.
- Plug the computer into an outlet that is on a different circuit than the TV or radio. (That is, make certain the computer and the radio or television set are on circuits controlled by different circuit breakers or fuses.)
- Consider installing a rooftop television antenna with coaxial cable lead-in between the antenna and TV.

If necessary, you should consult your dealer or an experienced radio/television technician for additional suggestions. You may find helpful the following booklet, prepared by the Federal Communications Commission:

"How to Identify and Resolve Radio-TV Interference Problems"

This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, stock number 004-000-00345-4.

Contents

Preface

This manual is the first book you should read when you open your Apple Dot Matrix Printer package. Depending on which type of Apple computer you have, you'll get another volume of this manual, the *Apple Dot Matrix Printer User's Manual, Part II*, containing information specific to the use of the Apple Dot Matrix Printer with that computer.

This manual is arranged so you can find the information you need, quickly and easily. Here is an overview of what this manual contains.

- Chapter 1, Getting To Know Your Printer, explains how to unpack your printer and familiarizes you with its various parts.
- Chapter 2, Setting Up Your Printer, describes how to load paper and ribbon in the printer, and how to give it a built-in performance test.
- Chapter 3, Care and Handling, discusses how to make your printer work at its best for a long time to come.
- Chapter 4, Controlling Your Printer, tells you how to use control codes to modify the printer's operation for various printing formats.
- Chapter 5, Advanced Control Codes, explains more sophisticated control codes—an extension of the methods introduced in Chapter 4.
- Appendix A, Troubleshooting, contains helpful hints to assist you in overcoming any problems that might occur.
- Appendix B, Command Summary, is a handy reference list of printer commands.
- Appendix C, ASCII, Binary and Hexadecimal Codes, lists code values for each character.

- Appendix D, Character Specifications, depicts each character as it is printed by the Apple Dot Matrix Printer.
- Appendix E, Printer Specifications, contains technical specifications for the Apple Dot Matrix Printer.
- Appendix F, Interface Specifications, contains technical information about the printer's parallel interface.
- A glossary and index are also provided.

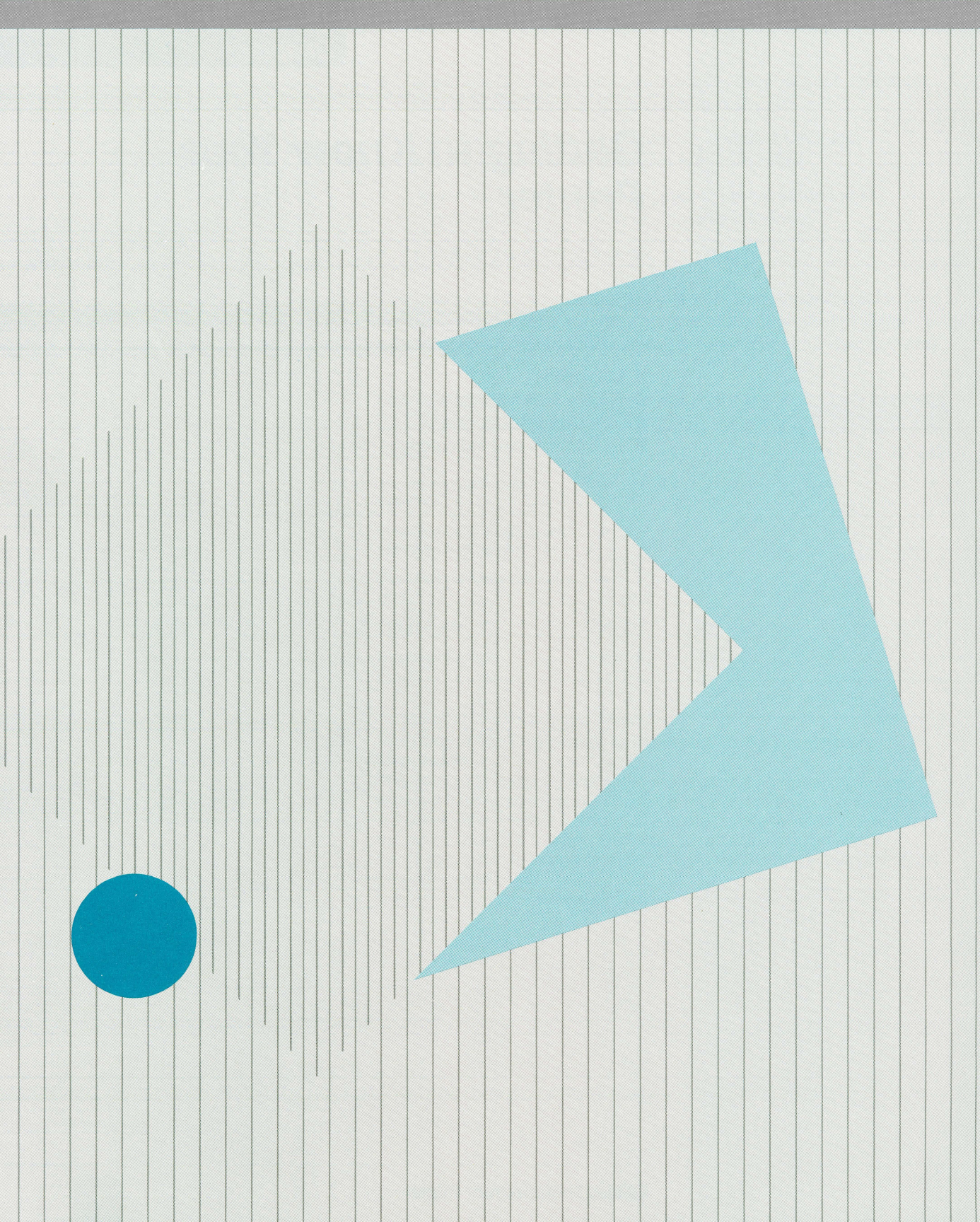
The following chart recommends chapters and appendixes for various reader levels. You may fall into more than one level (for example, you may be a first-time user setting up your own system).

	Chapters					Appendixes:			
Reader	1	2	3	4	5	A	B&C	D	E&F
The person setting up the system	●	●	●			●			●
First-time user; wants to use ready-made programs	●					●			
Experienced Apple computer user	●			●			●		
Programmer	●			●	●		●	●	
Business person	●	●				●			

Warning: This Equipment Is Intended To Be Electrically Grounded.

This product is equipped with a three-wire grounding type plug, a plug having a third (grounding) pin. This plug will only fit into a grounding-type AC outlet. This is a safety feature. If you are unable to insert the plug into the outlet, contact a licensed electrician to replace the outlet and, if necessary, install a grounding conductor. Do not defeat the purpose of the grounding-type plug.

Getting to Know Your Printer



Getting to Know Your Printer

With your new printer you can create a paper copy of anything you can display on the video screen. Obviously you can do things with the paper copy that are impossible with a video screen image: send it through the mail, clip it to a report, post it up on the wall, or file it with other written material.

microprocessor: a small integrated circuit chip (about the size of a postage stamp) that is a little computer, performing a complete set of basic computing functions.

character: any letter, number, punctuation mark, or special symbol.

font: a complete set of type in one size and style of characters.

But you can also do more. Your Apple Dot Matrix Printer contains its own **microprocessor**, allowing it to work on its own with the data it receives from your Apple computer. It can store tabulating commands and fill out forms, printing both backwards and forwards while moving the paper both up and down. It can print foreign language **characters** from its built-in **fonts**, and even reproduce alphabets of special symbols you have designed. It can underline your text or print it in boldface, with a wide range of character and line spacing options. Finally, it can print drawings: graphs, pictures, and diagrams, for example. Teamed up with your Apple computer, the Apple Dot Matrix Printer provides a whole new kit of tools for you to work with.

Unpacking

Your Apple Dot Matrix Printer and power cord are packed in a single carton. All cables, manuals, and other items specific to your particular Apple computer come in a separate, smaller Accessory Kit. Here's how to unpack the larger box:

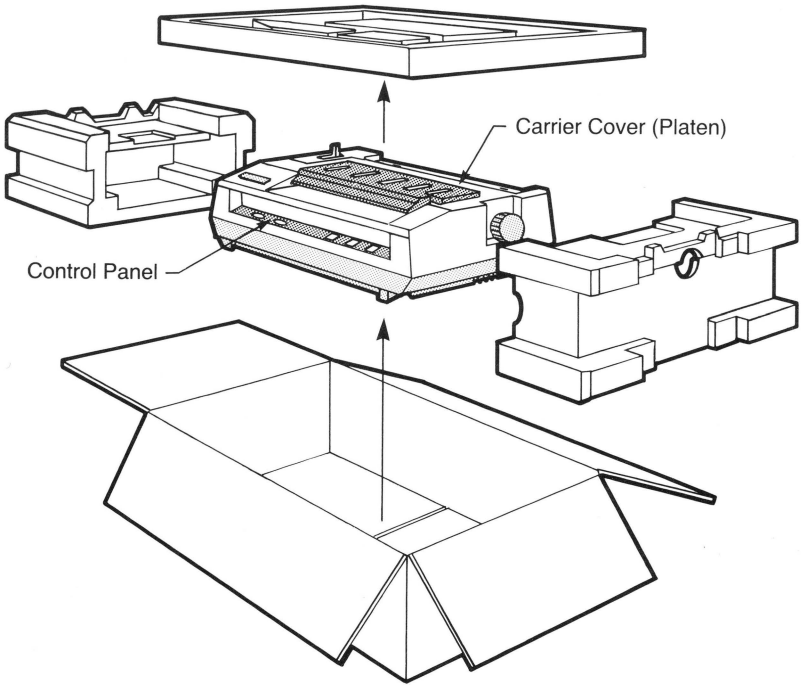


Figure 1-1. Unpacking Your Printer

1. Cut the tape seals on the top of the big carton, being careful not to cut too deeply into the box.
2. Open the top flaps of the carton. Remove the sample sheet of typing, ribbon cassette, and power cable.
3. Using both hands, draw the white polystyrene packing form upward and out of the box. Save it for later use. (You'll learn how to repack your printer in Chapter 3.)
4. Reach under the bottom side of the printer with both hands and lift it out. Place it nearby. Set the carton aside for future use.

Warning
Don't try to lift the printer by its knob or sides; reach completely underneath it.

5. Remove the plastic bag from the printer. Save it.

6. Remove all pieces of tape on the outside of the printer. (Each piece of tape is folded at one end to provide a handle for stripping it off.)
7. Remove the carrier cover from the printer: lift upward directly underneath the Apple label and pull it toward you. Peel off and discard the protective film that covers its gray plastic lid. Set the cover aside.
8. Remove and save the piece of cardboard that centers the typehead inside the printer.
9. Replace the carrier cover: fit its rear edge into the edge of the rest of the printer's cover (near the **platen**) and bring the front downward over the control panel. It should snap into place.
10. Check the power switch on the left side of the printer. If it is not already off, press the end marked ***OFF***.

platen: a rubber roller that provides a backing for the printing action.

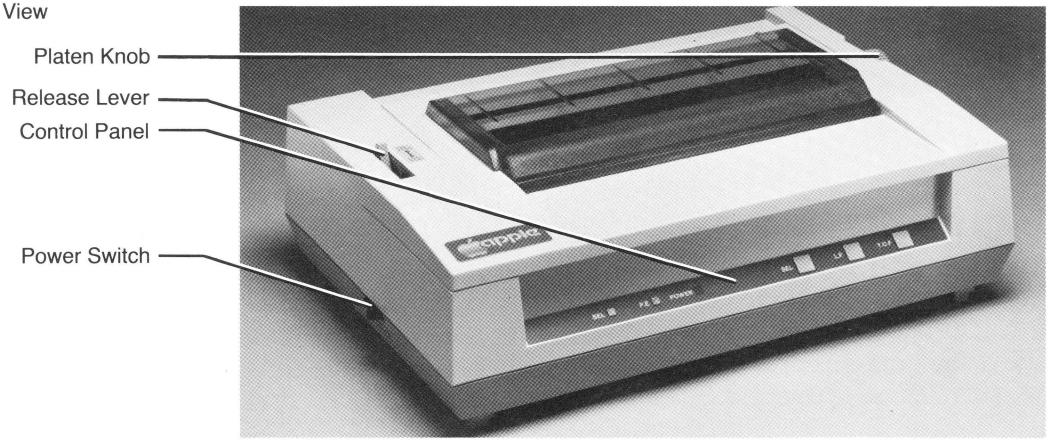
Warning

Do not attempt to plug in or operate the printer just yet. If you try to run the printer without installing ribbon and paper, you may damage its typehead.

First, a Few Names

Before proceeding further, you should take a minute to learn the names of your Apple Dot Matrix Printer's parts and controls. With the printer unpacked and sitting on the table in front of you, compare it to the labeled pictures.

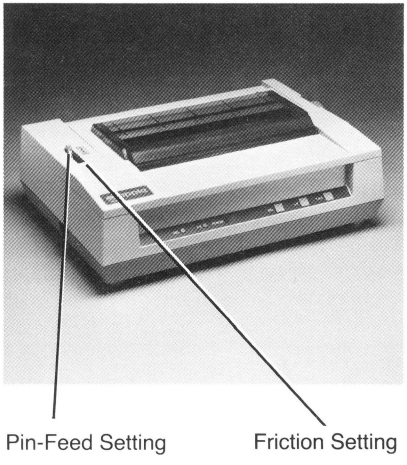
Figure 1-2. Front View



The **power switch** is located on the left side of the printer, near the bottom. When it is time to turn it on, you will push in the end with the white dot.

Warning
Leave the power switch off until you are ready to perform the built-in test described in Chapter 2, Setting Up Your Printer.

Figure 1-3. Setting the Release Lever



The **platen knob** and **release lever** are used only when paper is being loaded, as described in Chapter 2, Setting Up Your Printer. Don't touch them while the printer is printing.

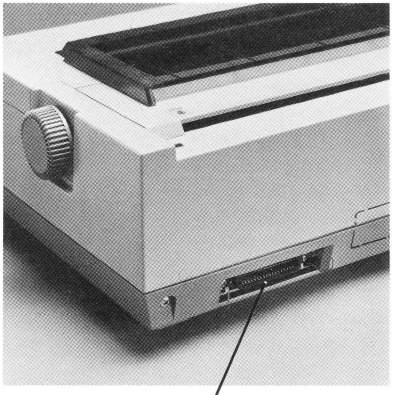
The **release lever** determines how paper is fed through the printer. The **pin-feed** setting is used for form paper with holes along the margins, and the **friction** setting is used for ordinary paper without holes.

The **control panel** is recessed in the front of the printer. Its buttons and lights are discussed under Controls and Indicators, later in this chapter.

interface: the computer equipment that translates signals from one part of a computer system to another.

You will use the **interface connector** on the back to connect the printer to your Apple computer, as described in the *Apple Dot Matrix Printer User's Manual, Part II.*

Figure 1-4. Rear View



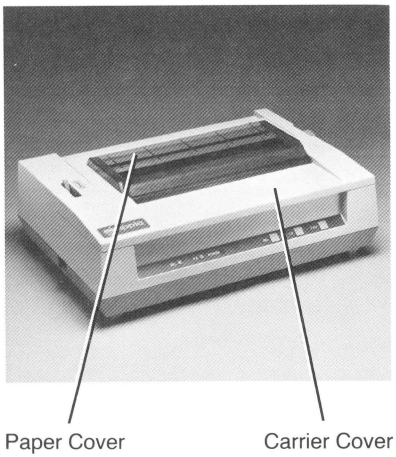
Inside the Machine

The only time you'll need to open your printer is to replace paper and ribbons or make certain adjustments. You should leave service of the working parts of your Apple Dot Matrix Printer to a qualified technician.

The two covers help prevent dirt and paper clips from getting inside the printer, and ensure that nothing interferes with the moving parts while they are working. The printer will not operate unless the carrier cover is completely shut.

Warning
Before opening either cover, always be sure to turn the power switch off.

Figure 1-5. The Printer Covers



Remove the covers now, following the directions below. Refer to Figure 1-6 to locate the parts.

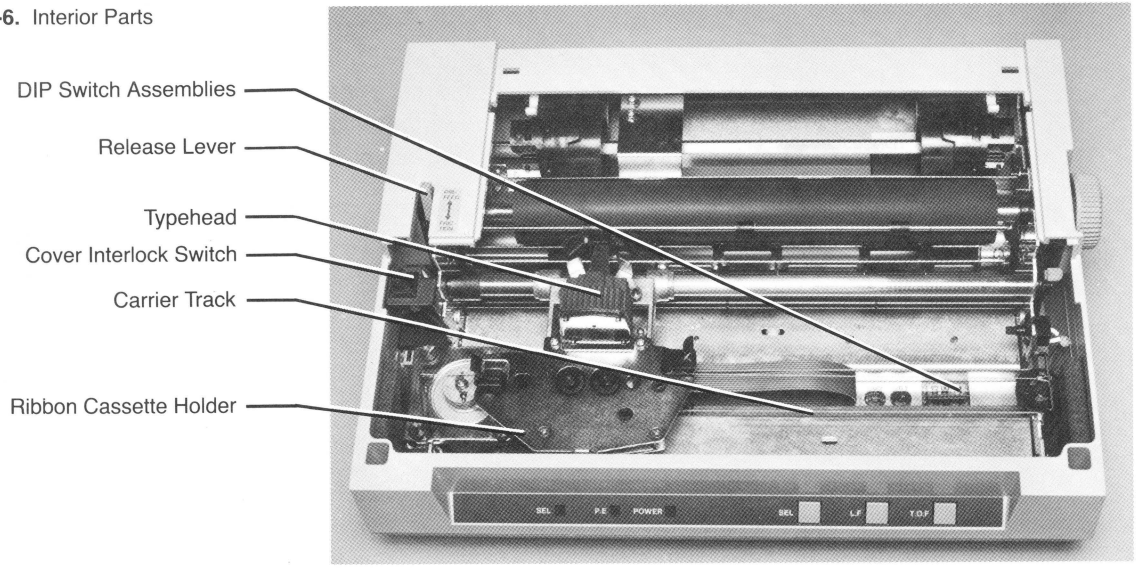
Remove the **carrier cover**, by lifting the lip overhanging the control panel and sliding the cover toward the front of the machine. The entire cover comes off. The clear plastic lid is hinged to allow access to the inside when changing ribbons or adjusting paper. It is normally kept closed.

The **cover interlock switch**, which prevents the printer from operating when you remove the carrier cover, is the black rubber button on the left side of the printer just forward of the release lever.

Grasp the center of the **paper cover** and pull gently upward. It should come up quite easily.

Now you're ready to locate some of the interior parts.

Figure 1-6. Interior Parts



The ribbon is enclosed within a plastic **ribbon cassette** that allows easy ribbon changing without threading or handling spools. Chapter 2, Setting Up Your Printer, tells you how to change the ribbon.

Removal and cleaning of the typehead is covered in Chapter 3, Care and Handling.

The **typehead** sticks up through the ribbon cassette. It prints characters by the *dot matrix* method, explained below.

DIP stands for Dual In-line Package.

Two **DIP switch assemblies** are located inside the machine, at the bottom, on the right side of the **carrier track** (the track the printer head assembly travels in). These switches control a number of important preset functions, as discussed in Chapter 4, under How to Set DIP Switches, and Chapter 5, Advanced Control Codes.

Warning

The two blue controls to the left of the DIP switch assemblies should be adjusted only by a service technician. They control the strength of the printer impression and the alignment of the printer head.

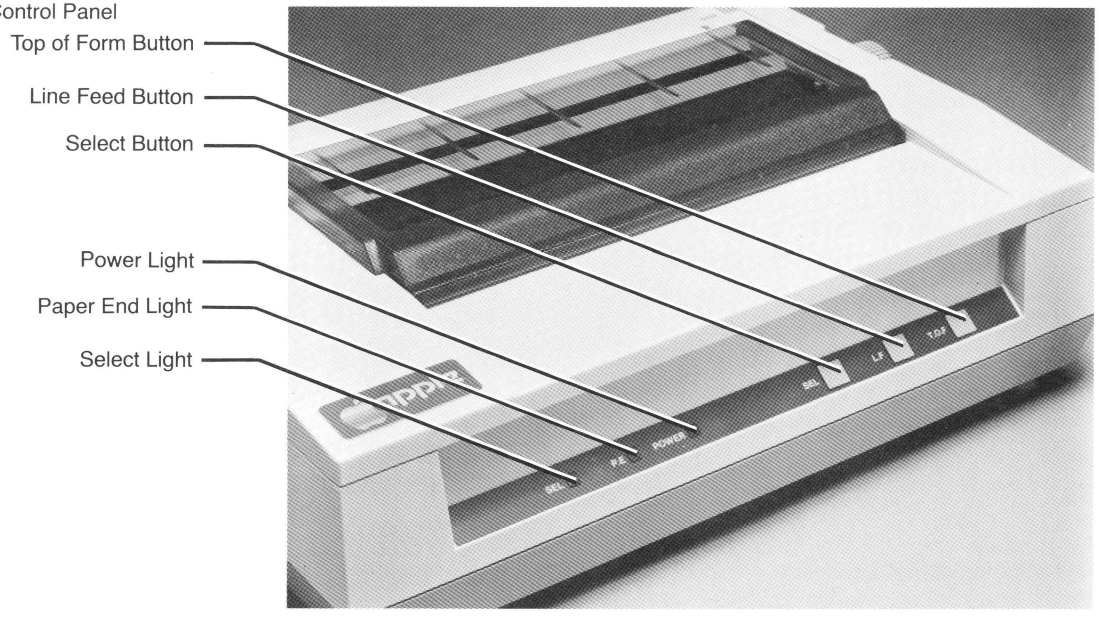
Controls and Indicators

You can operate your new Apple Dot Matrix Printer entirely from your Apple computer, but, for convenience, a few buttons and lights are included on the printer itself.

The green **power light** comes on whenever the printer is plugged in and the **power switch** is on.

The button marked *SEL* is the **select button**. When the corresponding **select light** (SEL light) is on, your printer can receive data from your Apple computer. When the SEL light is off, you can control the printer with the switches on its control panel, but it won't receive data from the computer. The SEL button works like a toggle switch between these two modes; each time you press the button, the printer changes to the other mode.

Figure 1-7. Control Panel



By The Way: If you open the carrier cover while the printer is printing, it will stop and the SEL light will go out. To resume printing, close the cover tightly and press the SEL button.

LF: Line Feed, an ASCII character that instructs the printer to feed one line of paper. An **ASCII character** is a character in the American Standard Code for Information Interchange, the binary code in which information is sent to the Apple Dot Matrix Printer.

TOF: Top of Form, the very top of a page of text.

The button marked *LF* is the **line feed button**. Each time you press it, the printer feeds through one line of blank paper. The LF button works only when the SEL light is off.

The button marked *TOF* is the **top of form button**. When you press this button, the printer feeds blank paper continuously until it reaches the top of the next page, where it stops. This is a handy way to bring completed work out of the printer so it can be torn off. The TOF button works only when the SEL light is off.

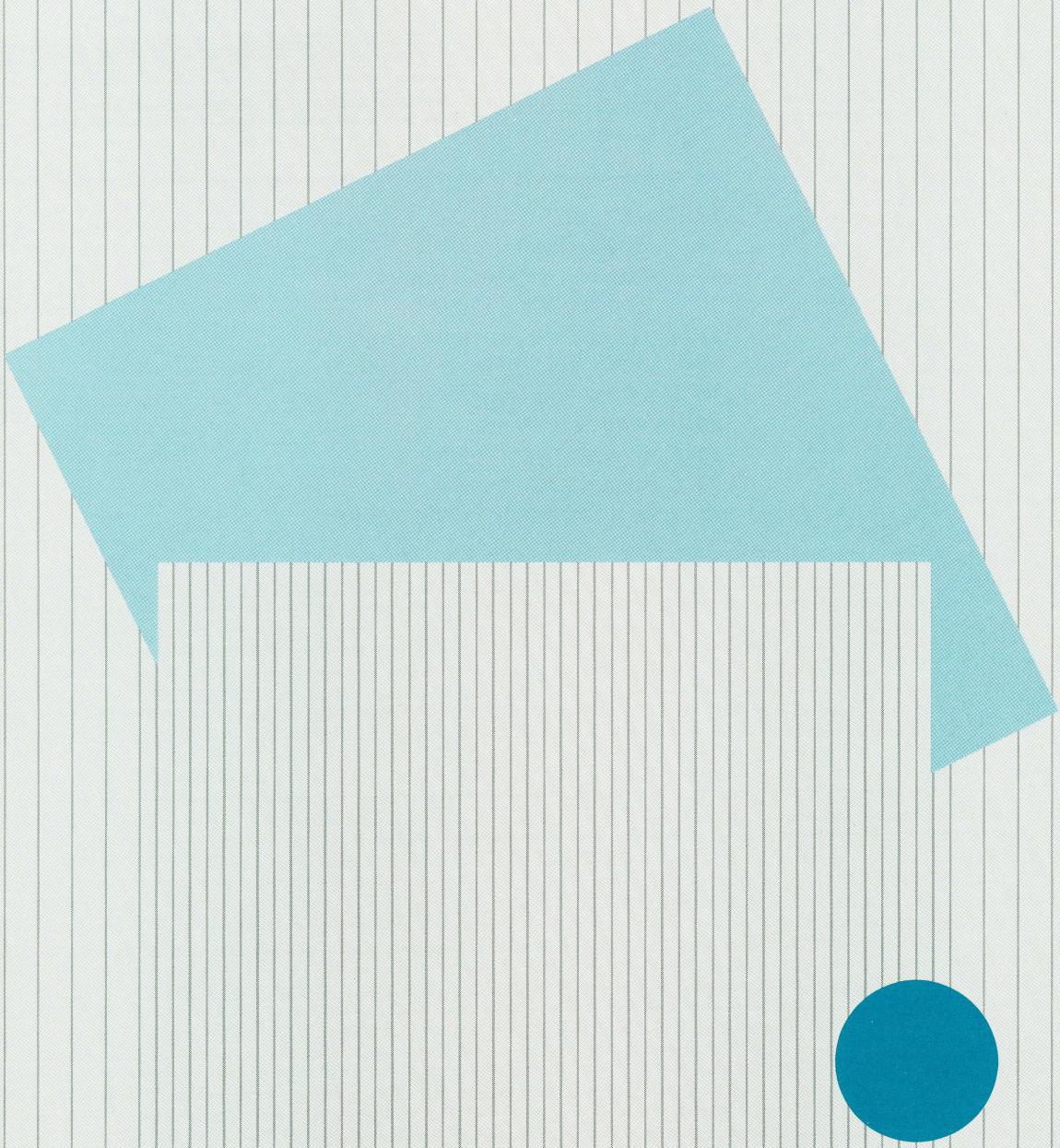
By The Way: You can stop the action of the printer at any time by pressing the SEL button while holding down the LF button. This *deselects* the printer, and while it is stopped, you can operate the LF and TOF buttons; commands from the computer will be ignored. To resume printing from the place where you stopped, press the SEL button.

When there is only about 1 inch of paper left in the printer, the **paper end light** (PE light), comes on and the printer stops printing. If you want to print the next line or so anyway (to finish a form that is nearly done), just press the SEL button once for each additional line to be printed.

Warning

Don't press the SEL button to make the Apple Dot Matrix Printer print when there is no paper under the typehead. This can damage both the typehead and the platen.

Setting Up Your Printer



Setting Up Your Printer

This chapter shows you how to get your printer up and running. You'll learn about loading the paper and ribbon, running the printer through a built-in test, and then connecting it to your computer.

The Paper

You can put ordinary typing paper, business forms, and letterheads into your Apple Dot Matrix Printer. You may find it more convenient to use special **pin-feed** or **roll paper** that is made for computer-driven printers.

pin-feed paper: Multi-sheet paper with holes along each margin. Each page is separated from the next by perforations (just as paper towels are perforated between sheets). The paper is folded at the perforations to make a stack that feeds continuously into the printer.

roll paper: Paper that comes in one complete, continuous roll (like a roll of butcher paper).

The Apple Dot Matrix Printer prints on ordinary bond paper, up to 24-lb. rating (standard pin-feed computer paper usually comes in 15- and 20-lb. ratings). Heavier paper may not feed properly; lighter paper, such as onionskin, may give a poor print image unless it is backed by a sheet of 15-lb. bond.

You can also use multiple forms in your printer, provided their total thickness (including carbon sheets) does not exceed 0.28 millimeters (0.011 inch), or about the thickness of four sheets of 15-lb. bond. You'll have to adjust the printer when printing on more than one sheet (see Adjusting for Paper Thickness).

For further information about multi-sheet forms, see Appendix E.

You can adjust your Apple Dot Matrix Printer to accept pin-feed or roll paper from 4-1/2 to 10 inches in overall width. This includes standard 9-1/2 inch wide pin-feed paper, which produces 8-1/2 by 11 inch finished pages after you tear off the perforation strips. You can also use several standard sizes of pin-feed label stock, for jobs such as printing mailing lists. If you like, you can position the paper so that the printer prints right up to the perforation line on either side.

Warning
Never put paper with staples or other objects in your Apple Dot Matrix Printer.

The next two sections describe how to load pin-feed paper into your Apple Dot Matrix Printer. If you plan to use roll paper or single sheets of paper without pin-feed holes, skip ahead to the section entitled Loading Plain Paper.

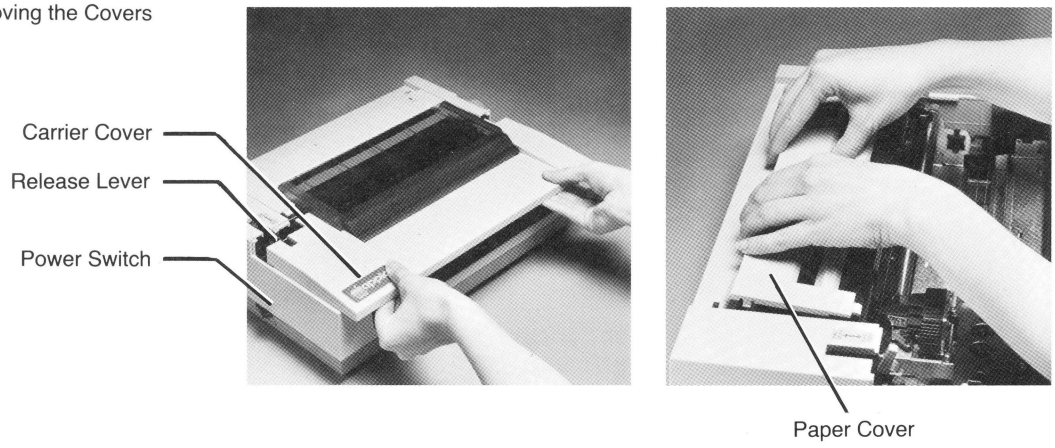
Setting the Pin-Feeder Width

sprockets: the toothed wheels at the rear of the printer, which engage pin-feed paper and draw it through the machine.

The first time you use pin-feed paper on your Apple Dot Matrix Printer you will need to set the spacing of the **sprockets**. Here is how to do it:

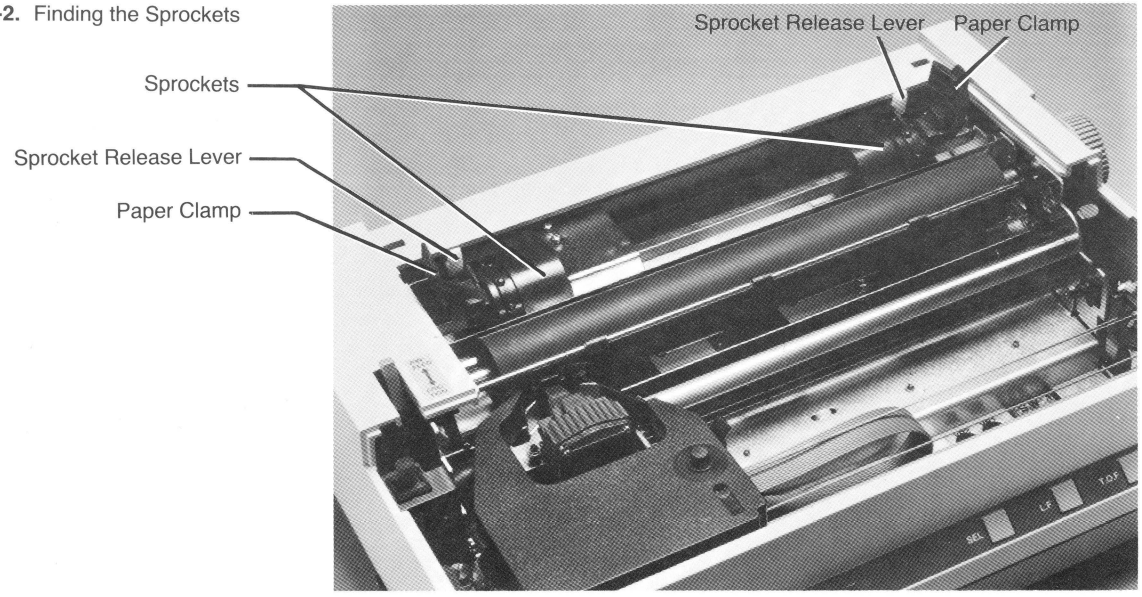
1. Tear off a single sheet of the pin-feed paper you are going to use, to serve as a gauge.
2. Turn off the printer.

Figure 2-1. Removing the Covers



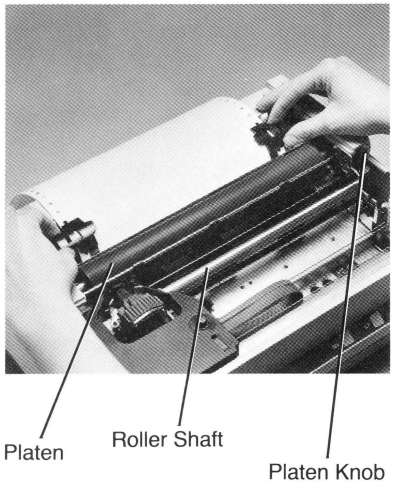
3. Remove both the carrier cover and the paper cover.
4. Set the release lever to PIN-FEED.

Figure 2-2. Finding the Sprockets



5. The sprockets are the two black plastic parts inside the machine at the rear. Lift up the two tabs that point toward the center, so that the hinged **paper clamps** over the two sprockets swing outward. Look underneath each tab, toward the back, and find the white **sprocket release levers**. When the white levers are pushed toward the rear, the sprockets are free to slide along their square shaft. When the levers are forward, the sprockets are locked in place.

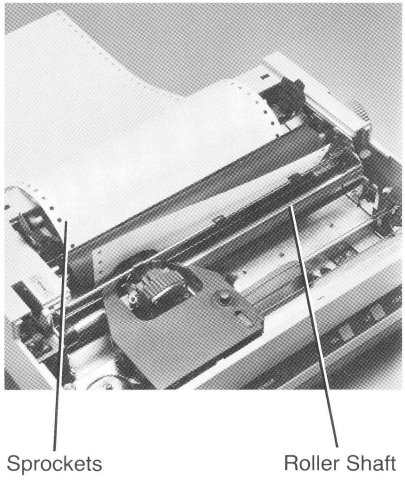
Figure 2-3. Adjusting the Sprockets



6. Push the white sprocket release levers to the rear (so that the sprockets are free to slide) and place a single sheet of pin-feed paper over the sprockets. Position the sprockets so that the pins fit through the holes in the paper. Snap the paper clamps back into place.
7. Feed the forward end of the paper under the rubber **platen** and into the printer, as you would in a typewriter, by turning the **platen knob**. Lift the **roller shaft** in the front of the machine and guide the paper under it.
8. You can now move the paper sideways, carrying the two sprockets with it, until it is centered with respect to the printing area. The two red rings at each end of the roller shaft tell you where the margins of an 8-inch printed line occur. When the paper is in place, pull the release lever forward to the FRICTION position to hold it in place.

9. Open the hinged cover on each sprocket and push the white lever forward. Make sure the sprocket pins fit easily in the holes in the paper, without pulling inward or outward.
10. Push the release lever back to the PIN-FEED position.

Figure 2-4. Loading Pin-Feed Paper

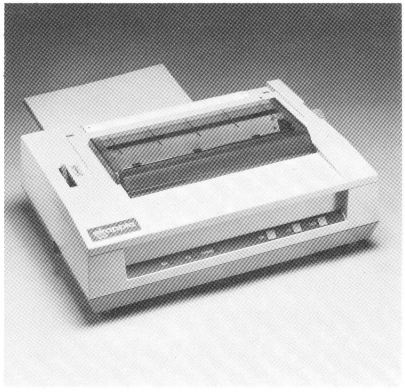


Loading Pin-Feed Paper

Follow these steps to load pin-feed paper into your Apple Dot Matrix Printer:

1. If the end of the paper you are going to use is not straight, cut across it with scissors.
2. Turn the power off.
3. If necessary, set the pin-feeder width as described above.
4. Remove both the carrier cover and the paper cover.
5. Set the release lever to FRICTION.
6. Grasp the roller shaft at both ends, and pull it forward.
7. Lift the paper clamps on the two black sprockets at the rear inside the machine, folding them outward to expose the sprockets.
8. Place the paper over the sprockets so that the pins go through the paper holes. Snap the paper clamps back down to hold the paper in place.
9. Pull the pin-feed paper into the printer by turning the platen knob clockwise (top away from you).
10. When the end of the paper comes up the front of the platen, under the typehead, snap the roller shaft shut on it.
11. Close the paper clamps on the sprockets.
12. Push the release lever back to the PIN-FEED position.
13. Replace the paper cover and the carrier cover.

Figure 2-5. Pin-Feed Paper Loaded



Loading Plain Paper

To load paper without pin-feed holes—either a single sheet or a roll—do the following:

1. Turn the power on and then off. This moves the typehead as far left as it will go. Leave the power off.

2. Open the clear plastic lid on the top of the machine.
3. Set the release lever to PIN-FEED.
4. Grasp the roller shaft by both ends, and pull it forward.

Figure 2-6. Loading Plain Paper

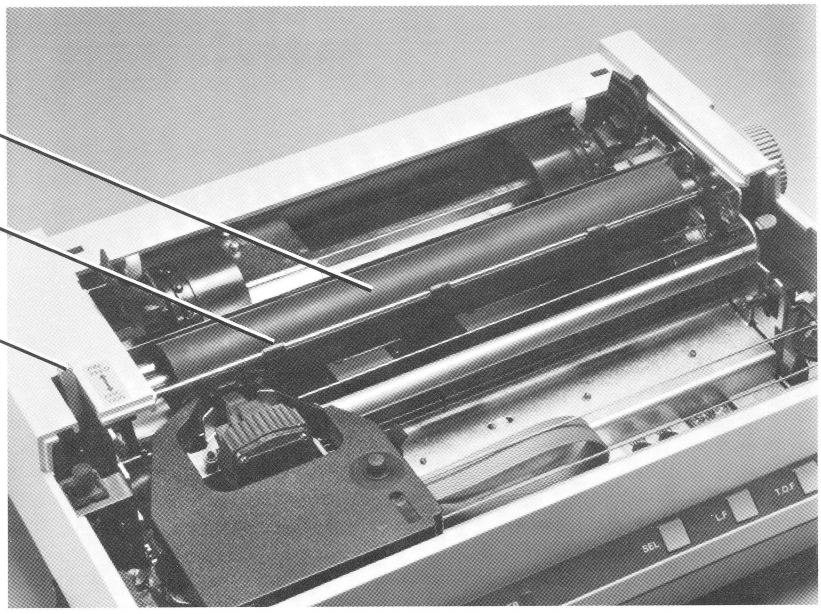


Figure 2-7. Plain Paper Loaded

TOF stands for Top of Form.

5. Push the end of the paper down into the slot in the paper cover, feeding it around the platen as you would in a typewriter.
6. When the paper comes up in front of the platen, you can move it sideways to the location you want. The red rings on the roller shaft indicate the limits of the printer's line of type. Snap the roller shaft shut.
7. Set the release lever to the FRICTION position.

Setting the Top of the Page

When you press the TOF button on your Apple Dot Matrix Printer's control panel, it feeds paper through to the top of the next page.

Pin-feed paper is perforated between pages, so pressing the TOF button brings the paper to a handy place to tear it off.

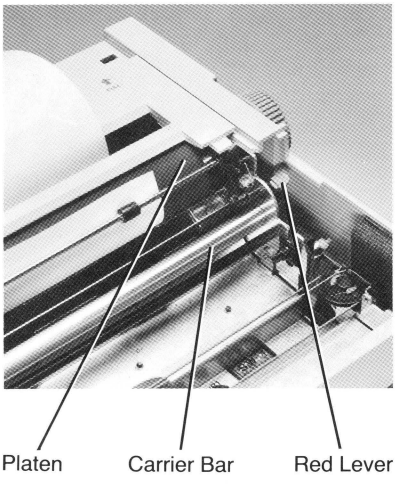
By the Way: Your printer was set at the factory for a page length of 11 inches (66 lines). If you want to change the page length, see Chapter 4, Controlling Your Printer.

To position the top of form after you have loaded a new supply of pin-feed paper do the following:

1. Turn the power on.
2. If the SEL light is lit, turn it off by pressing the SEL button.
3. Press the TOF button.
4. When the paper stops moving, turn the platen knob to bring the paper to the desired position. (Usually the top of the page should be level with the top of the printhead.)

Unless you turn the platen knob again (instead of moving paper up by means of the LF button), the TOF button will feed paper to the top of the next page each time you press it.

Figure 2-8. Adjusting for Paper Thickness



Adjusting for Paper Thickness

Your Apple Dot Matrix Printer will make higher-quality copies and give you longer service if you take care to adjust it for the thickness of paper you are using.

Remove the carrier cover and look inside the printer. On the right side, near the platen knob, you will find a red plastic lever. When this lever is pushed all the way back (toward the platen), the printer is correctly set to print on a single thickness of ordinary paper. When the lever is pulled all the way forward (toward the control panel), the printer is set for a 4-sheet multiple form. As you move the lever back and forth you can see a slight movement of the horizontal metal **carrier bar** on which the typehead slides, compensating for the paper thickness. You can also feel that it clicks in four positions, corresponding to 1 to 4 sheets of ordinary paper.

Installing and Removing the Ribbon

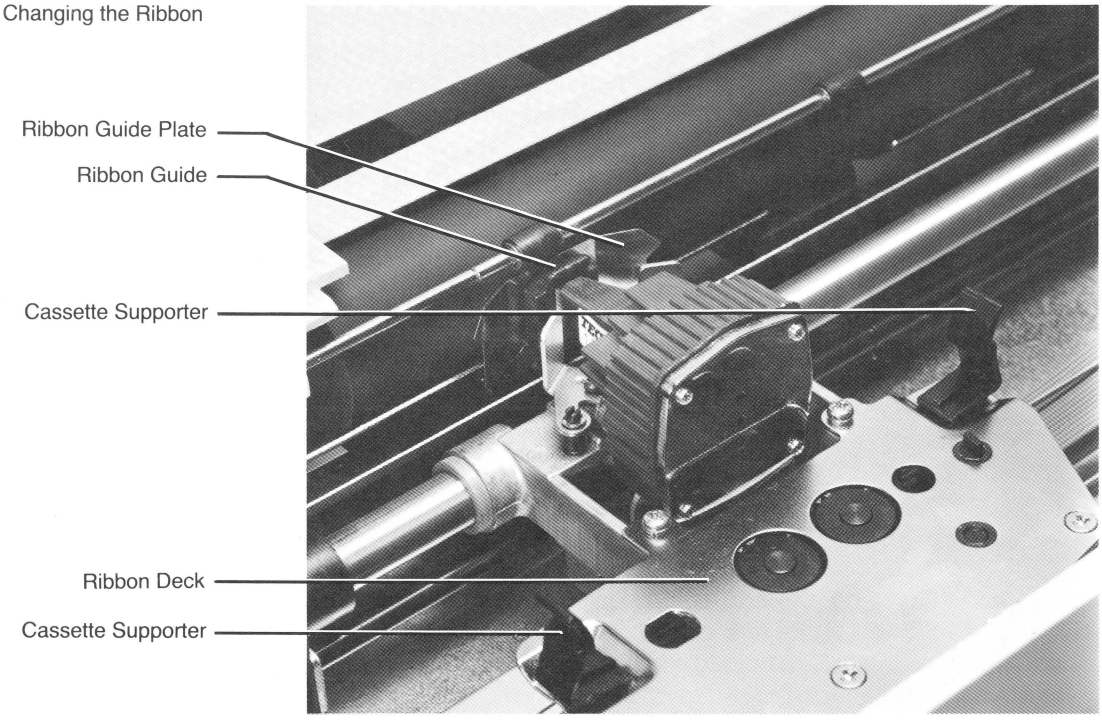
The ribbon cassette supplied with your printer is a special type, made specifically for this machine. You can get additional ribbons from your Apple dealer.

Changing ribbons is fast and easy. To install the ribbon that was packed with your printer, proceed as follows:

1. Turn off the power.
2. Remove the carrier cover.

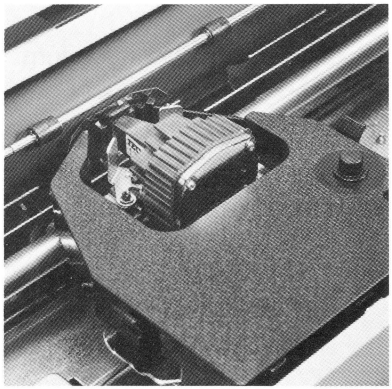
3. Take up slack in the ribbon by turning the knob on the cassette once or twice in the direction of the arrow.

Figure 2-9. Changing the Ribbon



4. Carefully slip the exposed portion of the ribbon between the black plastic **ribbon guide** and the thin metal **ribbon guide plate** (the part that nearly touches the paper). At the same time, guide the cassette downwards onto the **ribbon deck**. The two black plastic **cassette supporters** (the parts that stick up) fit into the notches on the sides of the cassette.

Figure 2-10. The Ribbon Loaded



5. The cassette should easily snap in place with a single motion. If it refuses to go down completely, or if the ribbon is caught in the space between the ribbon guide and guide plate, turn the knob on the cassette slowly in the direction of the arrow as you seat it. When properly installed, the cassette should lie flat on the ribbon deck.

To remove a used ribbon cassette, turn off the power and remove the carrier cover. Gently spread the two black plastic cassette supporters and lift up the cassette.

Warning

When pulling the cassette away, be careful not to get the ribbon caught between the ribbon guide and the guide plate.

Testing Your Printer

Inside your Apple Dot Matrix Printer is a microprocessor with a permanent program that can print a test alphabet on command. The printer does not need to be connected to a computer to run this program. It is a handy way to put the machine through its paces before hooking it up to anything else.

To run the built-in test, follow these steps:

1. If you have not already done so, load paper and ribbon into the printer.
2. Plug the printer into an electric power outlet and turn the printer on. The power light should come on.

Warning

All electrical connections to your computer and peripheral equipment **must be grounded**! The electrical ground prevents damage from a power surge to your computer or monitor or you. If your electrical outlet doesn't have a third hole (the round one), have a qualified electrician determine if the outlet box itself is grounded. (Many are.) If it is grounded, you can plug your computer into the outlet using an adapter available in any hardware store. This kind of adapter has a "pigtail," or metal tab, that can be secured with the screw that holds the cover plate to the outlet.

3. If the SEL light also comes on, press the SEL button once to turn it off.
4. Press the LF button a few times to make sure that paper feeds smoothly through the machine.
5. Turn the power off.
6. Press the TOF button and continue holding it in while you turn the power back on. Then release the TOF button. The Apple Dot Matrix Printer will print its complete set of characters repeatedly until you turn the power switch off. It takes 16 lines to print the entire pattern.

Examine the printout carefully. All the characters should be complete (no dots missing) and neatly aligned. The lines should appear equally black from end to end. Spacing between characters and between lines should be even. If this is not the case, please contact your Apple dealer.

Connecting Your Printer

Now that you know your new printer works, it is time to connect it to your Apple computer. Details of the electrical hookup are different for every Apple computer. Turn to the *Apple Dot Matrix Printer User's Manual, Part II* for instructions on how to perform the hookup. After you have successfully connected the printer to your computer, return to this book and read the remainder of this chapter. If you have difficulties making the connection, see Appendix A.

If you have modified the circuits of your Apple computer, or if you are connecting your printer to another brand of equipment, refer to Appendix F for a technical description of the electronic interface requirements.

Creating a Workspace

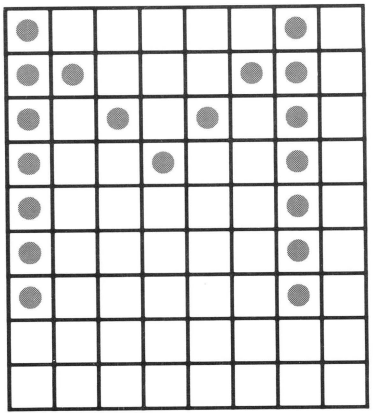
Your Apple Dot Matrix Printer prefers to work in a clean, vibration-free environment, away from such hazards as chemical fumes and spilled coffee. Your printer is small and light, so you can place it on a shelf or on top of a file cabinet, where it will be out of the way; or you can put it on the back of a desk or table, where it will be easy to reach. The principal limitation on its location is the six-foot connecting cable.

If you will be using any kind of paper other than single sheets, you will need room for the paper supply that feeds into the back of the printer. A stack of pin-feed paper behind the printer will require a space of about 9 inches by 12 inches; roll paper will require less space. Or you can place the printer at the back of a desk, shelf, or table, with the paper supply in a box on the floor underneath it.

How a Dot Matrix Printer Works

A conventional typewriter has a different type bar or typeball section for each character it can strike. The dot matrix printer, on the other hand, prints every character with a single typehead. It does this by generating each character as a pattern of dots chosen from an array up to sixteen dots wide by nine dots high. The printer's standard characters use seven dots of width, and eight dots of height; one column of dots creates a space between characters.

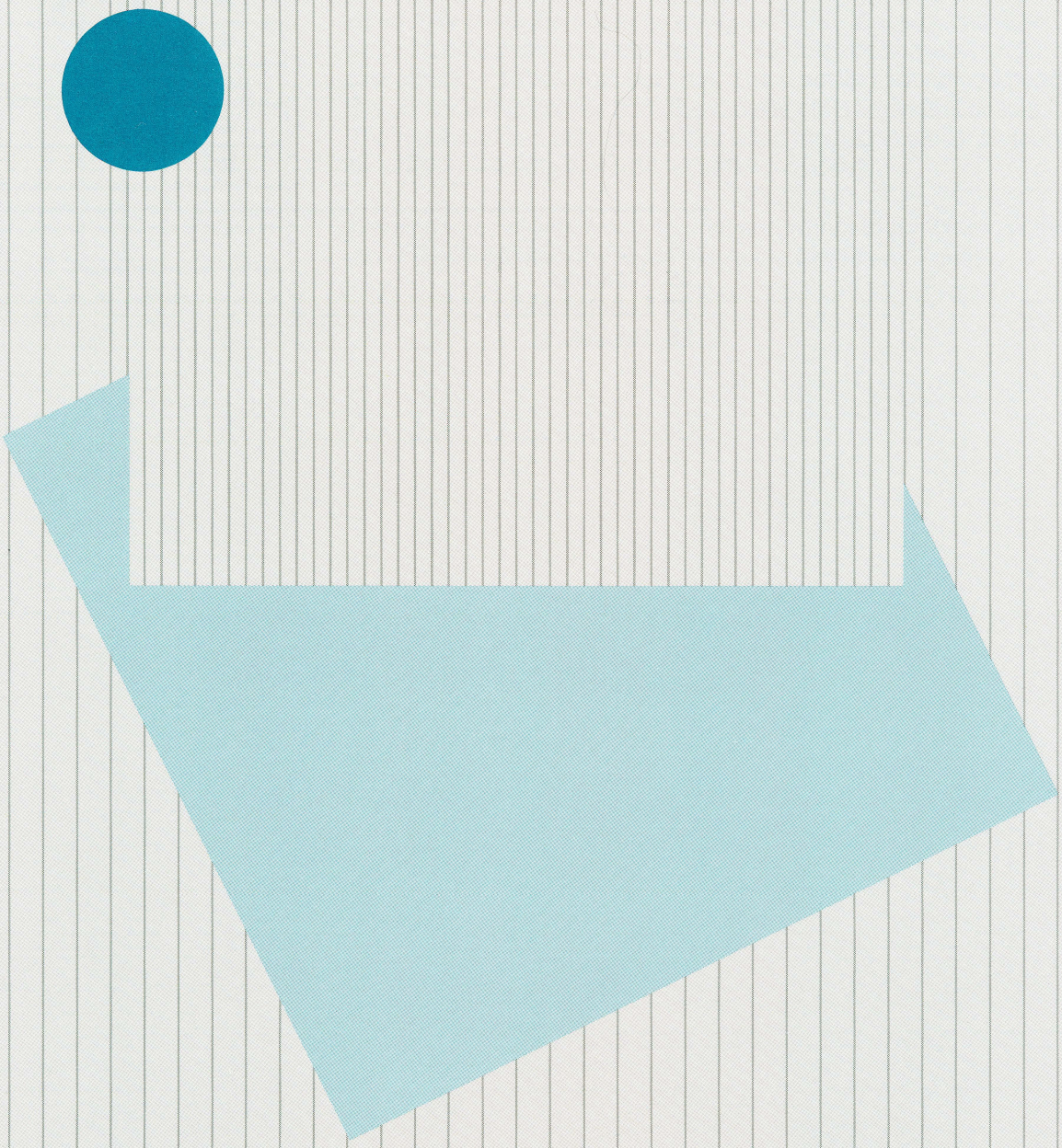
Figure 2-11. Dot Matrix M



Notice that the capital letter M is made up of 19 dots. The typehead contains only a single vertical column of 9 dot strikers (called **wires**). As the column of wires moves along the paper it strikes successive patterns to create each printed character. Thus, when your Apple Dot Matrix Printer prints a row of 80 characters, the wires may strike the paper as many as 10240 times (1 character = up to 16 dots wide × 8 dots high = 128 dots per character ×80 characters = 10240 dots per line). The crackling sound you hear as the printer prints comes from the rapidity of its individual strikes. The typehead can print characters while moving in either direction, by simply reversing the order of striking patterns.

Keeping track of which dots to print and where to print them is the job of a microprocessor inside the Apple Dot Matrix Printer.

Caring for Your Printer



Caring for Your Printer

Think of your Apple Dot Matrix Printer as a high-quality typewriter with a built-in microprocessor. By taking care of it as you would any fine machine, you will save yourself repair bills and always be assured of getting the results it was designed to deliver.

Operating Environment

The Apple Dot Matrix Printer is intended to be used in a reasonably clean indoor location. It will work reliably in temperatures from 41 to 104 degrees Farenheit (5 to 40 degrees Celsius) with 10 to 85 percent humidity.

Warning

When you're not using your printer you can store it at temperatures of −13 to +140 degrees Farenheit (−25 to +60 degrees Celsius) without damage, but never try to run it at these extremes.

The printer's covers protect it adequately from dust and foreign objects, but they afford little protection against liquids or vapors. Spilling any liquid inside, or allowing the printer to be exposed to chemical or solvent fumes (including steam from a coffee maker), can harm it.

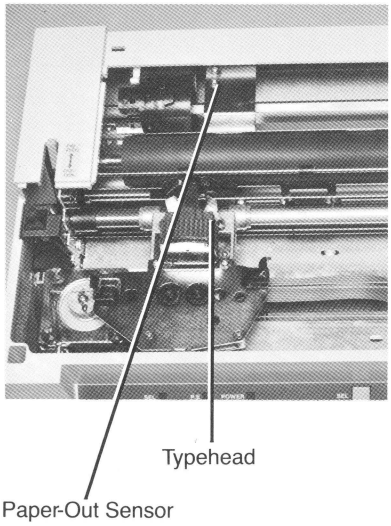
Cleaning

To clean the outside of the printer, just wipe it with a damp cloth. To remove thumbprints, add a drop of liquid soap.

Warning

Never use household cleansers, ammonia, or solvents such as cleaning fluid; they may eat the plastic.

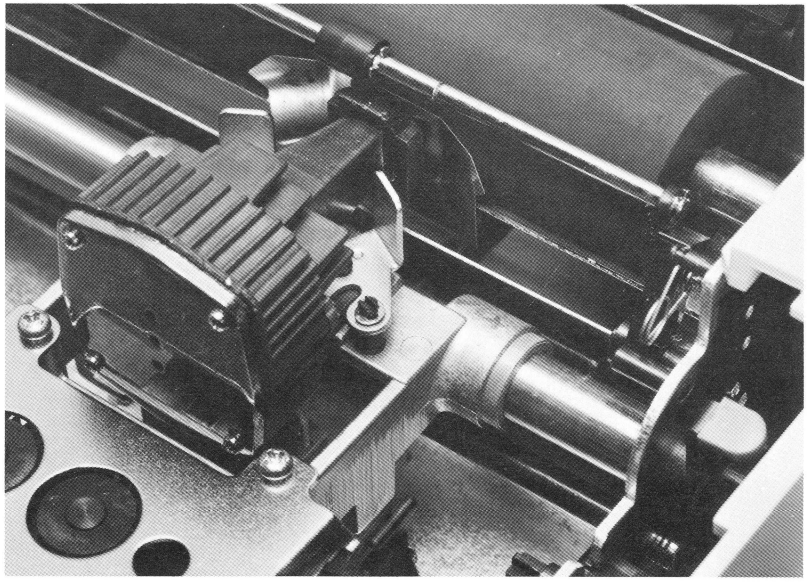
Figure 3-1. Paper-Out Sensor



Inside your Apple Dot Matrix Printer, only the **paper-out sensor** and **typehead** need routine cleaning. Clean them every few months—more often if you use the printer frequently. Here's how to do it:

1. Turn the power off before cleaning inside the printer.
2. Remove the carrier cover and paper cover. Find the paper-out sensor. Clean away any accumulation of paper dust and lint, using a soft brush (such as a small paintbrush or eyebrow brush).
3. Remove the ribbon cassette.
4. Spread the two metal tabs on each side of the typehead. If they don't move easily, pry them gently with a coin against the typehead. Lift the typehead straight upward. Since it fits tightly over two guide pins and has an electrical plug on the bottom, it may require modest force to bring it free; but do not strain it or attempt to pry it with tools.

Figure 3-2. Typehead Metal Tabs

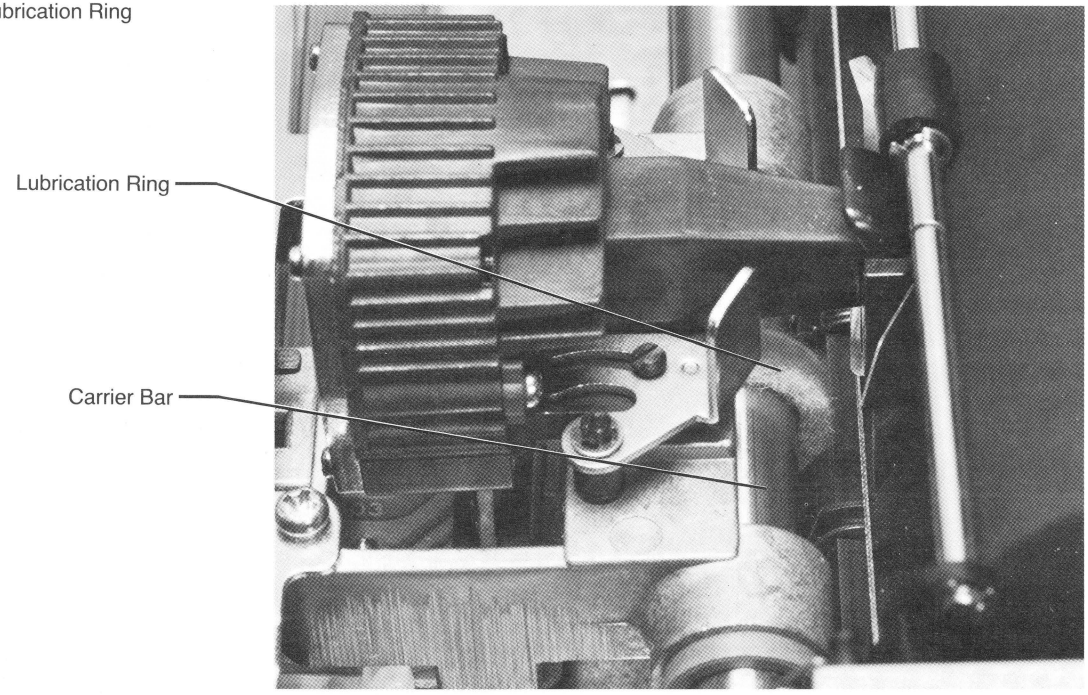


5. Using a soft brush, clean away all ribbon chips and paper dust from the typehead.
6. Replace the typehead and lock it in place by pushing the two metal tabs back toward each other.
7. Replace the ribbon cassette, carrier cover, and paper cover.

Lubrication

The **lubrication ring** is the only part of your Apple Dot Matrix Printer that needs regular oiling; all other parts of the mechanism are permanently lubricated.

Figure 3-3. Lubrication Ring



With the power off, remove the carrier cover and look underneath the typehead. You will see a white felt ring encircling the horizontal metal carrier shaft. As the typehead moves back and forth, oil soaked into this felt ring rubs off on the shaft.

Once a year (or more often if the printer is used frequently), you should clean and lubricate the shaft. With the typehead at the far left end, carefully wipe the shaft clean, using a cloth that will not leave lint behind. Remove the ribbon. Put two or three drops of light machine oil on the top of the felt ring. You can reach it more easily if you remove the typehead. Be careful not to get oil on other parts of the mechanism. Replace the typehead, ribbon, and carrier cover. Finally, after you have everything in place, perform a few lines of the built-in test to spread the new oil over the shaft.

To position the typehead at the far left, turn the printer on and off once.

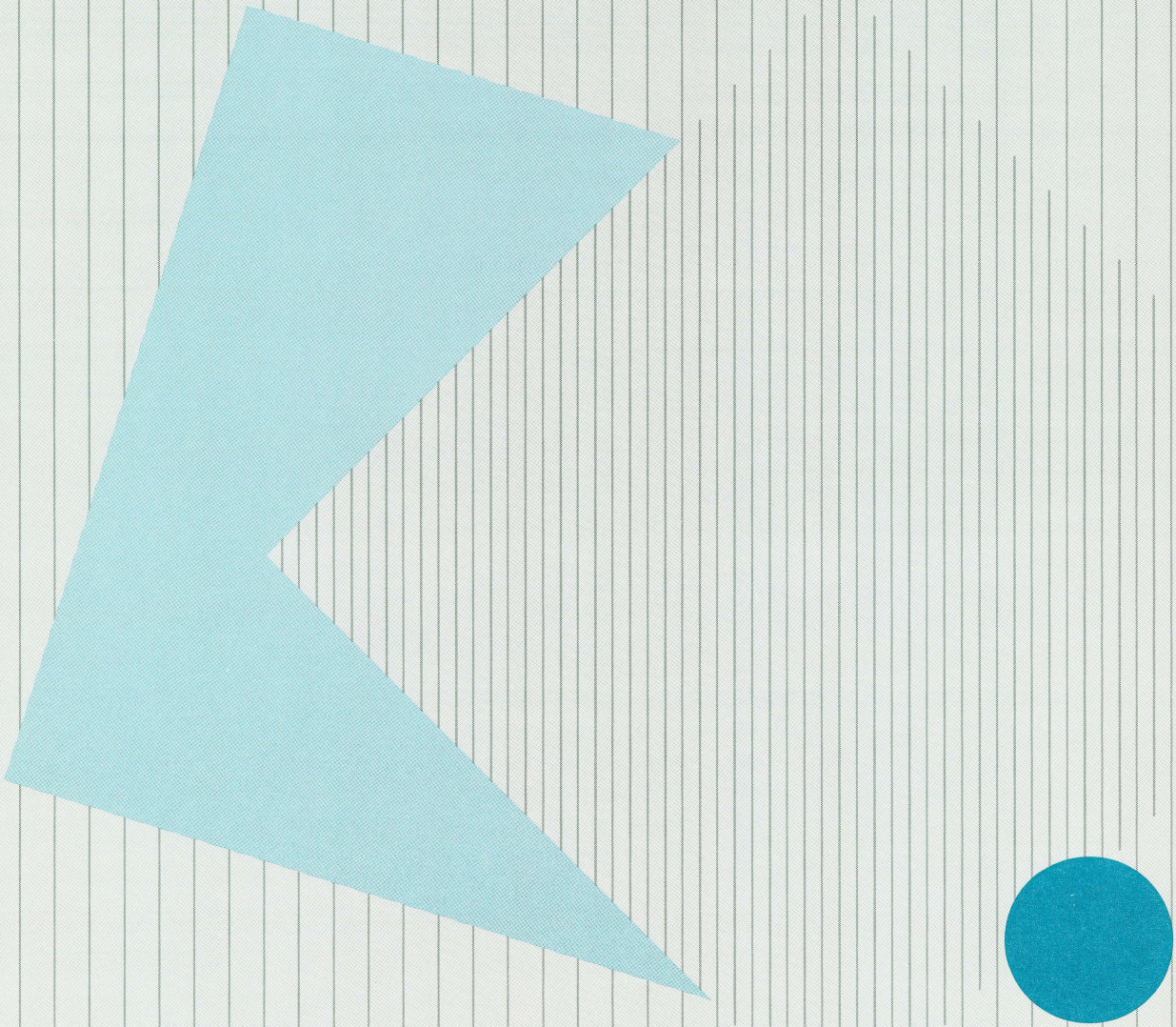
To perform the built-in test, turn the printer off. Then hold the TOF button down and turn the printer back on. Release the TOF button. To stop the test, turn the printer off again.

Repacking

If you should have to ship or store your printer in the future, the original shipping carton and its accessories make the best container. To repack the printer, follow these steps:

1. Before repacking your printer, position the typehead in the center of its range, so the cardboard protector will fit over it. Don't attempt to do this manually! You must print a half-line of text to position the typehead in the middle of the line.
2. Remove the power cable, connecting cable, and ribbon cassette. Pack them separately in envelopes or plastic bags.
3. Place the cardboard typehead protector inside the printer over the typehead.
4. Close all covers securely and tape them down.
5. Place the entire printer in its plastic bag.
6. Cradle the printer inside its original shipping carton, using the two molded polystyrene packing forms. Each form has an arrow on the face that fits against the printer. The arrow points toward the front of the machine. On the lower form, which should have remained at the bottom of the carton, the arrow is inside a square recess; on the upper form it is not. Gently lower the printer (in its plastic bag) onto the lower form. Cover it with the upper form. The two forms should meet and interlock, with the printer completely inside them. Put the ribbon cassette and power cable in the recesses of the upper form. Reseal the carton with sturdy tape.
7. Store the connecting cable and manuals in the accessory kit.

Controlling Your Printer



Controlling Your Printer

This chapter describes some of the more versatile capabilities of the Apple Dot Matrix Printer. With the technical information in this chapter, you can change the printing **format** of your printer to fit your personal style.

format: the shape and appearance of the printer's output, including page size, character width, character spacing, and line spacing, for example.

The dot matrix printing method gives you maximum flexibility in creating written records in exactly the form you want. Besides being able to format ordinary text with a full range of tabbing controls and typographical options (such as boldface printing), you can create alphabets of custom characters and even construct page-size **graphics** patterns by the placement of individual dots. Here's what your Apple Dot Matrix Printer can do for you:

graphics: designs, pictures, and patterns, composed of dots and lines.

- Print all the letters, numbers, and punctuation marks that you can type on your Apple computer keyboard or display on the video screen. In addition, it can print foreign language characters.
- Set the number of characters per inch (**character pitch**) to 9, 10, 12, 15, or 17; or allow the character pitch to be determined by the width of each character. Pitches can be mixed within a line.

character pitch: Number of characters per inch.

- Set the spacing between lines (**line feed pitch**) to increments of 1/144 inch, including the standard 6 or 8 lines per inch. Line spacing can be changed within any line.

line feed pitch: Number of lines per inch.

- Feed paper both up and down, permitting the generation of mathematical formulas and the placement of subscripts and superscripts.
- Set page length to any number of lines up to 72, to conform to standard page length, or allow the printout to be continuous, without page breaks.
- Print zeros either unslashed (0) or slashed (Ø).

- Print in boldface. The printer does this by printing each character twice, with a small shift of position.
- Underline text.
- Print in double-width "headline" style.
- Change the location of the left-hand printed margin. The location of the right-hand margin is usually determined by the program you use in your Apple computer.
- Easily fill out complex forms by using a complete set of pre-programmed tab controls—including format specifications for an entire page.
- Print symbols or foreign language characters you design yourself. You can add up to 175 8-dot by 8-dot characters, or 95 characters that are 8 dots high by 16 dots wide. You can mix these special symbols freely with the standard alphabets and print them with all the formatting features listed above.
- Print drawings, graphs, diagrams, and similar line graphics, by instructing your Apple Dot Matrix Printer to print individual dots in specific locations. The available resolution of 160 dots to the inch horizontally and 144 to the inch vertically produces sharp, unbroken lines. You can print graphics up to 8 inches wide and any height.

You can accomplish all of this through the relatively simple programming techniques described in this chapter and the next.

Control Codes

Your printer gets its information on how to behave from three sources:

- Its microprocessor, the "smarts" of the printer.
- DIP switches inside the printer case.
- Formatting commands from your computer.

standard instruction: an instruction automatically present when no superseding instruction has been given.

Each time you turn the printer on, the microprocessor is ready to follow a certain set of rules (called **standard instructions**) on how to print—unless you change the rules. Some of the standard instructions are contained within the microprocessor itself, other instructions are determined by DIP switch settings. For example, the microprocessor automatically instructs the printer to print 6 lines per vertical inch; the way the DIP switches are set at the factory causes the microprocessor to instruct the printer to print 66 lines per page, to print bidirectionally, and so on. You can override these rules in two ways.

See the section How to Set DIP Switches.

One way to change the rules is to change the DIP switch settings. Most DIP switch settings affect printer functions that you seldom need to change, such as page length. By setting the appropriate DIP switch in advance, the printer knows that every time you turn the power on, each page is a certain length—say, 66 lines.

control code: one or more characters that change the way the printer operates (as opposed to text characters, which are simply printed).

The second and most common way to override the microprocessor rules, and the DIP switch settings as well, is to send special **control codes** from your computer. You'll want to use control codes for things such as printing boldface text, underlining, indenting, and so on.

Each time your Apple Dot Matrix printer receives a control code in the information your computer is sending, it pauses imperceptibly to intepret the code and follow its instructions; then it resumes printing. There are two types of control codes: control characters and control sequences.

Control Characters

Some printer control codes consist of a single control character. A control character is a special character that is usually not displayed on your video screen and won't be printed as a character by your printer. A control character changes the nature of the character that follows it, similar to the way the SHIFT key makes lowercase letters into uppercase. For example, the L key produces the letter *L*, but CONTROL-L tells the printer to stop printing on one page and space down to the top of the next page. To learn how to produce a control character with your particular Apple computer, refer to the appropriate *Apple Dot Matrix Printer User's Manual, Part II*.

Control Sequences

Most printer control codes consist of an ESCAPE character followed by a sequence of characters. An ESCAPE character is a control character: it changes the nature of the characters that follow it. For example, you can generate an ESCAPE ! to begin boldface printing. To learn how to produce an ESCAPE character with your particular Apple computer, refer to the appropriate *Apple Dot Matrix Printer User's Manual, Part II*.

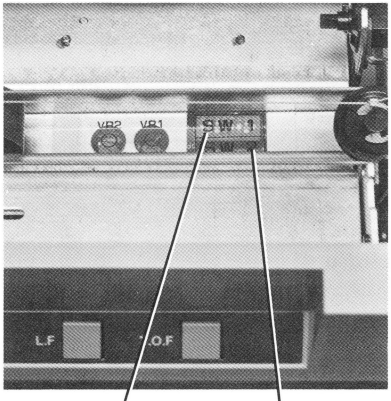
By the Way: If the first character after an ESCAPE character is not a legitimate control code identifier, both it and the ESCAPE character will be ignored by the printer.

file: an ordered collection of data with a name. Just as paper files are stored in file cabinets, computer files are normally stored on disks. Text files are simply files of text, while data files are files of data and code files are files of code (usually the programs that make it easier for you to use the computer).

Because many standard Apple programs also use the ESCAPE character for special purposes (for instance, to leave a word processor program), it is often not possible simply to type an ESCAPE into **text files**. Techniques for surmounting this difficulty are discussed in the *Apple Dot Matrix Printer User's Manual, Part II* for your computer.

How to Set DIP Switches

Figure 4-1. DIP Switches



DIP stands for Dual In-line Package, which is a technical description of the physical form of these switches. When the carrier cover is removed and the typehead is at the far left end, you can see the two DIP switch assemblies in the bottom of the machine at the right end. They are covered with a flap of clear plastic. There are two DIP switch assemblies: SW1 is toward the back of the machine and SW2 is toward the front. Each assembly contains 8 switches, numbered 1 through 8. Switch 1 is on the right end, switch 8 on the left end. In the following discussion, individual switches will be identified by the switch assembly name followed by the individual switch number—for example, SW2-5 is switch number 5 on assembly SW2.

To change a DIP switch setting, curl back the plastic cover and poke the small switch handle to the opposite position with a pointed tool. In the following discussion, a DIP switch is said to be *closed* when its handle is toward the back of the printer, with the red dot showing on the switch. It is *open* when its handle is toward the front of the machine.

Warning

Don't use a pencil or pen to change a DIP switch setting; they can leave foreign matter behind, which eventually gets into the switch. A toothpick works best.

Using Control Codes

The following paragraphs contain a discussion of each printer function that you change by resetting a DIP switch or sending a control code. In each case, the required control code is given in three forms:

- As one or more keyboard characters.
- As a sequence of decimal values for the equivalent ASCII codes.
- As a sequence of **hexadecimal** values for the equivalent ASCII codes.

You don't need to understand what these numbers mean right now, but you may need to know about them later if you write your own programs or construct format files to send control codes to your printer.

ASCII: Acronym for American Standard Code for Information Interchange; the code in which information is sent to your printer.

hexadecimal: the base-16 numbering system. Hex numbers consist of the numerals 0 through 9, and the capital letters A through F.

For a discussion of decimal and hexadecimal ASCII code equivalents, see Appendix C.

For Experts Only: Those parts of the control codes that consist of letters, numbers, punctuation marks, and other printing characters are easy to send to your printer. However, non-printing control characters such as ESCAPE and TAB sometimes require special programming techniques. The easiest way to send non-printing control characters to the printer is by including them in a normal output statement (such as a BASIC PRINT statement or a Pascal WRITE statement).

This has the disadvantage that the characters you type are not visible in your program listing. Worse yet, their presence will be detected by the Apple Dot Matrix Printer if you use it to print a copy of your source code, and they will be interpreted as printer control codes during the printout.

One technique, although it requires longer program statements, is to create such characters as ESCAPE and TAB by means of CHR or CHR$ functions. The Pascal function CHR(nn) and the BASIC function CHR$(nn) both return the ASCII character that corresponds to the decimal number nn. For example, if nn is 27, the function returns an ESCAPE character. Thus, the control code to begin underlining, ESCAPE X, can be sent to the printer by the following statements:

```
{Pascal}    WRITE (ADMP, CHR(27), 'X')
{BASIC}     PRINT #1 CHR$(27);"X"
```

Your *Apple Dot Matrix Printer User's Manual, Part II* can tell you the best way to insert control characters in a file.

The procedures for creating graphics and custom characters with the Apple Dot Matrix Printer (discussed in Chapter 5, Advanced Control Codes) often require that you send the printer ASCII characters containing specific bit patterns. The methods just described are valuable here.

Hexadecimal and Binary Numbers

binary: the base-2 numbering system used by most digital computers. Every binary number consists of a sequence of zeros and ones; the farthest right (least significant) digit has a value of 1, the next a value of 2, then 4, 8, 16, and so on.

bit: a single binary digit, either a zero or a one.

A **binary number** is a sequence of zeros or ones. Every letter, symbol, or command sent to your Apple computer is first converted into an **8-bit** binary number. For example, capital X becomes 01011000; the ESCAPE character becomes 00011011. The official list of correspondences between characters and binary numbers is called ASCII.

But 8-bit binary numbers are lengthy and difficult for most humans to read and write; so they are usually changed into 2-digit hexadecimal numbers that are easier to use. Hex numbers use the ten ordinary (decimal) numerals to represent 0 through 9, plus the capital letters A through F to represent 10 through 15. Each hex digit represents four binary digits:

Table 4-1. Hexadecimal and Binary Equivalents

Hex	Binary	Hex	Binary	Hex	Binary	Hex	Binary
0	0000	4	0100	8	1000	C	1100
1	0001	5	0101	9	1001	D	1101
2	0010	6	0110	A	1010	E	1110
3	0011	7	0111	B	1011	F	1111

Thus to convert an 8-bit binary number into a 2-digit hex number, simply replace the first 4 bits with the first hex digit and the last 4 bits with the second hex digit. Hexadecimal numbers are designated by preceding the digits with a dollar sign ($); for example,

$1A = 00011010

Character Pitch

With the Apple Dot Matrix Printer you can print characters in seven different widths, from 9 per inch to 17 per inch. Two of these options print proportionally, with the width selected to suit each character (for instance, *m* wider than *l*).

Here are the control codes:

Code	Decimal	Hex	Function
ESCAPE N	27 78	$1B $4E	Pica (10 to the inch)
ESCAPE E	27 69	$1B $45	Elite (12 to the inch)
ESCAPE p	27 112	$1B $70	Pica Proportional
ESCAPE P	27 80	$1B $50	Elite Proportional
ESCAPE n	27 110	$1B $6E	Extended (9 to the inch)
ESCAPE q	27 113	$1B $71	Condensed (15 to the inch)
ESCAPE Q	27 81	$1B $51	Ultracondensed (17 to the inch)

If you would like to see the difference between proportional and fixed-width characters, refer to appendix D, Character Specifications.

The setting of DIP switch 2-5 selects either elite proportional or pica character pitch when the power is turned on. If switch 2-5 is open, your printer will print with pica pitch (ten characters per inch). If switch 2-5 is closed, your printer will print with elite proportional pitch. If all your printing will use only one of these options, you can leave SW2-5 set (open for pica, closed for elite proportional) and will never need to send the printer a control code for character pitch. After that, you can change the character pitch at any time by sending the control code shown above to the printer.

By the Way: If you change character pitch after having set up a system of horizontal tabs (see Horizontal Tabbing in Chapter 5, Advanced Control Codes), the tabs will remain in the same absolute position and the new printing may not align with them.

Each character pitch establishes a different rate of horizontal dot spacing, as shown below:

Any of these character pitches can be printed as boldface or "headline" printing.

Code	Function	Dots per Inch (Approximate)	Dots per 8″ Line (Approximate)
ESCAPE N	Pica (10 characters per inch)	80	640
ESCAPE E	Elite (12 characters per inch)	96	768
ESCAPE p	Pica (proportional)	144	1152
ESCAPE P	Elite (proportional)	160	1280
ESCAPE n	Extended (9 characters per inch)	72	576
ESCAPE q	Condensed (15 per inch)	120	960
ESCAPE Q	Ultracondensed (17 per inch)	136	1088

Elite Character Spacing

When your Apple Dot Matrix Printer is printing in Elite Proportional character pitch (selected by the ESCAPE P control code), you can also specify how much space will be left between each character. The normal (standard) state is one dot-width between characters. With any one of the following ESCAPE codes you can increase the inter-character spacing up to six dots:

Code	Decimal	Hex	Function
ESCAPE 1	27 49	$1B $31	1 dot between characters
ESCAPE 2	27 50	$1B $32	2 dots between characters
ESCAPE 3	27 51	$1B $33	3 dots between characters
ESCAPE 4	27 52	$1B $34	4 dots between characters
ESCAPE 5	27 53	$1B $35	5 dots between characters
ESCAPE 6	27 54	$1B $36	6 dots between characters

The control code must be placed between the two characters to be spaced. To space all of the characters on one entire line, you must place at least one of these control codes after each character. Two or more of these control codes between two characters will accumulate dot-widths, and space the two characters farther apart, up to 128 dot-widths total.

Remember: These control codes work only in Proportional Elite character pitch. If you wish to use them with any other character pitch, you'll have to precede each character-spacing control code with ESCAPE P and follow it with the appropriate control code to return to the pitch you are using.

Character-spacing control codes are used primarily in programs that print text with both left and right margins straight (as is text in a newspaper) by distributing the extra space in each line among the text characters.

Character Repetition

You can send a single control code to the Apple Dot Matrix Printer that will cause it to print the same character up to 999 times. The entire control code is 5 characters long:

Code	Decimal	Hex	Function
ESCAPE R nnn c	27 82 nnn c	$1B $52 nnn c	Print nnn repetitions of character c

For example, the following control code will cause 24 asterisks to be printed one after the other:

ESCAPE RØ24*

The number nnn in this control code must always be 3 digits long; however, leading zeros may be replaced by spaces.

leading zeros: zeros that occur at the beginning of a number; deleted by most programs.

line feed: a vertical motion of the platen, moving the paper up or down one print line.

By the Way: If the number nnn is so large that the repeated characters run beyond the end of the line, DIP switch 1-6 must be closed to produce a line feed; otherwise the excess characters will print over other characters on the same line (see Buffer Overflow Action, page 52).

Slashed and Unslashed Zeros

Some people prefer to print the numeral zero with a slash through it (Ø) to distinguish it from the capital letter O. The Apple Dot Matrix Printer can print zeros either way. DIP switch 2-1 controls the standard instruction: if SW2-1 is open, printed zeros will be unslashed (0), if SW2-1 is closed, printed zeros will be slashed (Ø). You can also use the following control codes to change the way that zeros are printed:

Code	Decimal	Hex	Function
ESCAPE Z	27 90	$1B $5A	Print unslashed zeros
CONTROL-JQ	10 81	$ØA $51	
ESCAPE D	27 68	$1B $44	Print slashed zeros
CONTROL-JQ	10 81	$ØA $51	

Foreign Characters

font: a complete set of type in one size and style of characters.

Your Apple Dot Matrix Printer has seven different language fonts to aid in printing text in German, French, Italian, Swedish, Spanish, and British English, as well as American English. You can choose any one of these character groups to substitute for these ten "American" symbols:

@ [\ ] ‘ { | } ~

The table below illustrates the characters in each foreign language font.

Table 4-2. Alternate Language Characters

If you would like to see exactly how the foreign language characters are printed in both fixed-width and proportional fonts, refer to appendix D, Character Specifications.

Language	DIP Switches 1–3	1–2	1–1	Command Sequence	Alternate Character Set
American	0	0	0	ESC Z ' R	# @ [\ ] ' { | } ~
Italian	0	0	0	ESC Z ' R ESC D ! R	£ § ° ç é ' à ò è ì
American	0	1	0	ESC Z ' R ESC D " R	# @ [\ ] ' { | } ~
British	0	1	1	ESC Z ' R ESC D # R	£ @ [\ ] ' { | } ~
German	1	0	0	ESC Z ' R ESC D $ R	# § Ä Ö Ü ' ä ö ü ß
Swedish	1	0	1	ESC Z ' R ESC D % R	# @ Ä Ö Å ' ä ö å ~
French	1	1	0	ESC Z ' R ESC D & R	£ à ° ç § ' é ù è ¨
Spanish	1	1	1	ESC D ' R	£ § / Ñ ¿ ' ° ñ ç ~

In Table 4-3, the top and bottom lines show the "American" characters. The other lines give the alternate character groups that can be substituted for these characters by using the control codes shown. The three DIP switches SW1-1, SW1-2, and SW1-3, specify the standard character group. The table below shows what control codes and combinations of positions of the three DIP switches provide the alternate character groups available. Note that there are two DIP switch settings that produce "American" symbols; you can use either one.

Table 4-3. Control Codes and DIP Switch Settings for Alternate Language Characters

Hexadecimal	23	40	5B	5C	5D	60	7B	7C	7D	73
English (USA)	#	@	[	\	]	`	{	|	}	~
English (UK)	£	@	[	\	]	`	{	|	}	~
German	#	§	Ä	Ö	Ü	`	ä	ö	ü	ß
French	£	ä	°	ç	§	`	é	ù	è	¨
Italian	£	§	°	ç	é	ù	à	ò	è	ì
Swedish	#	@	Ä	Ö	Å	`	ä	ö	å	~
Spanish	£	§	/	Ñ	¿	`	°	ñ	ç	~
English	#	@	[	\	]	`	{	|	}	~

You can choose only one complete alternate group at a time—only one line from the previous table. Once you have chosen an alternate group, the ten special symbols will always print the alternate characters of that group until you choose a different font.

By the Way: Using any of the control codes shown above (except the last) will have the side effect of closing DIP switch 1-6 (see Buffer Overflow Action, in Chapter 5). If this is not what you want, follow the control code with an ESCAPE Z(R.

You should set DIP switches 1-1, 1-2, and 1-3 to the character group you will normally use; this will cause that group to be chosen every time you turn on your Apple Dot Matrix Printer. When you wish to switch to another group while printing text, you can use the control codes in the previous table. For example, the following sequence will print a British pound-sign even though your American character group has been selected by DIP switch settings:

```
ESCAPE Z$R ESCAPE D#R          #          ESCAPE Z'R
```

Switches from American to British

Prints British pound sign

Switches back from British to American

Backspacing

You can print any two characters on top of one another by sending the printer a backspace control code between them:

Code	Decimal	Hex	Function
CONTROL-H c	8 c	$08 c	Backspace one character and print the character c

This is handy for printing certain symbols, such as the *plus-or-minus* sign or the *cents* sign (c with a vertical bar through it). You can use only one CONTROL-H at a time. If you wish to backspace repeatedly (for example, to print a line with slashes through every character) you must follow each character with CONTROL-H plus the overprinted symbol.

By the Way: Many editor programs have their own responses to CONTROL-H, which may prevent you from entering it directly into a text file. For more information on entering such "illegal" commands, see your *Apple Dot Matrix Printer User's Manual, Part II*.

Underlining

The Apple Dot Matrix Printer recognizes a pair of control codes to start and end sections of underlined text:

Code	Decimal	Hex	Function
ESCAPE X	27 88	$1B $58	Start underlining text
ESCAPE Y	27 89	$1B $59	Stop underlining text

Your printer underlines characters by always printing the bottom dot in the typehead. Underlining does not require double striking of characters, nor does it affect printing speed. When an ESCAPE X control code is in force, all text is underlined, including spaces and punctuation. You can underline with boldface printing (see below), and with all character pitches, including headlines (see Headline Type).

Boldface Printing

The Apple Dot Matrix Printer creates boldface characters by printing each character twice with a small shift of position. There are two control codes for this function, one to start boldface printing and the other to end it.

Code	Decimal	Hex	Function
ESCAPE !	27 33	$1B $21	Start boldface printing
ESCAPE "	27 34	$1B $22	End boldface printing

Boldface printing will darken all characters in all character pitches, including headlines. If you use it with underlining, it will increase the darkness of the underline as well as the character.

Headline Type

Your printer has the ability to print double width boldface characters, which make excellent headlines. To start or end double-width printing, use the following control codes:

Code	Decimal	Hex	Function
CONTROL-N	14	$0E	Begin headline mode
CONTROL-O	15	$0F	End headline mode

You can print headlines in conjunction with all of the character pitch options listed previously; the dot spacing remains the same, but you get half as many characters per inch. Thus you can select from seven giant typefaces, ranging from 4.5 to the inch (extended) to 8.5 to the inch (ultracondensed).

Direction of Typehead Motion

You can print lines either strictly from left to right (like a typewriter) or back and forth. Since printing in both directions is slightly faster, you will usually want to use bidirectional printing. When printing certain patterns with graphics control codes, however, you may prefer one-direction printing because it improves the quality. If SW2-8 is open, your printer goes automatically to bidirectional printing, if SW2-8 is closed, your printer will print from left to right only.

To control the printing direction, use the following control codes:

Code	Decimal	Hex	Function
ESCAPE >	27 62	$1B $3E	Left-to-right printing only
ESCAPE <	27 60	$1B $3C	Bidirectional printing

Each of these control codes remains in force until cancelled by the other.

Automatic Line Feed

Many standard programs that create text files automatically add a line feed after every carriage return that they send. Others offer this feature as an option.

If the program that prepares text for your printer sends only a carriage return character to start a new line, you can cause the printer to add the line feed by itself. If SW1-8 is closed, a line feed will be added after every carriage return, if SW1-8 is open, no line feed will be added.

If the program already adds a line feed, you can add an automatic line feed to produce double-spaced printing.

You can use the following control codes to control automatic line feeds too:

Code	Decimal	Hex	Function
ESCAPE D	27 68	$1B $44	Add automatic line feed
CONTROL-JR	138 82	$8A $52	
ESCAPE Z	27 90	$1B $5A	No line feed added
CONTROL-JR	138 82	$8A $52	

Note: The CONTROL-J in these two codes must be a **high ASCII** CONTROL-J (decimal 138, hex $8A). DIP SW2-6 must be open in order for it to be recognized as a high ASCII character (see Data Byte Length, in Chapter 5).

Line Feed Pitch

When the printer is turned on, it selects by default a vertical line spacing of 6 lines to the inch. At any time you can change this to 8 lines per inch with a single control code:

Code	Decimal	Hex	Function
ESCAPE A	27 65	$1B $41	6 lines per inch
ESCAPE B	27 66	$1B $42	8 lines per inch

In addition to these two pitches, however, you can select any line spacing, in increments of 1/144 of an inch, from 1/144 up to 99/144 of an inch:

Code	Decimal	Hex	Function
ESCAPE T nn	27 84 nn	$1B $54 nn	Distance between lines to be nn/144 inch (nn = 01 to 99)

These three codes affect subsequent end-of-line actions; they do not affect the placement of the line in which they are included. They remain in effect until you set a new line-feed pitch, or until you turn the power off.

The vertical distance between dots is approximately 1/72 of an inch, so this control code permits line feeding to be as little as one-half of a dot dimension. Although the control code ESCAPE T00 is ignored, the control code ESCAPE T01 can be used to feed the paper an imperceptible amount. This is handy if you want to overprint one line of text with another.

The control code ESCAPE T18 establishes a line feed pitch of eight to the inch (144 divided by 18 is 8), and ESCAPE T24, one of six to the inch (144 divided by 24 is 6).

By the Way: If you change the line feed pitch, it will change the number of inches of paper fed by each press of the TOF button.

Line Feed Direction

Paper can feed backward or forward through the printer, in response to these control codes:

Code	Decimal	Hex	Function
ESCAPE f	27 102	$1B $66	Forward (normal) line feeding
ESCAPE r	27 114	$1B $72	Reverse line feeding

The printer will continue to feed in the direction last selected until it receives the opposite control code. Every time you turn the power on, forward line feeding is automatically selected.

Multiple Line Feeding

You can issue a single control code to make your Apple Dot Matrix Printer feed as many as 15 blank lines at once. This control code will work in both forward and reverse line feed directions, and with any line feed pitch:

Code	Decimal	Hex	Function
CONTROL-_ n	$1F n	IF n	Feed n lines of blank paper n = 1, 2, 3, 4, 5, 6, 7, 8, 9, :, ;, <, =, >, ?

Note that CONTROL-_ is CONTROL-underline.

The single ASCII character n must be one of the numerals 1 through 9 for 1 to 9 lines. For 10 to 15 lines, use the following characters:

Number of Lines	Use
10	:
11	;
12	<
13	=
14	>
15	?

Left Margin Setting

When you turn the power on, your Apple Dot Matrix Printer starts each line of print as far left as the typehead can travel. This is called *position 0* (not 1), and corresponds physically with the red ring engraved at the left end of the roller shaft. However, you can change the left print margin at any time by sending the printer this 5-character control code:

Code	Decimal	Hex	Function
ESCAPE L nnn	27 76 nnn	$1B $4C nnn	Set left margin to position nnn

For example, the following control code advances the left margin to the 36th character position:

ESCAPE L035

Similarly, the control code ESCAPE L000 moves the left margin back to the far left end. The left margin remains at the selected setting until another ESCAPE L control code is sent to the printer, or until the power is turned off.

Although the number nnn must always contain 3 digits, you can replace leading zeros with spaces if desired.

Note that the position of the margin, which is measured by counting characters, depends on the character pitch in force at the time the margin control code is sent. If you subsequently change the character pitch, the margin will not move to accommodate the change.

By the Way: If Elite Proportional pitch is in force, the margin will be measured at ten character positions to the inch; with Pica Proportional it will be measured at nine to the inch.

If you set horizontal tab positions in your Apple Dot Matrix Printer, as described under Horizontal Tabbing Commands, in Chapter 5, they will be measured from the left margin currently in force. Changing the left margin later will not move the tab positions to correspond to the new margin.

Remember: When you combine margin settings with tab settings, the margin positions start with 0, while the tab positions start with 1. Thus, for example, a margin setting of 5 will start each line at the same place as a tab setting of 6.

Page Length

The TOF (Top of Form) button on the Apple Dot Matrix Printer control panel advances the paper to the top of the next page. The maximum distance advanced can be either 66 or 72 lines. If SW1-4 is open, there are 66 lines per page, if SW1-4 is closed, there are 72 lines per page.

You can decrease the number of lines per page, set by DIP switch 1-4, by sending the printer a vertical tabbing control code. This is explained under Vertical Tabbing in Chapter 5.

Note that the distance the paper advances is based on the number of printed lines; if you change the line pitch, the page length changes accordingly. Thus, a page length of 66 lines turns out to be 11 inches only if the line pitch is set to six lines per inch.

Form Feeding

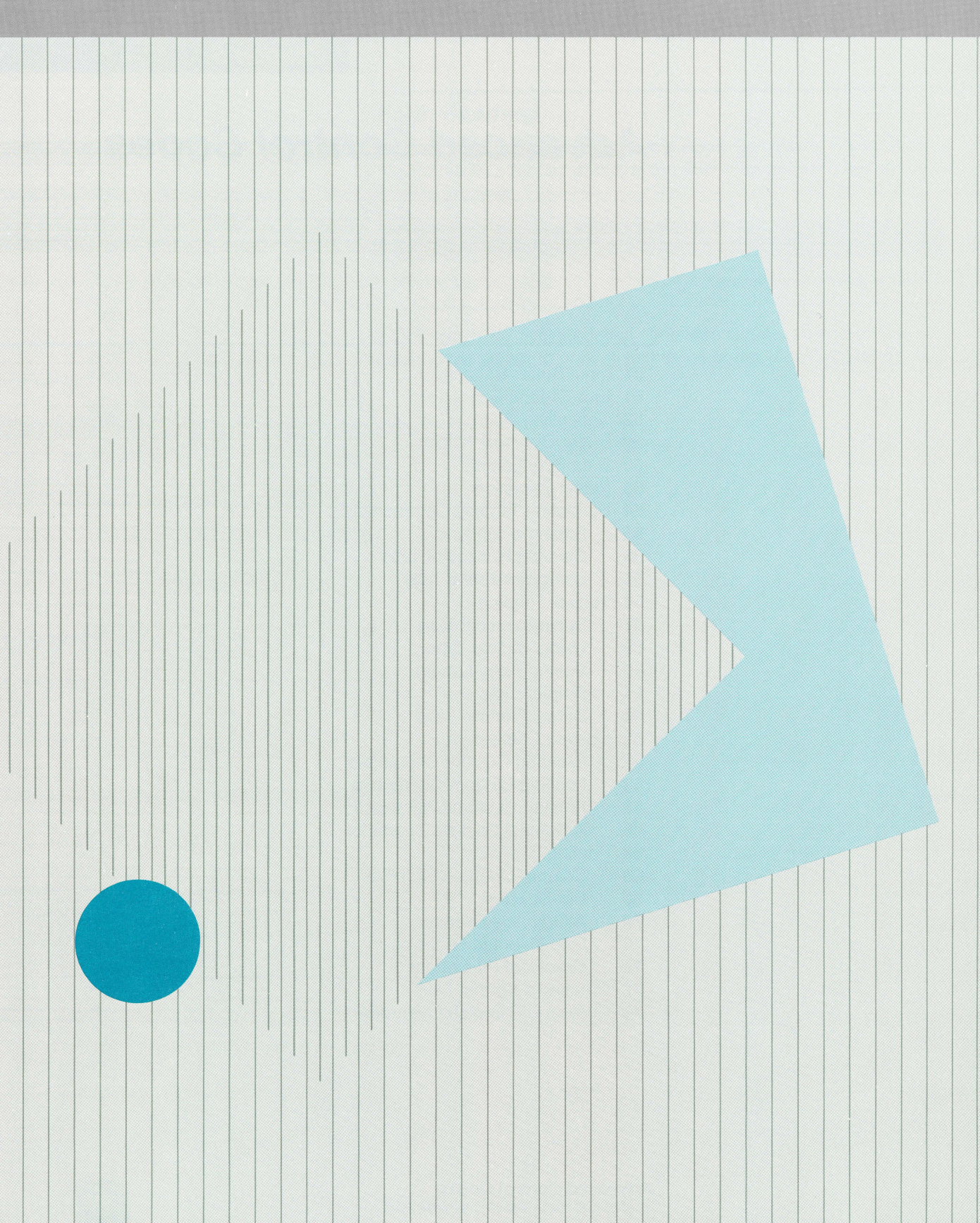
You can send a control code to your Apple Dot Matrix Printer that has the same effect as pressing the TOF (Top of Form) button on its control panel:

Code	Decimal	Hex	Function
CONTROL-L	12	$0C	Feeds paper to next top of form

If DIP switch 1-7 is closed, this code also signals an end-of-line, causing the printer to print all text in the buffer (see Chapter 5).

Chapter 5

Advanced Control Codes



Advanced Control Codes

Once you have become familiar with the control codes described in the preceding chapter, read this chapter to learn how to use even more sophisticated control codes.

Input Buffer Capacity

buffer: a memory area that holds information temporarily, until it can be processed.

end-of-line character: a character telling the printer that the preceding text constitutes a full line and may be printed.

The text sent to your printer is stored in a buffer, and isn't printed until the **buffer** is full, or until the printer receives an **end-of-line character** (described in the next section). If SW2-2 is closed, the buffer empties the instant it receives an end-of-line character or as soon as one full line of text has been assembled. If SW2-2 is open, the buffer empties only when it has been completely filled with characters or it receives an end-of-line character. The printer prints the contents of the buffer straight through, without pausing.

The buffer can accept a maximum of about 3000 characters.

The time it takes to print a given amount of text is slightly longer when the buffer capacity is restricted to a single line, because the computer stops more often to empty the buffer. However, this option is desirable when you are running certain interactive programs. For example, if you want to be able to halt your program whenever it prints certain data, you should close switch 2-2 so that program execution will not run far ahead of what is being printed.

End-of-Line Character

The end-of-line character is normally a carriage return (CR). However, if you like, you can specify that carriage return, line feed (LF), vertical tab (VT), form feed (FF), and the multiple line feed control code (control-_) all be recognized as the end-of-line character. If SW1-7 is open, carriage return will be the only end-of-line character. If SW1-7 is closed, carriage return, line feed, vertical tab, form feed, and the multiple line feed control code will all be interpreted as end-of-line characters.

You can also use the following control codes to change the end-of-line character:

Code	Decimal	Hex	Function
ESCAPE ZHR	27 90 72 82	$1B $5A $48 $52	CR only
ESCAPE DHR	27 68 72 82	$1B $44 $48 $52	CR, LF, VT, FF, CONTROL-_

Cancelling Text

If you have text in the buffer—in other words, text that has been sent to your Apple Dot Matrix Printer but not yet printed—you can erase it from the printer's input buffer with the following control code:

Code	Decimal	Hex	Function
CONTROL-X	24	$18	Cancel all unprinted text

CONTROL-X does not cancel control codes; it cancels only ordinary text.

Buffer Overflow Action

When the buffer becomes full, it automatically prints its contents. At this time the printer may or may not feed a line of paper. If SW1-6 is closed, a line feed will be generated when the buffer overflows. If SW1-6 is open, a line feed will not be generated.

By setting the buffer capacity to a single line (see Input Buffer Capacity) and setting this switch to add a line feed, you can have the printer format a continuous stream of text into lines without sending it any end-of-line characters.

You can also use the following control codes to change the buffer overflow action:

Code	Decimal	Hex	Function
ESCAPE Z(R	27 90 40 82	$1B $5A $28 $52	No line feed added
ESCAPE D(R	27 68 40 82	$1B $44 $28 $52	Line feed added

Data Byte Length

bit: A single binary digit, consisting of either a zero or a one.

byte: a binary number composed of eight bits.

Your Apple computer sends text to the printer in **eight-bit data bytes**.

Normal ASCII characters use only the lower seven bits, so usually the highest value bit is ignored. Thus, it usually does not matter whether or not your Apple Dot Matrix Printer processes the eighth (highest value) bit of data it receives. However, certain control codes require characters in which the eighth bit is set, so a control is provided to allow you to choose whether or not to recognize it. If SW2-6 is open, the eighth bit is recognized, if SW2-6 is closed, the eighth bit is ignored.

For most uses of your Apple Dot Matrix Printer, switch 2-6 should be kept closed, so that the printer will accept text even when the 8th bit is set. However, if you create graphics or custom characters to be printed by your Apple Dot Matrix Printer you may need to open switch 2-6, as explained in Creating Custom Characters.

You can also use the following control codes to change the data byte length:

Code	Decimal	Hex	Function
ESCAPE D	27 68	$1B $44	Ignore 8th bit
CONTROL-J2	10 50	$0A $32	
ESCAPE Z	27 90	$1B $5A	Recognize 8th bit
CONTROL-J2	10 50	$0A $32	

Select Condition

selected: your printer responds to commands from the computer, ignoring the LF and TOF buttons.

deselected: your printer responds to the LF and TOF buttons, ignoring the computer.

When you turn your printer on, the printer is in either one of two states—selected or deselected—depending on DIP switch 2-7. When **selected**, your printer responds to commands from your Apple computer, and when **deselected**, it responds to the LF and TOF buttons. You can change it from one condition to the other either by pressing the SEL button on the control panel or by sending it a control code. If SW2-7 is open, your printer is deselected when you turn it on, and if SW2-7 is closed your printer is selected. It is usually most convenient to leave switch 2-7 closed, so that the printer responds to commands from the computer.

Use these two control codes to select or deselect the printer:

Code	Decimal	Hex	Function
CONTROL-Q	17	$11	Select printer
CONTROL-S	19	$13	Deselect printer

If you place these codes at the beginning and end of each file you want printed, the printer will be selected only while it's actually receiving data. That way, the printer will consume less power while it isn't printing, and the LF and TOF buttons will work. To do this, place a CONTROL-Q as the first character of the file, and CONTROL-S as the next-to-last character, followed by a carriage return.

Sometimes you may want to disable the printer's ability to recognize select and deselect control codes. For example, if CONTROL-Q and CONTROL-S were used to control some other function within a program, you wouldn't want the printer to be affected, too. The setting of DIP switch 1-5 determines whether or not the printer responds to these control codes. If SW1-5 is open, your printer recognizes select and deselect codes normally. If SW1-5 is closed, the control codes will be ignored.

You can also use the following two control codes to determine whether CONTROL-Q and CONTROL-S will be recognized:

Code	Decimal	Hex	Function
ESCAPE DRR	27 68 82 82	$1B $44 $52 $52	Ignore select codes
ESCAPE ZRR	27 90 82 82	$1B $5A $52 $52	Recognize select codes

Horizontal Tabbing Commands

TAB: a character that instructs the printer to begin printing at a preset location (called a tab stop).

You can set up to 32 horizontal tab positions for your Apple Dot Matrix Printer. Each tab character (**TAB** or CONTROL-I) sent to the printer advances the typehead to the next tab position. However, the printer will ignore tabs if no tab positions have been set or if the typehead is at or beyond the last tab position. Control codes can be used to clear tab positions individually or all at once. Turning off the printer power clears all tab positions.

Here are the codes you use:

Code	Decimal	Hex	Function
ESCAPE (a,b,—n.	27 40 a,b,—n.	$1B $28 a,b,—n.	Set horizontal tab line
ESCAPE) a,b,—n.	27 41 a,b,—n.	$1B $29 a,b,—n.	Clear selected tabs
ESCAPE 0	27 48	$1B $30	Clear all tabs
CONTROL-I	9	$09	Go to next tab

Setting a Tab Line

To set a line of horizontal tab positions, you send an ESCAPE character, a left parenthesis, and a sequence of numbers. The numbers are all 3-digit ASCII numerals (normal keyboard characters), and are sent to the printer in ascending numerical order. Separate the numbers by commas, and end them with a period. The numbers specify the character positions, starting from the left margin, where tabs will be set. The left margin is position 1. For example,

ESCAPE(005,023,067.

sets tabs at character positions 5, 23, and 67. You can replace leading zeros with spaces.

You specify tab positions relative to the current position of the left margin. If you change the left margin after setting the tabs, the tab positions will not change.

The character positions that determine tab positions are based on the character pitch in force at the time you enter the horizontal tab line. If you later change the character pitch, the tabs will remain in the same absolute locations and will no longer correspond to actual character positions. If tabs are set while proportional pitch is in force, they will be based on a pitch of 10 characters per inch.

You cannot set individual tab positions; you must enter an entire tab line. When you enter a line of tab settings, all previous tabs are cleared.

By the Way: If there is an error anywhere in the tab setting control code—bad syntax, tab numbers not in increasing numerical order, a tab number beyond the end of the line, or more than 32 tab numbers—the whole entry will be ignored and all previous tabs will be cleared.

Clearing Horizontal Tabs

Although you must set horizontal tabs one entire line at a time, you can clear them individually. The clearing command is identical to the setting command, except that a right parenthesis follows the ESCAPE character, instead of a left parenthesis. An ESCAPE character followed by a zero will clear all tabs. If you attempt to clear a tab that is not set, you won't affect the rest of the command, but bad syntax causes the whole command to be ignored.

Using Horizontal Tabs

To move the printhead to the next tab position, send a CONTROL-I. This character is sometimes called the ASCII *HT* command. A string of several CONTROL-I characters will jump over tabs to the position desired, as with a typewriter.

Many text editor programs have their own horizontal tabbing facilities, which use a TAB key or CONTROL-I. If you are using one of these programs, you will not be able to enter CONTROL-I directly into your file. See your *Apple Dot Matrix Printer User's Manual, Part II* for further information on entering such "illegal" characters.

Vertical Tabbing

The Apple Dot Matrix Printer's microprocessor contains a memory called an **Electronic Vertical Form Unit** (or EVFU) that keeps track of up to 72 vertical tab positions on a page. To set vertical tabs, send the printer control codes that specify the top and bottom of the page, and control codes foreach line in between. You can set up to 5 tabs per line.

After you set the vertical tabs, refer to the tab positions by sending vertical tab control codes to the printer. As usual, a form feed control code causes an advance to the next top of form.

This powerful facility allows you to create up to 5 separate vertical tabbing patterns simultaneously, thus permitting up to 5 separate forms to be run without resetting the tabs for each form.

Setting Vertical Tabs

To set a structure of vertical tabs, send a top of form (TOF) control code, control codes for vertical tab positions, a bottom of form (BOF) control code, and a control code for the next TOF. The distance between the two TOF settings corresponds to the page length. The following table shows the three control codes for setting the TOF and BOF:

Code	Decimal	Hexadecimal	Function
CONTROL-] A@	29 65 64	$1D $41 $40	Set Starting TOF
C@	67 64	$43 $40	Set Bottom Of Form
A@ CONTROL-^	65 64 30	$41 $40 $1E	Set TOF—Next form

Between the first two control codes, you can enter up to 71 two-character codes to set vertical tabs for all lines between the TOF and BOF. Each such code identifies the vertical tabs associated with each line, starting from the line marked by the TOF (which need not be the physical top of the paper). The tabs are labeled B, C, D, E, and F. Any line can have any combination of these 5 tabs. The following table lists all the possible codes:

Code	Decimal	Hex	Function
@@	64 64	$40 $40	Set no tabs
B@	66 64	$42 $40	Set tab B
D@	68 64	$44 $40	Set tab C
H@	72 64	$48 $40	Set tab D
P@	80 64	$50 $40	Set tab E
`@	96 64	$60 $40	Set tab F
F@	70 64	$46 $40	Set tabs B, C
J@	74 64	$4A $40	Set tabs B, D
R@	82 64	$52 $40	Set tabs B, E
b@	98 64	$62 $40	Set tabs B, F
L@	76 64	$4C $40	Set tabs C, D
T@	84 64	$54 $40	Set tabs C, E
d@	100 64	$64 $40	Set tabs C, F
X@	88 64	$58 $40	Set tabs D, E
h@	104 64	$68 $40	Set tabs D, F
p@	112 64	$70 $40	Set tabs E, F

Code	Decimal	Hex	Function
N@	78 64	$4E $40	Set tabs B, C, D
V@	86 64	$56 $40	Set tabs B, C, E
f@	102 64	$66 $40	Set tabs B, C, F
Z@	90 64	$5A $40	Set tabs B, D, E
j@	106 64	$6A $40	Set tabs B, D, F
r@	114 64	$72 $40	Set tabs B, E, F
\@	92 64	$5C $40	Set tabs C, D, E
l@	108 64	$6C $40	Set tabs C, D, F
t@	116 64	$74 $40	Set tabs C, E, F
x@	120 64	$78 $40	Set tabs D, E, F
^@	94 64	$5E $40	Set tabs B, C, D, E
n@	110 64	$6E $40	Set tabs B, C, D, F
v@	118 64	$76 $40	Set tabs B, C, E, F
z@	122 64	$7A $40	Set tabs B, D, E, F
|@	124 64	$7C $40	Set tabs C, D, E, F
~@	126 64	$7E $40	Set all tabs

Between the BOF control code and the TOF control code for the next page, you must enter enough two-character "no tab" codes (@@) to fill out the length of paper from one TOF to the next. For example, suppose you are printing a 36-line form on fanfold paper with pages 66 lines long. You send control codes to form a vertical tab structure such as the following:

```
Line 1: Starting TOF code
Line 2: \
--- >34 tab setting or "no tab" codes
Line 35: /
Line 36: BOF code
Line 37: \
--- >30 "no tab" codes
Line 66. /
Line 67: Next TOF code.
```

Send the 136 characters required to create this structure to the printer in an uninterrupted stream, without spaces or carriage returns (although you can end the whole sequence with a carriage return). For this reason, setting them up in a format file (see Creating a Format File) or generating them by executing a program is safer than trying to enter them directly from the keyboard.

Using Vertical Tabs

Once you have sent a vertical tab structure to your Apple Dot Matrix Printer, you can use it as long as you don't turn the power off. To use the tab positions you have set, send the following control codes to the printer:

Code	Decimal	Hex	Function
CONTROL-_ B	31 66	$1F $42	Drop to next line with tab B
CONTROL-_ C	31 67	$1F $43	Drop to next line with tab C
CONTROL-_ D	31 68	$1F $44	Drop to next line with tab D
CONTROL-_ E	31 69	$1F $45	Drop to next line with tab E
CONTROL-_ F	31 70	$1F $46	Drop to next line with tab F
CONTROL-_ A	31 65	$1F $41	Drop to next BOF or TOF
CONTROL-L	12	$0C	Drop to next TOF

Note that CONTROL-_ is CONTROL-underline.

By the Way: If you reverse the line feed direction (see Chapter 4, Controlling Your Printer) the vertical tab structure will still function, but it will be inverted with respect to the physical paper. In other words, a tab B on the first line will be the second tab position from the right on the last line.

Setting Page Length

Even if you do not use the vertical tab commands, you may wish to use the vertical tab control codes to set the maximum length of each printed page. Text fills the page until it reaches the line identified as the BOF. After the BOF line is completed, the printer advances paper to the next TOF line before printing any more.

For example, suppose you wish to print out a file of continuous text in the form of 60-line pages printed on fanfold paper that is 66 lines long. You enter the following vertical tab control codes:

CONTROL-] A@ <58 @@ codes> C@ <6 @@ codes> A@ CONTROL-^

(The spaces in the previous line have been inserted for clarity; you shouldn't put spaces in the actual control code.)

As you load paper into the printer, set the top of the page to 3 lines below the perforations between pages. Your text will be printed in 60-line blocks, each block centered vertically on the 66-line page.

Here is an example that illustrates the use of vertical tabs. Suppose you have a form 12 lines long with 10 lines of text. Let's say you wish to set the following tabs:

Line 1:	TOF
Line 2:	No tabs
Line 3:	Tab B
Line 4:	Tab C
Line 5:	No tabs
Line 6:	Tabs B and D
Line 7:	Tabs C and D
Line 8:	No tabs
Line 9:	Tab E
Line 10:	BOF
Line 11:	
Line 12:	
Line 13:	TOF, next form.

To send these vertical tab positions to your Apple Dot Matrix Printer, you use the following control codes:

CONTROL-] A@ @@ B@ D@ @@ J@ L@ @@ P@ C@ @@ @@ A@ CONTROL-^

(The spaces in the previous line have been inserted for clarity; you shouldn't put spaces in the actual control code.)

Then, if you send a CONTROL-_ followed by a tab letter, the paper advances to the next line for which that tab has been set. From Line 1, for instance, the control code CONTROL-_ C causes an advance to Line 4; two CONTROL-_ B control codes in succession cause an advance to Line 6; and so on. A CONTROL-_ A control code advances paper to the next BOF or TOF, whichever comes first. A CONTROL-L advances paper to the next TOF.

Helpful Hints

When using vertical tabbing control codes, you will find it helpful to remember these tips.

Vertical tabbing works by counting lines. This means that the distance in inches between tab positions depends on the line feed pitch. If you change the pitch after the tabs have been set, the whole format expands or contracts accordingly. Since you can select any pitch from 1/144 to 99/144 of an inch in increments of 1/144 of an inch, you can tailor your printing to virtually any physical page format. If necessary, you can change line feed pitches within a form to place the printing exactly where you want it.

The maximum number of lines for which you can store vertical tab information is either 66 or 72, depending on the setting of DIP switch 1-4. If you attempt to set more lines than this, the extra commands will be ignored.

Be careful how you set the TOF and BOF. If you don't set them correctly, your vertical tabs will not work.

An illegal tab command (such as an attempt to go to a tab not present in the rest of the structure) advances the paper to the BOF line. You cannot go from a tab position within one form to a tab position within the next; you must go to the next TOF first.

Default Vertical Tabs

When you turn your Apple Dot Matrix Printer on, the print length (TOF to BOF) and page length (TOF to TOF) are both either 66 or 72 lines, depending on the setting of DIP switch 1-4. Each page contains a B tab every 6 lines, and no others.

Custom Characters

Tired of using ordinary letters and numbers? The Apple Dot Matrix Printer lets you design your own alphabet! It contains a special memory that is capable of holding up to 175 custom-designed characters. Control codes allow you to switch the entire Apple character set from "normal" characters to new ones you have designed, and back again. You can easily mix custom symbols with ordinary text. Your custom-designed characters act just like the others: they expand and contract with changes in character pitch; you can underline them, print them in boldface, and expand them into headlines.

To use this capability, you need to understand how to create new characters, how to load them into your Apple Dot Matrix Printer's memory, and how to fetch them from memory and print them.

We will discuss each of these phases separately, and then illustrate them with a specific example.

Creating Custom Characters

Briefly, the dot-matrix typehead contains a vertical array of nine dot strikers (called **wires**), spaced 1/72 of an inch apart. "Normal" characters are printed by striking up to seven patterns in a row, with the eighth pattern left blank to separate the characters. The fixed-width alphabets (pica, extended, condensed, and so on) print all characters eight dots wide; the proportional alphabets vary the number of dots per character to fit the width of each letter or symbol. The difference between one character pitch and another is not in the number of dots per character, but in their horizontal spacing. Thus an ultracondensed *A* is printed with the same dot pattern as a pica *A*, but with 136 dots to the horizontal inch instead of 80.

Custom characters are able to go beyond "normal" character limits, for they can be up to 16 dots wide. The width is defined for each individual character, and is either proportional or fixed. A custom character is assigned to any keyboard position that normally prints something, including uppercase and lowercase characters.

The dot-striking wires in the typehead are numbered from 1 at the top to 9 at the bottom. When designing a custom character you can use either the top eight wires (1 through 8) or the bottom eight wires (2 through 9). The "normal" alphabet uses wires 1 through 7 for capital letters and 3 through 7 for lowercase, with 8 and 9 being reserved for descenders, such as the tails on lowercase *y, g,* and *p*. Wire 9 is used for underlining as well. Thus the "Baseline" for normal printing is wire 7.

If you design each new custom character on square-ruled paper first, you can check its proportions and its vertical placement with respect to other characters. This also makes it easy to translate the dot pattern into a series of **data bytes** you send to your Apple Dot Matrix Printer. Each vertical column of dots translates into a binary number in which each bit set to *1* (for *on*) corresponds to a dot. The **least significant bit** of this number corresponds to the top of the character (wire 1 or 2, depending on whether the upper or lower eight wires are being used), and the **most significant bit** to the bottom. Specify spacing included with the character with one or more binary zero numbers (ASCII nulls). The example at the end of this section shows how to calculate these numbers when creating a new symbol (in this case, a plus-or-minus sign).

data byte: an eight-digit binary number.

least significant bit: The last digit of an eight-digit binary number.

most significant bit: The first digit of an eight-digit binary number.

Loading Custom Characters

As soon as you have designed a new custom character, you can load it into your Apple Dot Matrix Printer's memory. Following are the codes you use:

Code	Decimal	Hex	Function
ESCAPE –	27 45	$1B $2D	Maximum width is 8 dots
ESCAPE +	27 43	$1B $2B	Maximum width is 16 dots
ESCAPE I	27 73	$1B $49	Start loading new character(s)
CONTROL-D	4	$04	End of new character(s) loading
A.....P	65...80	$41...$50	Width code when using top 8 wires; A = 1 ... P = 16
a.....p	97..112	$61...$70	Width code when using bottom 8 wires; a = 1 ... p = 16

To load one or more new custom characters into memory, follow these steps:

1. Select a maximum width of 8 or 16 dots by sending the printer either ESCAPE – or ESCAPE +. If you choose a maximum width of 16 dots, the memory can hold fewer characters than if you choose a maximum width of 8. The maximum width selection remains until it is cancelled by the other control code or until you turn off the power.
2. Send the printer an ESCAPE I to tell it you are starting a group of new character specifications.
3. For each new character, send the following information to the printer:

3a. The regular character that is to be assigned a new symbol. This can be any uppercase or lowercase letter, any numeral, or any punctuation mark, including spaces. It may not be RETURN, ESCAPE, TAB, or any other non-printing character. (If you select a maximum width of 8 dots in step 1 above, you can also use 80 of the printing characters again with ASCII bit 8 set, for a total of 175 custom characters. See the explanation of the ESCAPE * control code in Printing Custom Characters.)

For a table of ASCII characters corresponding to binary numbers, see Appendix C.

3b. A width code from the table above. If the new character is seven dots wide (including spacing) and you want it printed using wires 1 through 8, send G; if it is 13 dots wide and uses wires 2 through 9, send m; and so on.

3c. As many eight-bit binary numbers (in the form of ASCII characters) as were specified by the width code just sent. Each binary number specifies a one-column dot pattern, from the left to the right. Bit 0 of each number corresponds to the top wire, and bit 7 corresponds to the bottom.

4. After repeating steps 3a, 3b, and 3c for each custom character, send the printer a CONTROL-D character to signal that the loading sequence is complete.

Warning

Be careful when sending this sequence to the printer. If you get out of step by one character, the whole result can become garbled.

Printing Custom Characters

Once their specifications are stored in your Apple Dot Matrix Printer's memory, you can fetch and print custom characters at any time. The following codes switch the entire keyboard of printing characters from one font to another:

Code	Decimal	Hex	Function
ESCAPE '	27 39	$1B $27	Switch to custom character font
ESCAPE *	27 42	$1B $2A	Switch to custom character font (high ASCII values)
ESCAPE $	27 36	$1B $24	Switch back to "normal" font

Whenever one of these control codes appears in text being printed, the printer changes fonts and continues to print with that font until it receives one of the other codes (or until you turn the power off, at which time it reverts to the "normal" font). Most of the time you will probably want to fetch a single custom symbol. To do this you send the printer ESCAPE ' (or ESCAPE *), the keyboard character to which the custom symbol was assigned, and ESCAPE $.

ESCAPE ' (ESCAPE accent grave) and ESCAPE * (ESCAPE asterisk) have the following different characteristics:

- ESCAPE ' fetches custom characters in both eight-dot-maximum and 16-dot-maximum storage modes assigned to ordinary keyboard characters (including space)—ASCII characters with decimal values 32 through 126 (see Appendix C).
- ESCAPE ' also fetches custom characters assigned to ASCII characters with decimal values 160 through 191. These characters can't be more than eight dots wide and must have been stored in the eight-dot-maximum mode. When you use ESCAPE ' for this purpose, make sure that DIP switch 2-6 is open or an ESCAPE Z CONTROL-J2 control code is in force (see Data Length Byte, earlier in this chapter).

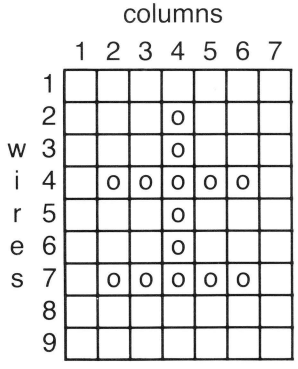
- ESCAPE * fetches custom characters assigned to ASCII characters with decimal values 160 through 239. In effect, it reassigns them to characters 128 lower—in other words, ASCII 32 through 111 (all of the normal keyboard characters except the punctuation marks {, |, }, and ~, and lowercase letters above o). For this control code to be effective, make sure that DIP switch 2-6 is closed or an ESCAPE D CONTROL-J2 control code is in force (see Data Byte Length, earlier in this chapter).

Since the ESCAPE ' control code permits you to change to a font containing up to 95 custom characters of any width (regardless of the position of DIP switch 2-6) and fetch them with ordinary keyboard characters, you will probably never need to use the ESCAPE * control code. However, it is available if you ever need to store and use as many as 175 custom characters up to eight dots wide.

A Sample Custom Character

Suppose you are using your Apple Dot Matrix Printer to print technical specifications in which the plus-or-minus sign (±) is used extensively. You could print this symbol by printing plus-backspace-underline, but the result would look awkward. A better solution is to use a custom character.

The first step is to design the new symbol on square-ruled paper, numbering the columns. It should look like this:



The next step is to translate the columns into binary numbers, and then into ASCII characters. The new symbol uses wires 1 through 8, so the least significant (or last) digit of each binary number corresponds to wire 1 and the most significant to wire 8. Looking at the layout on squared paper, it is easy to see that the first number consists entirely of zeros, the next has a *1* for the second and fifth digits (wires 7 and 4); and so on. By referring to Appendix C you can find out what ASCII characters correspond to these numbers. The following table shows the result:

Column	Binary	ASCII
1	00000000	NUL (CONTROL-@)
2	01001000	H
3	01001000	H
4	01111110	~
5	01001000	H
6	01001000	H
7	00000000	NUL (CONTROL-@)

Since the new symbol is only seven dots wide, you can enter it in the eight-dot maximum storage mode. Let's assume that you want to fetch it from the custom character font by using the *&* character. The resulting loading sequence is:

ESCAPE - ESCAPE I & G CONTROL-@ H H ~ H H CONTROL-@ CONTROL-D

Of course the spaces shown above are omitted from the actual sequence sent to the printer. The character G is the width code. It indicates that the top eight wires print the symbol and that it is seven dots wide (G is the seventh letter of the alphabet).

After you load the new character by means of the sequence above, you can print the character at any time by sending to the printer this sequence:

ESCAPE ' & ESCAPE $

These five characters change the printer's type style to the custom font, print the symbol assigned to the *&* key, and change it back to the "normal" font.

By the Way: Whenever you turn the power off, the entire memory of custom characters is lost. It is therefore a good idea to put your loading sequences into a format file, which you can send to the printer every time the power is turned on. (See Creating a Format File.)

Printing Graphics

You can make your Apple Dot Matrix Printer print a completely black page, consisting of 23,040 dots per square inch. While this is usually not of any interest, it illustrates the printer's capability to create any graphics pattern up to eight inches wide and any length.

There are three primary ways to create graphics patterns with the Apple Dot Matrix Printer:

- By printing a line of many different vertical dot patterns, each up to eight dots high;
- By repeating a single vertical dot pattern all the way across a line;
- By the exact placement of single dots or small groups of dots at one or more positions along a line.

In all cases, printed graphics are produced one line at a time. Each line can be up to eight dots high and up to 1,280 dots long.

Column-Oriented Graphics

The Apple Dot Matrix Printer can print horizontal lines with dots in any pattern you desire. Each vertical column of up to eight dots is defined by a separate character, so a single line may require up to 1,280 characters (bytes) for its definition. After it prints each line, the printer is ready to receive a new line.

Each control code defining one horizontal line of dot graphics starts with these six characters:

Code	Decimal	Hex	Function
ESCAPE G nnnn	27 71 nnnn	$1B $47 nnnn	Type line corresponding to the following nnnn data bytes

The decimal number *nnnn* after the ESCAPE G consists of four ordinary keyboard numerals; it specifies the number of data bytes (up to 9999) that follow. This 6-character prefix plus the data bytes themselves constitute the complete control code, which may thus run up to 10,005 characters.

Remember: In this and other control codes, you can replace leading zeros with spaces.

Each of the data bytes defines a vertical column of eight dots printed by the typehead. A dot is printed for each bit set to *1* in the data byte. Bit 7 causes the dot at the bottom of the column to be printed and bit 0 causes the dot at the top to be printed. For example, the data byte for *k* (decimal 107, hex $6B, binary 01101011) causes a column of dots to be printed, as shown in the following figure:

The columns print from left to right, starting at the left margin of the page.

See your *Apple Dot Matrix Printer User's Manual, Part II* for information on how to send nonprinting characters.

Data bytes are frequently nonprinting characters. Most graphics patterns, however, are generated by programs written for the specific purpose, in which case the data bytes are specified by Pascal CHR or BASIC CHR$ functions. (See A Graphics Example.)

Remember: CHR functions require base-ten numbers as arguments. If you design the bytes in binary or hexadecimal, you must convert to decimal before using CHR functions.

Dot Spacing

The vertical spacing of the striker wires in the typehead is approximately 1/72 of an inch. The horizontal character pitch that produces 72 dots per inch is *extended,* or 9 characters per inch. Then, if you select a vertical line feed pitch of 16/144 of an inch, the result is a uniform matrix of dot positions—72 per inch in each direction, with a total density of 5,184 dots per square inch. The dot size is such that horizontal and vertical lines appear connected for this matrix. To produce 9 characters per inch horizontally and a line feed pitch of 16/144 of an inch use

ESCAPE n ESCAPE T16

Although you can select finer-scale horizontal dot spacing, it takes longer to print.

A Graphics Example

Suppose you are using your Apple Dot Matrix Printer to print custom business forms, for which it is desirable to cross-hatch certain areas. The following Pascal procedure, when included in the program that generates the form, does this. It takes three previously declared integer variables passed to it from the main program:

- LEFTEDGE: The character position of the left edge of the cross-hatched block;
- WIDTH: The width, in ninths of an inch, of the block;
- HEIGHT: The height, in ninths of an inch, of the block.

This procedure assumes that the printer has been opened with a REWRITE procedure and assigned the textfile identifier ADMP.

```
PROCEDURE HATCH;
VAR N, M : INTEGER;
BEGIN
  {Set left margin}
  WRITE (ADMP, CHR(27), 'L', LEFTEDGE:3);
  {Set character and line pitch for 72 per inch}
  WRITE (ADMP, CHR(27), 'n', CHR(27), 'T16');
  FOR N := 1 TO HEIGHT DO
    BEGIN
    {Set Graphics Mode and width}
    WRITE (ADMP, CHR(27), 'G', (WIDTH * 8):4);
      FOR M := 1 TO WIDTH DO
      BEGIN
      {8 bytes to produce diamond pattern}
      WRITE (ADMP, CHR(24), CHR(36), CHR(66), CHR(129));
      WRITE (ADMP, CHR(129), CHR(66), CHR(36), CHR(24))
      END;
    {Type each line when complete}
    WRITELN (ADMP)
    END;
  {Restore previous margin and (pica) character and line pitch}
  WRITE (ADMP, CHR(27), 'LØØØ', CHR(27), 'N', CHR(27), 'A')
END;
```

You can modify the last line to suit any other character and line pitch in use outside the procedure.

Line-Oriented Graphics

You can send control codes to your Apple Dot Matrix Printer that cause it to repeat a single vertical dot pattern up to 9999 times horizontally. The result is a set of horizontal lines whose thickness and spacing (within the 1/10-inch-height of the typehead) are determined by a binary number. The control code required is as follows:

Code	Decimal	Hex	Function
ESCAPE V nnnn c	27 86 nnnn c	$1B $56 nnnn c	Type nnnn repetitions of the dot column specified by c

The character *c* is the ASCII equivalent of an eight-bit binary number specifying where dots appear in the column. Bit 0 is at the top of the column and bit 7 is at the bottom, with a *1* wherever a dot is to be printed.

This control code is useful for generating the horizontal rules used in tables and forms. The length of the rule is controlled precisely by the number *nnnn* of horizontal dots (for a table of the number of dots per inch printed by various character pitches, see Chapter 4, Controlling Your Printer). The number *nnnn* must always have 4 digits; however, you can replace leading zeros with spaces. For example, to produce three hairline rules, use the character *I*, because its digital ASCII representation is 01001001.

Here are some handy values for the specifying character *c*:

One hairline rule:	@
Two hairline rules:	H
Three hairline rules:	I
One heavy rule:	Ø
Two heavy rules:	f
One extra-heavy rule:	8

Exact Dot Placement

For the greatest flexibility and accuracy in creating graphics with your Apple Dot Matrix Printer, use the following dot placement control code:

Code	Decimal	Hex	Function
ESCAPE F nnnn	27 70 nnnn	$1B $46 nnnn	Place succeeding printing nnnn dot positions from left margin

For a table of the number of dots per inch for each character pitch, see Chapter 4, Controlling Your Printer.

The number *nnnn* consists of four ASCII numerals, but you can replace leading zeros with spaces. The resulting placement depends on the character pitch you have in force at the time you send this control code.

By the Way: Dot positions are counted from the left margin as set by the ESCAPE L control code (see Chapter 4, Controlling Your Printer).

Follow each ESCAPE F control code with at least one printing control code. This may consist of an ordinary character (in which case that character is printed at the location specified), a dot column control code such as ESCAPE G or ESCAPE V, or another ESCAPE F control code. (See Line Oriented Graphics to learn more about ESCAPE V and Column Oriented Graphics to learn more about ESCAPE G.)

By the Way: In order for multiple ESCAPE F control codes to be executed correctly, send them to the printer in ascending numerical order (in other words, left to right).

Creating a Format File

The printer's memory is lost every time the power is turned off. A format file contains control codes—outside of the memory—that prepare the printer for a specific job. This allows you to retain the control codes for later use.

You can send a format file to the Apple Dot Matrix Printer by itself, prior to running a job, or incorporate it in another text file to instruct the printer on how to format a particular section.

Many format files are quite short (specifying character pitch, line feed pitch, and left margin setting, for example). Others that control the more sophisticated functions of the Apple Dot Matrix Printer—form tabulating commands, custom character specifications, and dot-by-dot graphics—may be very long.

Custom DIP Switch Overrides

If you want to create your own control codes to override DIP switch settings, use the following basic control codes:

Code	Decimal	Hex	Function
ESCAPE D ab	27 68 ab	$1B $44 ab	Simulates closing of switches corresponding to *ab* bits with value *1*
ESCAPE Z ab	27 90 ab	$1B $5A ab	Simulates opening of switches corresponding to *ab* bits with value *1*

The two-character group *ab* following ESCAPE D or ESCAPE Z specifies which switch settings change. Each bit in byte *a* corresponds to one of the switches in DIP switch assembly 1. Each bit in byte *b* corresponds to one of the switches in DIP switch assembly 2.

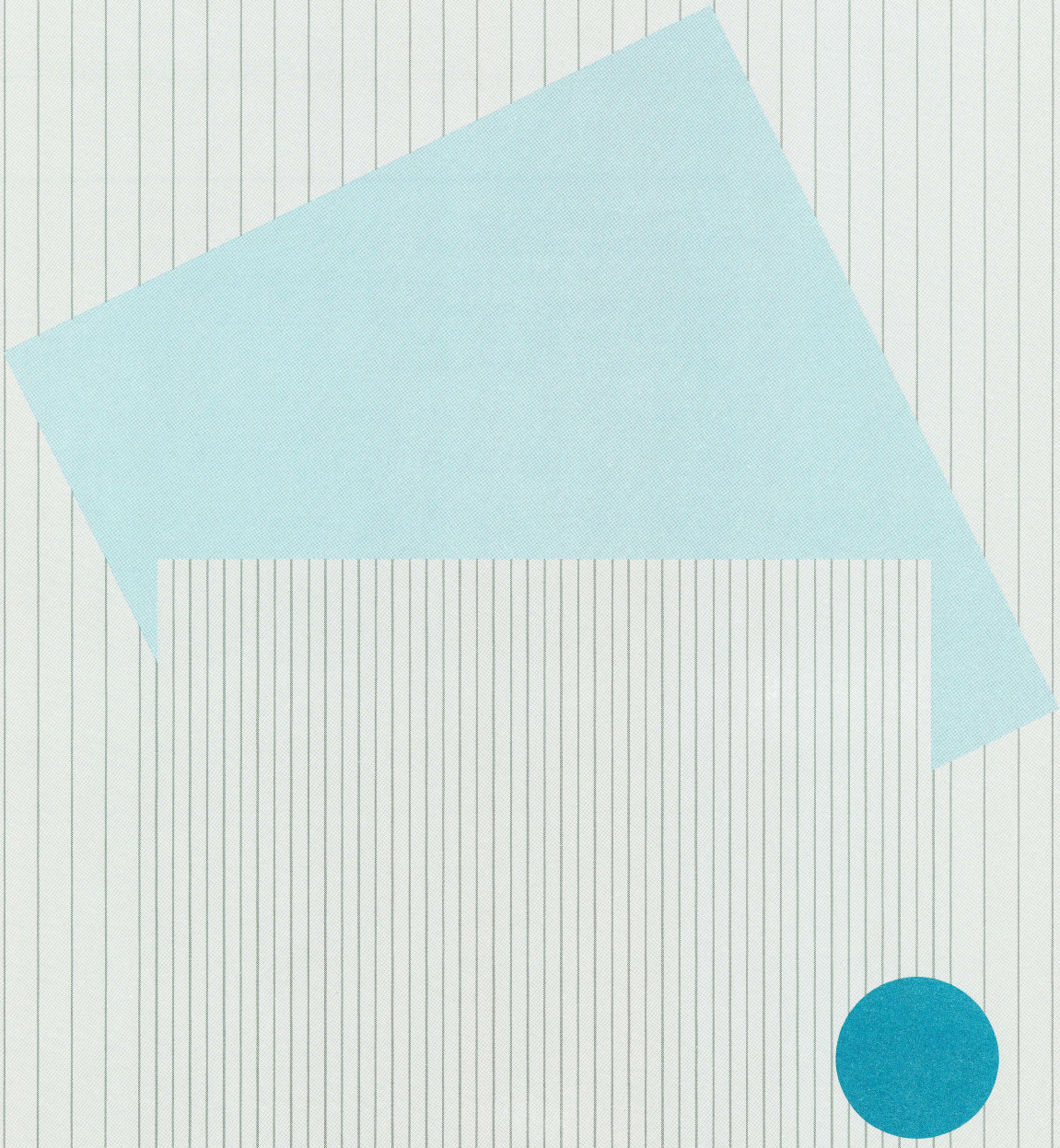
	byte a							
bit:	7	6	5	4	3	2	1	0
SW:	1-8	1-7	1-6	1-5	1-4	1-3	1-2	1-1
	byte b							
bit:	7	6	5	4	3	2	1	0
SW:	2-8	2-7	2-6	2-5	2-4	2-3	2-2	2-1

For each bit with a value of *1*, the corresponding switch closes (for an ESCAPE D code), or opens (for an ESCAPE Z code). For each bit with a value of *zero*, the corresponding switch is unaffected. For example, to open switches 1-6, 1-5, 2-1, and 2-6 you would use the control code ESCAPE Z0!, because the ASCII character 0 has the decimal equivalent 48 and the binary equivalent 00110000, and the ASCII character ! has the decimal equivalent 33, or 00100001.

Appendix C in this manual contains a table of correspondences between eight-bit binary codes and ASCII characters.

The DIP switches 1-4, 2-8, 2-7, 2-5, 2-4, 2-3, and 2-2 are unaffected by control codes, so if you set their corresponding bits in bytes *a* and *b* to *1*, it has no effect.

Appendixes



Troubleshooting

After you've checked out and installed your Apple Dot Matrix Printer, what happens if your printer doesn't run? Maybe you have one of these common problems.

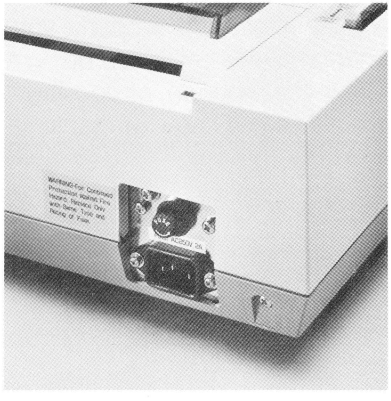
- **IS THE COVER OPEN?** The Apple Dot Matrix Printer has an interlock switch that prevents it from running unless the protective carrier cover is completely closed and latched. If the printer stops printing because the cover is open, you can restart it by pressing the SEL button.
- **ARE YOU OUT OF PAPER?** When there is less than one inch of paper left, the paper end detector underneath the platen halts the printer and turns on the PE light. If you want to print one or two more lines anyway, you can override this switch by pressing the SEL button. But if you are using pin-feed paper, bear in mind that by this time it will have ceased to feed properly.

▲ **Warning**

Do not print without paper under the typehead. You'll damage both the platen and the printing wires.

- **IS THE FUSE BLOWN?** It's easy to overlook the small cartridge fuse mounted next to the power cord on the back of the printer. If the printer won't work and the power light does not come on, unplug the power cord and remove the fuse by unscrewing the plastic cap marked *fuse* in the direction of the arrow. Check whether the metal wire inside is broken or not. If it is, replace it with a 2 ampere type 3AG fuse, obtainable at most electronic supply or auto parts stores. If the fuse blows again when you turn power back on, consult your Apple dealer.

Figure A-1. Fuse



- **IS AN INTERFACE CONNECTION LOOSE?** Sometimes the hookup between the printer and the Apple computer works loose. If you suspect this problem, first turn off the power and then open the cover of your computer. Unplug and reconnect the interface board and cable. Look for any evidence of dirt or thumbprints on the connecting strip that projects from the bottom of the card. Make sure the flat cable has not become damaged or pinched.

See Chapter 4, Controlling Your Printer, for an explanation of DIP switch settings.

- **ARE THE DIP SWITCHES INCORRECTLY SET?** The DIP switches inside the Apple Dot Matrix Printer control many of its format functions; if they are incorrectly set, they alter the appearance of the printout. Two switches, however, affect the ability of the printer to become activated, or selected, which is necessary before it prints anything at all. So if the SEL light does not come on when it should, check that switches SW2-7 and SW1-5 are correctly set. SW2-7 establishes whether or not the printer will become active automatically whenever you turn the power on. SW1-5 determines whether or not the printer will respond to certain activating codes (CONTROL-Q and CONTROL-S) sent to it by your computer.

The built-in test is described in Chapter 2, Setting Up Your Printer.

- **IS YOUR SYSTEM INCORRECTLY CONFIGURED?** If your computer requires some sort of system reconfiguration before the computer and printer can communicate, make sure you have configured your system properly. In addition, verify that the computer is attempting to communicate with the printer via the same slot in which the interface card is installed.

- **IS THE PROGRAM AT FAULT?** Sometimes software problems seem the same as hardware problems. The printer may fail to produce clean copy not because there is something wrong with its mechanism, but because the commands it receives from the computer are incomplete or confusing. A quick way to check this is to run the built-in test. This test exercises most of the mechanical functions of the printer, as well as its internal microprocessor. If the test runs properly, you can be fairly certain that any format problems—garbled or missing text, overprinted lines—lie in the program, or possibly in the interface. Try using a program that you know works, to check out the system as a whole.

Command Summary

This appendix is a complete collection of all Apple Dot Matrix Printer control codes and DIP switch settings.

Dip Switch Settings

Switch	Setting	Function	Code
1 1 1-2 1-3		Select alternate characters	See "Foreign Characters"
1-4 1-4	Closed OPEN	Page length 72 lines Page length 66 lines	
1-5 1-5	CLOSED Open	Ignore select codes Respond to select codes	ESCAPE DRR ESCAPE ZRR
1-6 1-6	CLOSED Open	Line feed at buffer overflow No line feed at overflow	ESCAPE D(R ESCAPE Z(R
1-7 1-7	CLOSED Open	End-of-line at CR, LF, VT, FF, US End-of-line only at CR	ESCAPE DHR ESCAPE ZHR
1-8 1-8	Closed OPEN	Add LF after every CR Do not add LF after every CR	ESCAPE D{J}R ESCAPE Z{ J}R
2-1 2-1	Closed OPEN	Print line through zero Print zero without line	ESCAPE D(J)Q ESCAPE Z(J)Q
2-2 2-2	CLOSED Open	Input buffer 1 line only Input buffer 3k bytes	
2-5 2-5	Closed OPEN	Elite proportional pitch Pica fixed width pitch	ESCAPE P ESCAPE N
2-6 2-6	CLOSED Open	Ignore 8th data bit Recognize 8th data bit	ESCAPE D(J)2 ESCAPE Z(J)2
2-7 2-7	CLOSED Open	Power on to select state Power on to deselect state	
2-8 2-8	Closed OPEN	Print left to right only Print in both directions	ESCAPE >* ESCAPE <*

Note that {J} means a high ASCII CONTROL-J (decimal 138, hex $8A). (J) means CONTROL-J (decimal 10, hex $0A).

Three DIP switch settings cannot be overridden by control codes: switches 1-4, 2-2, and 2-7.

Two DIP switches have no function: 2-3 and 2-4.

General Control Codes

Code	Decimal	Hex	Function
ESCAPE N	27 78	$1B $4E	Pica (10 to the inch)
ESCAPE E	27 69	$1B $45	Elite (12 to the inch)
ESCAPE p	27 112	$1B $70	Pica Proportional
ESCAPE P	27 80	$1B $50	Elite Proportional
ESCAPE n	27 110	$1B $6E	Extended (9 to the inch)
ESCAPE q	27 113	$1B $71	Condensed (15 to the inch)
ESCAPE Q	27 81	$1B $51	Ultracondensed (17 to the inch)
ESCAPE 1	27 49	$1B $31	1 dot space between elite proportional characters
ESCAPE 2	27 50	$1B $32	2 dots space between elite proportional characters
ESCAPE 3	27 51	$1B $33	3 dots space between elite proportional characters
ESCAPE 4	27 52	$1B $34	4 dots space between elite proportional characters
ESCAPE 5	27 53	$1B $35	5 dots space between elite proportional characters
ESCAPE 6	27 54	$1B $36	6 dots space between elite proportional characters
ESCAPE R nnn c	27 82 nnn c	$1B $52 nnn c	Print nnn repetitions of character c
CONTROL-H c	8 c	$08 c	Backspace one character and print the character c
ESCAPE X	27 88	$1B $58	Start underlining text
ESCAPE Y	27 89	$1B $59	Stop underlining text
ESCAPE !	27 33	$1B $21	Start boldface printing
ESCAPE "	27 34	$1B $22	End boldface printing

Code	Decimal	Hex	Function
CONTROL-N	14	$0E	Begin headline mode
CONTROL-O	15	$0F	End headline mode
ESCAPE >	27 62	$1B $3E	Left-to-right printing only
ESCAPE <	27 60	$1B $3C	Bidirectional printing
ESCAPE A	27 65	$1B $41	6 lines per inch
ESCAPE B	27 66	$1B $42	8 lines per inch
ESCAPE T nn	27 84 nn	$1B $54 nn	Distance between lines to be nn/144 inch (nn = 01 to 99)
ESCAPE f	27 102	$1B $66	Forward (normal) line feeding
ESCAPE r	27 114	$1B $72	Reverse line feeding
CONTROL-_ n	31 n	$1F n	Feed n lines of blank paper n=1,2,3,4,5,6,7,8,9,:,;,<,=,>,?
ESCAPE L nnn	27 76 nnn	$1B $4C nnn	Set left margin to position nnn
CONTROL-L	12	$0C	Feeds paper to next top of form
ESCAPE ZHR	27 90 72 82	$1B $5A $48 $52	End-of-line at CR only
ESCAPE DHR	27 68 72 82	$1B $44 $48 $52	End-of-line at CR, VT, FF, HT, CONTROL-_
CONTROL-X	24	$18	Cancel all unprinted text
ESCAPE Z(R	27 90 40 82	$1B $5A $28 $52	No line feed at buffer overflow
ESCAPE D(R	27 68 40 82	$1B $44 $28 $52	Line feed added at buffer overflow
ESCAPE D CONTROL-J2	27 68 10 50	$1B $44 $0A $32	Ignore 8th bit of data byte
ESCAPE Z CONTROL-J2	27 90 10 50	$1B $5A $0A $32	Recognize 8th bit of data byte
CONTROL-Q	17	$11	Select printer
CONTROL-S	19	$13	Deselect printer
ESCAPE DRR	27 68 82 82	$1B $44 $52 $52	Ignore select codes
ESCAPE ZRR	27 90 82 82	$1B $5A $52 $52	Recognize select codes

Tabbing Control Codes

Code	Decimal	Hex	Function
ESCAPE (a,b,--n.	27 40 a,b,--n.	$1B $28 a,b,--n.	Set horizontal tab line
ESCAPE) a,b,--n.	27 41 a,b,--n.	$1B $29 a,b,--n.	Clear Selected horizontal tabs
ESCAPE 0	27 48	$1B $30	Clear all tabs
CONTROL-I	9	$09	Go to next tab
CONTROL-] A@	29 65 64	$1D $41 $40	Set starting TOF
C@	67 64	$43 $40	Set Bottom Of Form
A@ CONTROL-^	65 64 30	$41 $40 $1E	Set TOF of next form
CONTROL-_ B	31 66	$1F $42	Drop to next tab B
CONTROL-_ C	31 67	$1F $43	Drop to next tab C
CONTROL-_ D	31 68	$1F $44	Drop to next tab D
CONTROL-_ E	31 69	$1F $45	Drop to next tab E
CONTROL-_ F	31 70	$1F $46	Drop to next tab F
CONTROL-_ A	31 65	$1F $41	Drop to next BOF or TOF
CONTROL-L	12	$0C	Drop to next TOF

Custom Character Control Codes

Code	Decimal	Hex	Function
ESCAPE -	27 45	$1B $2D	Maximum width will be 8 dots
ESCAPE +	27 43	$1B $2B	Maximum width will be 16 dots
ESCAPE I	27 73	$1B $49	Start loading new character(s)
CONTROL-D	4	$04	End of new character(s) loading
A.....P	65...80	$41...$50	Width code when using top 8 wires; A = 1 ... P = 16
a.....p	97..112	$61...$70	Width code when using bottom 8 wires; a = 1 ... p = 16
ESCAPE '	27 39	$1B $27	Switch to custom character font
ESCAPE *	27 42	$1B $2A	Switch to custom character font (special—see below)
ESCAPE $	27 36	$1B $24	Switch back to "normal" font

Graphics Control Codes

Code	Decimal	Hex	Function
ESCAPE G nnnn	27 71 nnnn	$1B $47 nnnn	Print 1x8 graphics columns corresponding to the following nnnn data bytes
ESCAPE V nnnn c	27 86 nnnn c	$1B $56 nnnn c	Print nnnn repetitions of the dot column specified by c
ESCAPE F nnnn	27 70 nnnn	$1B $46 nnnn	Place succeeding printing nnnn dot positions from left margin

DIP Switch Override Control Codes

Code	Decimal	Hex	Function
ESCAPE D ab	27 68 ab	$1B $44 ab	Simulates closing of switches corresponding to *ab* bits with a value of *1*
ESCAPE Z ab	27 90 ab	$1B $5A ab	Simulates opening of switches corresponding to *ab* bits with a value of *1*

ASCII, Binary, and Hexadecimal Codes

There are 256 possible eight-bit binary numbers, from 00000000 to 11111111. Of these, the first 128 (from 00000000 to 01111111) have been assigned to characters and commands used in data processing and communication. Their standard assignment forms the ASCII character set. (ASCII stands for the American Standard Code for Information Interchange.)

The remaining 128, which differ from the first 128 only because their most significant binary digit (first digit) is *1* instead of *0*, are not officially assigned. Nevertheless they are often called *high ASCII characters.*

The following chart lists the 128 standard ASCII character assignments. For each character it gives the binary, decimal, and hexadecimal equivalents for both standard and "high" versions.

	Low ASCII			High ASCII		
ASCII	**Dec**	**Hex**	**76543210**	**Dec**	**Hex**	**76543210**
NUL	0	00	00000000	128	80	10000000
SOH	1	01	00000001	129	81	10000001
STX	2	02	00000010	130	82	10000010
ETX	3	03	00000011	131	83	10000011
EOT	4	04	00000100	132	84	10000100
ENQ	5	05	00000101	133	85	10000101
ACK	6	06	00000110	134	86	10000110
BEL	7	07	00000111	135	87	10000111
BS	8	08	00001000	136	88	10001000
HT	9	09	00001001	137	89	10001001
LF	10	0A	00001010	138	8A	10001010
VT	11	0B	00001011	139	8B	10001011
FF	12	0C	00001100	140	8C	10001100
CR	13	0D	00001101	141	8D	10001101
SO	14	0E	00001110	142	8E	10001110
SI	15	0F	00001111	143	8F	10001111
DLE	16	10	00010000	144	90	10010000
DC1	17	11	00010001	145	91	10010001

	Low ASCII			High ASCII		
ASCII	**Dec**	**Hex**	**76543210**	**Dec**	**Hex**	**76543210**
DC2	18	12	00010010	146	92	10010010
DC3	19	13	00010011	147	93	10010011
DC4	20	14	00010100	148	94	10010100
NAK	21	15	00010101	149	95	10010101
SYN	22	16	00010110	150	96	10010110
ETB	23	17	00010111	151	97	10010111
CAN	24	18	00011000	152	98	10011000
EM	25	19	00011001	153	99	10011001
SUB	26	1A	00011010	154	9A	10011010
ESC	27	1B	00011011	155	9B	10011011
FS	28	1C	00011100	156	9C	10011100
GS	29	1D	00011101	157	9D	10011101
RS	30	1E	00011110	158	9E	10011110
US	31	1F	00011111	159	9F	10011111
SP	32	20	00100000	160	A0	10100000
!	33	21	00100001	161	A1	10100001
"	34	22	00100010	162	A2	10100010
#	35	23	00100011	163	A3	10100011
$	36	24	00100100	164	A4	10100100
%	37	25	00100101	165	A5	10100101
&	38	26	00100110	166	A6	10100110
'	39	27	00100111	167	A7	10100111
(	40	28	00101000	168	A8	10101000
)	41	29	00101001	169	A9	10101001
*	42	2A	00101010	170	AA	10101010
+	43	2B	00101011	171	AB	10101011
,	44	2C	00101100	172	AC	10101100
−	45	2D	00101101	173	AD	10101101
.	46	2E	00101110	174	AE	10101110
/	47	2F	00101111	175	AF	10101111
0	48	30	00110000	176	B0	10110000
1	49	31	00110001	177	B1	10110001
2	50	32	00110010	178	B2	10110010
3	51	33	00110011	179	B3	10110011
4	52	34	00110100	180	B4	10110100
5	53	35	00110101	181	B5	10110101
6	54	36	00110110	182	B6	10110110
7	55	37	00110111	183	B7	10110111
8	56	38	00111000	184	B8	10111000
9	57	39	00111001	185	B9	10111001
:	58	3A	00111010	186	BA	10111010
;	59	3B	00111011	187	BB	10111011
<	60	3C	00111100	188	BC	10111100
=	61	3D	00111101	189	BD	10111101
>	62	3E	00111110	190	BE	10111110
?	63	3F	00111111	191	BF	10111111
@	64	40	01000000	192	C0	11000000
A	65	41	01000001	193	C1	11000001
B	66	42	01000010	194	C2	11000010
C	67	43	01000011	195	C3	11000011
D	68	44	01000100	196	C4	11000100
E	69	45	01000101	197	C5	11000101
F	70	46	01000110	198	C6	11000110
G	71	47	01000111	199	C7	11000111
H	72	48	01001000	200	C8	11001000
I	73	49	01001001	201	C9	11001001
J	74	4A	01001010	202	CA	11001010

	Low ASCII			High ASCII		
ASCII	**Dec**	**Hex**	**76543210**	**Dec**	**Hex**	**76543210**
K	75	4B	01001011	203	CB	11001011
L	76	4C	01001100	204	CC	11001100
M	77	4D	01001101	205	CD	11001101
N	78	4E	01001110	206	CE	11001110
O	79	4F	01001111	207	CF	11001111
P	80	50	01010000	208	D0	11010000
Q	81	51	01010001	209	D1	11010001
R	82	52	01010010	210	D2	11010010
S	83	53	01010011	211	D3	11010011
T	84	54	01010100	212	D4	11010100
U	85	55	01010101	213	D5	11010101
V	86	56	01010110	214	D6	11010110
W	87	57	01010111	215	D7	11010111
X	88	58	01011000	216	D8	11011000
Y	89	59	01011001	217	D9	11011001
Z	90	5A	01011010	218	DA	11011010
[	91	5B	01011011	219	DB	11011011
\	92	5C	01011100	220	DC	11011100
]	93	5D	01011101	221	DD	11011101
^	94	5E	01011110	222	DE	11011110
_	95	5F	01011111	223	DF	11011110
`	96	60	01100000	224	E0	11100000
a	97	61	01100001	225	E1	11100001
b	98	62	01100010	226	E2	11100010
c	99	63	01100011	227	E3	11100011
d	100	64	01100100	228	E4	11100100
e	101	65	01100101	229	E5	11100101
f	102	66	01100110	230	E6	11100110
g	103	67	01100111	231	E7	11100111
h	104	68	01101000	232	E8	11101000
i	105	69	01101001	233	E9	11101001
j	106	6A	01101010	234	EA	11101010
k	107	6B	01101011	235	EB	11101011
l	108	6C	01101100	236	EC	11101100
m	109	6D	01101101	237	ED	11101101
n	110	6E	01101110	238	EE	11101110
o	111	6F	01101111	239	EF	11101111
p	112	70	01110000	240	F0	11110000
q	113	71	01110001	241	F1	11110001
r	114	72	01110010	242	F2	11110010
s	115	73	01110011	243	F3	11110011
t	116	74	01110100	244	F4	11110100
u	117	75	01110101	245	F5	11110101
v	118	76	01110110	246	F6	11110110
w	119	77	01110111	247	F7	11110111
x	120	78	01111000	248	F8	11111000
y	121	79	01111001	249	F9	11111001
z	122	7A	01111010	250	FA	11111010
{	123	7B	01111011	251	FB	11111011
|	124	7C	01111100	252	FC	11111100
}	125	7D	01111101	253	FD	11111101
~	126	7E	01111110	254	FE	11111110
DEL	127	7F	01111111	255	FF	11111111

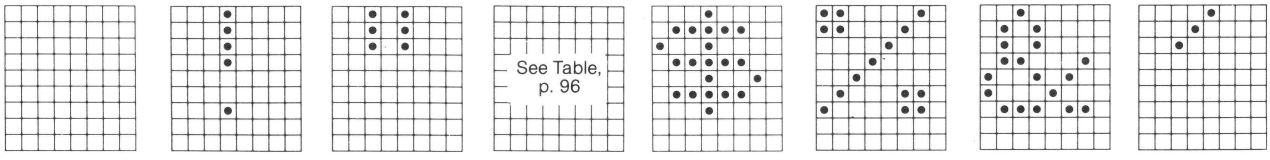
Character Specifications

This appendix depicts the printer's stored dot-matrix patterns for all characters in both fixed-width and proportional printing modes.

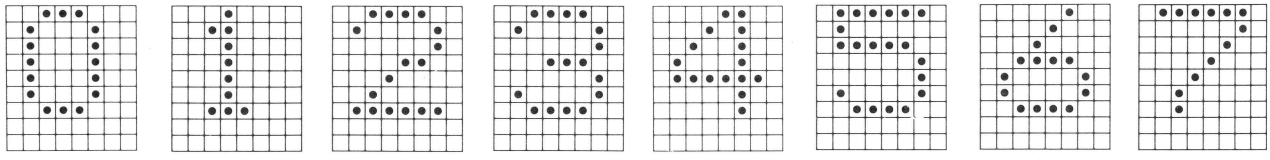
Fixed-Width Characters

All fixed-width characters are created by eight vertical columns, each of which is nine dots tall. The right-most column never contains dots, and the bottom two dots in each column are used only by lowercase characters with descenders, commas, and semicolons. The decimal and hexadecimal codes for each character appear at its upper left.

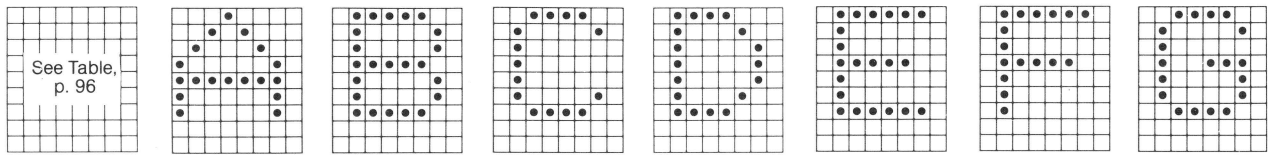
32/20$ 33/21$ 34/22$ 35/23$ See Table, p. 96 36/24$ 37/25$ 38/26$ 39/27$



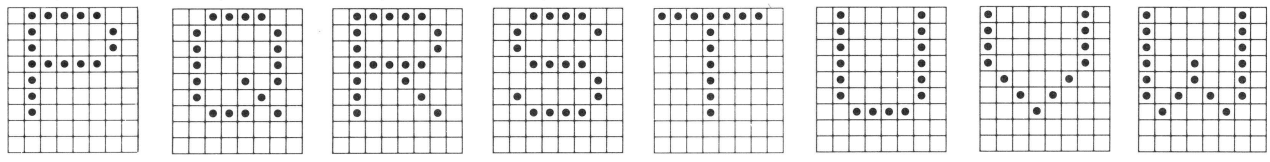
48/30$ 49/31$ 50/32$ 51/33$ 52/34$ 53/35$ 54/36$ 55/37$



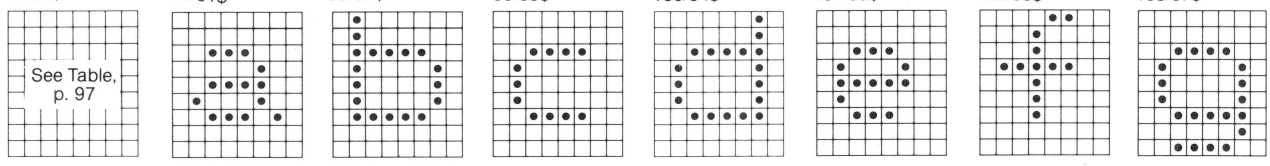
64/40$ See Table, p. 96 65/41$ 66/42$ 67/43$ 68/44$ 69/45$ 70/46$ 71/47$



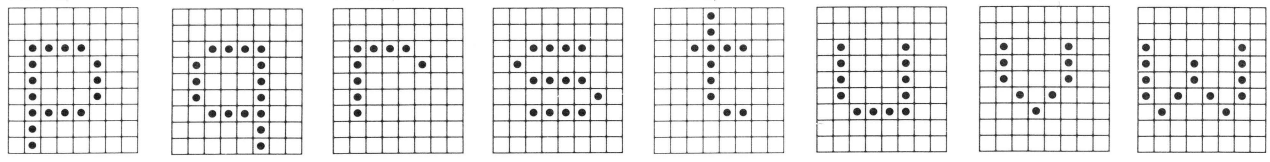
80/50$ 81/51$ 82/52$ 83/53$ 84/54$ 85/55$ 86/56$ 87/57$

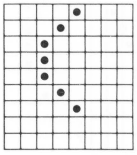


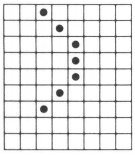
96/60$ See Table, p. 97 97/61$ 98/62$ 99/63$ 100/64$ 101/65$ 102/66$ 103/67$

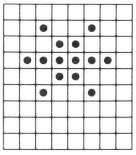


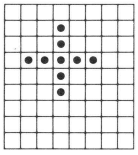
112/70$ 113/71$ 114/72$ 115/73$ 116/74$ 117/75$ 118/76$ 119/77$

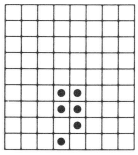


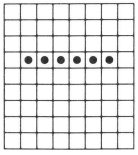
40/28$ 

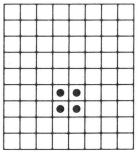
41/29$ 

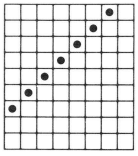
42/2A 

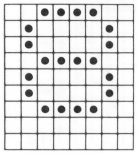
43/2B 

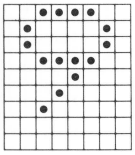
44/2C 

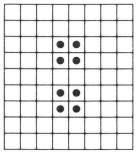
45/2D 

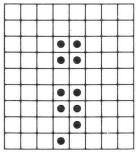
46/2E 

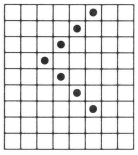
47/2F 

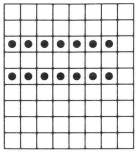
56/38$ 

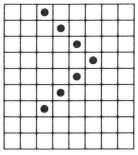
57/39$ 

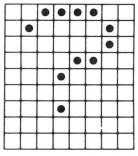
58/3A 

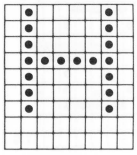
59/3B 

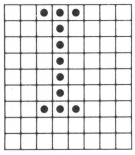
60/3C 

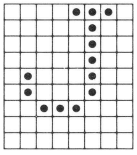
61/3D 

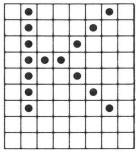
62/3E 

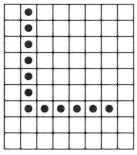
63/3F 

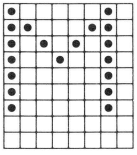
72/48$ 

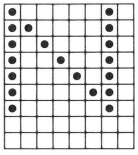
73/49$ 

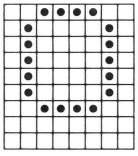
74/4A 

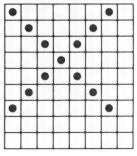
75/4B 

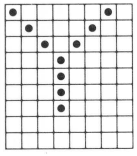
76/4C 

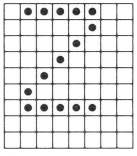
77/4D 

78/4E 

79/4F 

88/58$ 

89/59$ 

90/5A 

91/5B

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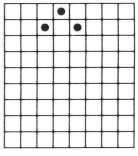
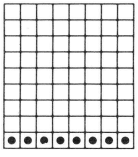
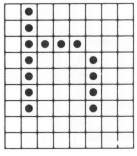
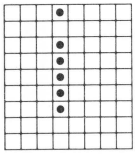
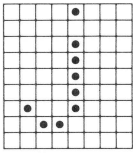
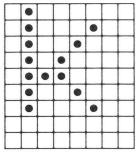
94/5E 

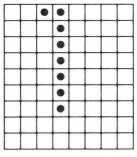
95/5F 

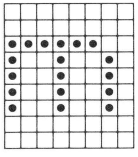
104/68$ 

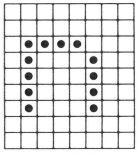
105/69$ 

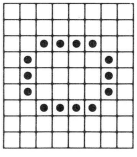
106/6A 

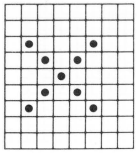
107/6B 

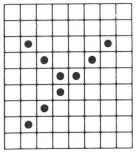
108/6C 

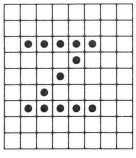
109/6D 

110/6E 

111/6F 

120/78$ 

121/79$ 

122/7A 

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48/$30 slash on

Proportional Characters

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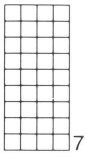
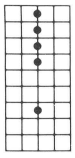
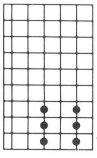
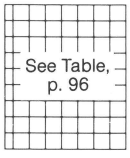
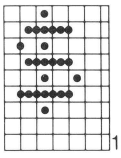
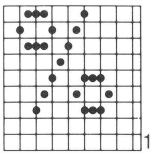
32/20$  7

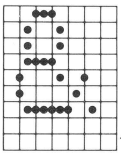
33/21$  7

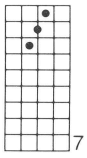
34/22$  10

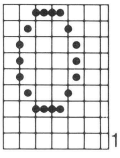
35/23$ 

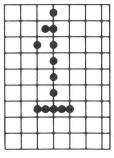
36/24$  12

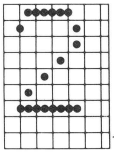
37/25$  16

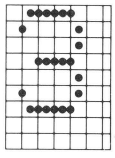
38/26$  13

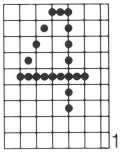
39/27$  7

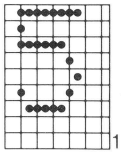
48/30$  12

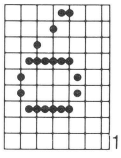
49/31$  12

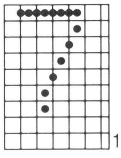
50/32$  12

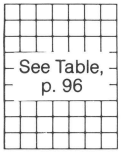
51/33$  12

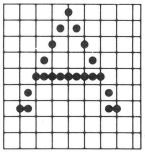
52/$34  12

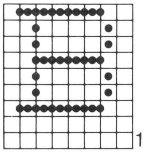
53/$35  12

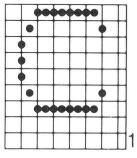
54/36$  12

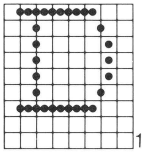
55/$37  12

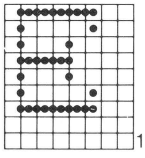
64/40$ 

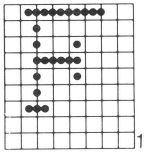
65/41$  16

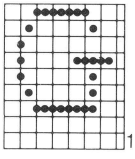
66/42$  15

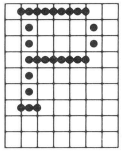
67/43$  14

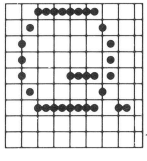
68/44$  15

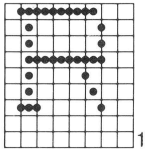
69/45$  15

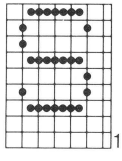
70/46$  15

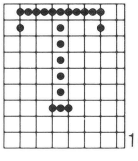
71/47$  14

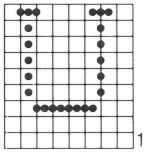
80/50$  13

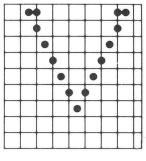
81/51$  16

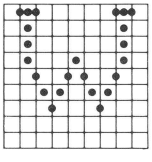
82/52$  15

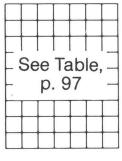
83/53$  12

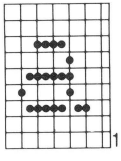
84/54$  14

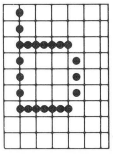
85/55$  15

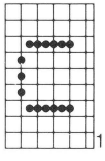
86/56$  16

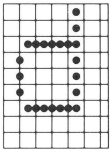
87/$57  17

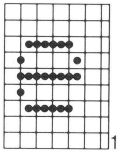
96/60$ 

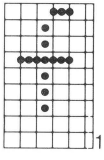
97/61$  12

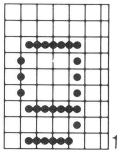
98/62$  12

99/63$  10

100/64$  12

101/65$  12

102/66$  10

103/67$  12

112/70$ 12

113/71$ 12

114/72$ 10

115/73$ 12

116/74$ 10

117/75$ 12

118/76$ 12

119/77$ 16

40/28$ 7

41/29$ 7

42/2A 12

43/2B 12

44/2C 7

45/2D 12

46/2E 7

47/2F 12

56/38$ 12

57/39$ 12

58/3A 7

59/3B 7

60/3C 12

61/3D 12

62/3E 12

63/3F 12

72/48$ 15

73/49$ 9

74/4A 13

75/4B 12

76/4C 13

77/4D 17

78/4E 16

79/4F 15

88/58$ 11

89/59$ 14

90/5A 11

91/5B See Table, p. 94

92/5C See Table, p. 96

93/5D See Table, p. 96

94/$5E 12

95/5F 17

104/68$ 12

105/69$ 8

106/6A 7

107/6B 10

108/6C 8

109/6D 16

110/6E 12

111/6F 12

120/78$ 12

121/79$ 12

122/7A 10

123/7B See Table, p. 97

124/7C See Table, p. 97

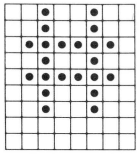
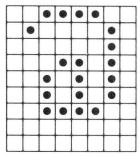
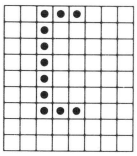
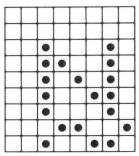
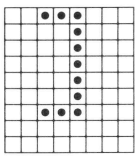
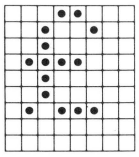
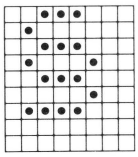
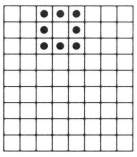
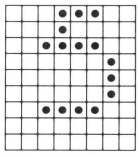
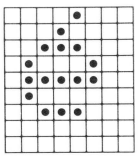
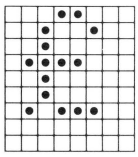
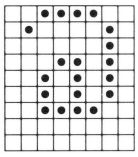
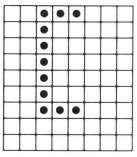
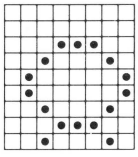
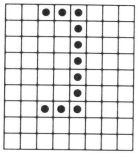
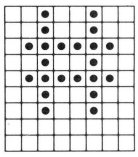
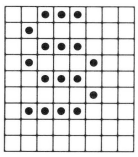
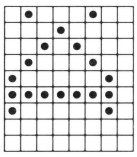
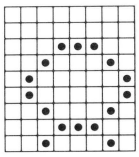
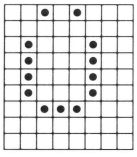
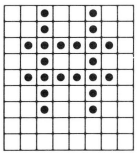
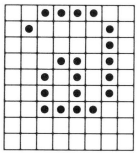
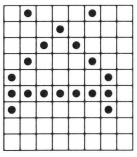
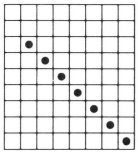
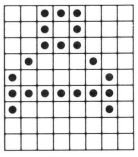
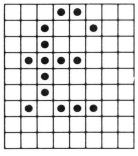
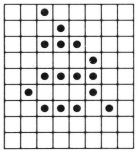
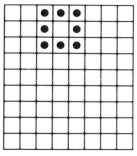
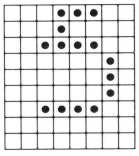
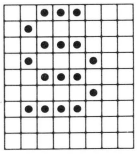
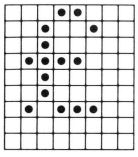
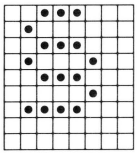
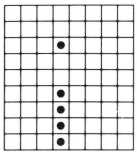
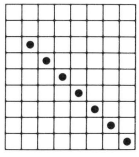
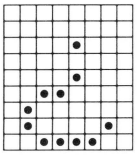
125/7D See Table, p. 97

126/7E See Table, p. 97

48/$30 slash on 12

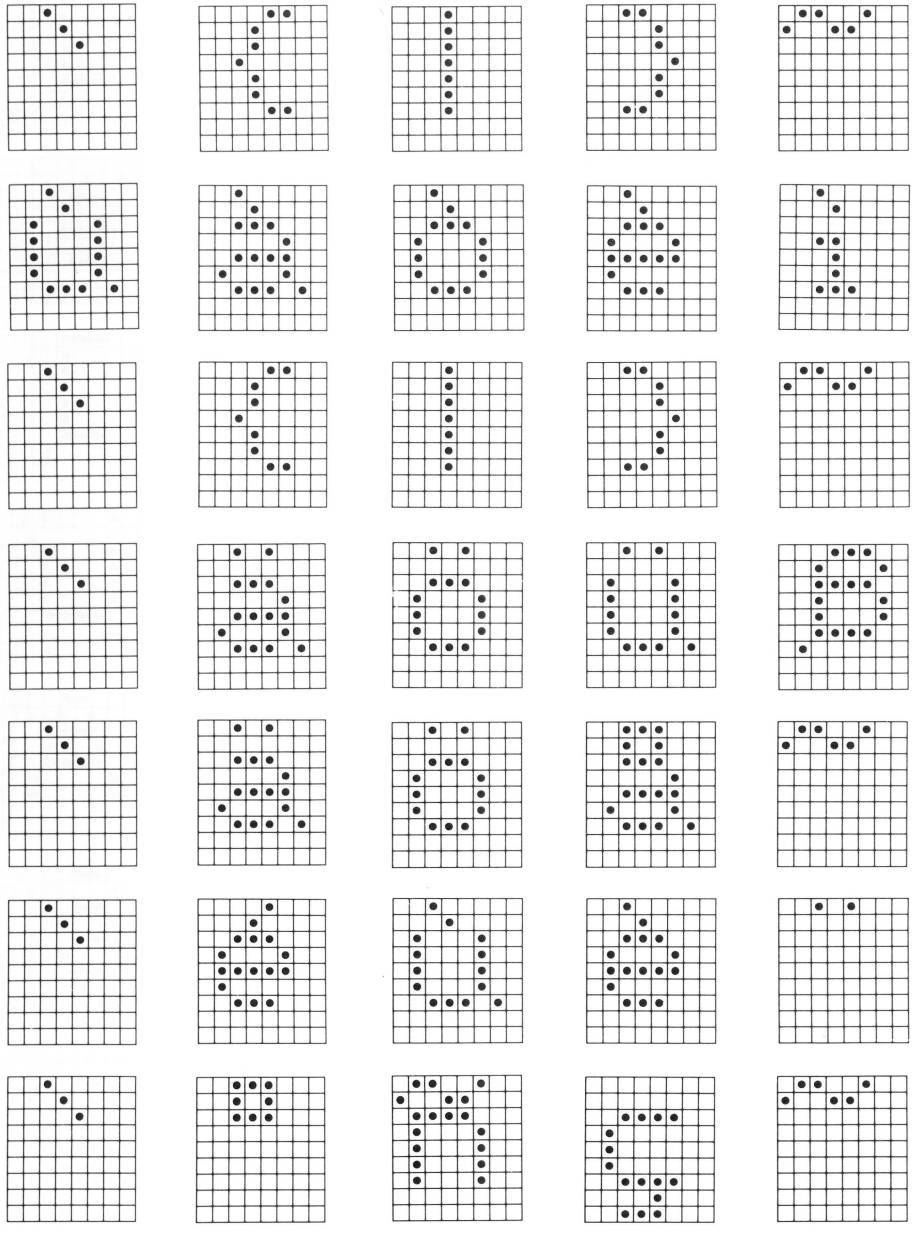
Fixed-Width Foreign Language Characters

All fixed-width foreign language characters are created by eight vertical columns, each of which is nine dots tall. The right-most

ASCII CODE / LANGUAGE	35/23H	64/40H	91/5B	92/5B	93/5D
ENGLISH (USA)					
ITALIAN					
ENGLISH (UK)					
GERMAN					
SWEDISH					
FRENCH					
SPANISH					

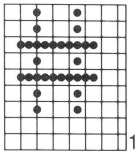
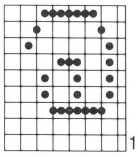
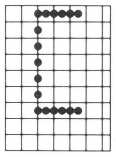
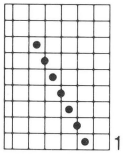
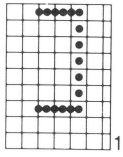
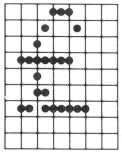
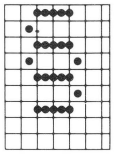
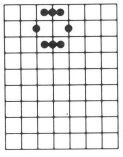
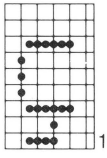
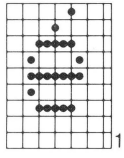
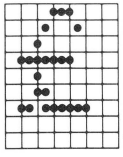
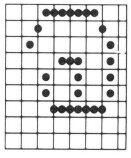
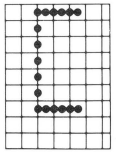
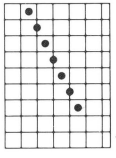
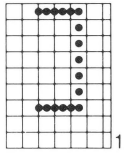
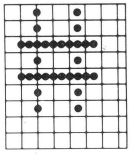
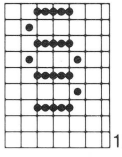
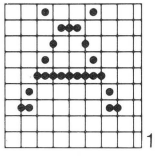
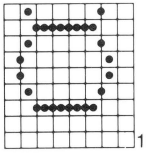
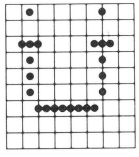
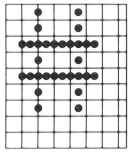
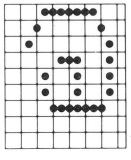
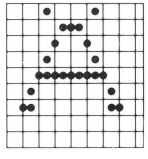
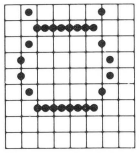
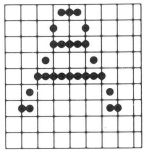
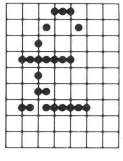
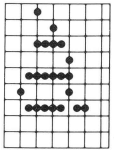
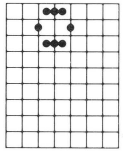
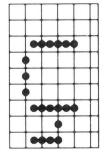
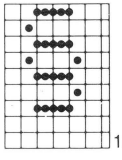
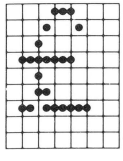
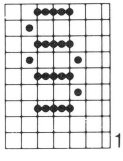
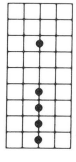
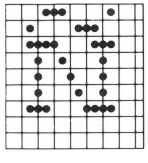
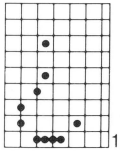
column never contains dots. The decimal and hexadecimal codes for each character appear at its upper left.

96/60H	123/7B	124/7C	125/7D	126/7E



Proportional Foreign Language Characters

The decimal and hexadecimal codes for each character appear at its upper left. The width of the character appears at its lower right.

ASCII CODE (Dec. Hex.) / LANGUAGE	35/23H	64/40H	91/5B	92/5C	93/5D
ENGLISH (USA)	 14	 14	 12	 12	 12
ITALIAN	 13	 12	 13	 10	 12
ENGLISH (UK)	 13	 14	 12	 12	 12
GERMAN	 14	 12	 16	 15	 15
SWEDISH	 14	 14	 16	 15	 16
FRENCH	 13	 12	 13	 10	 12
SPANISH	 13	 12	 7	 16	 12

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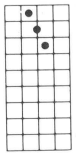
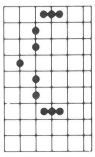
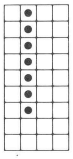
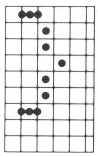
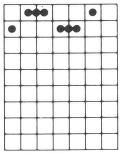
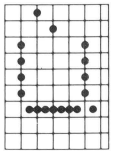
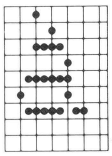
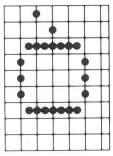
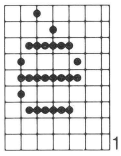
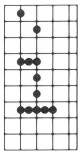
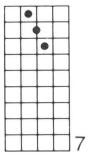
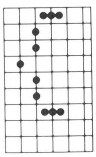
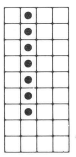
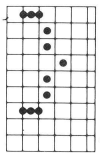
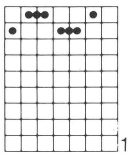
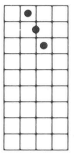
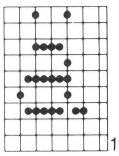
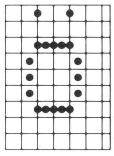
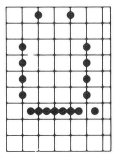
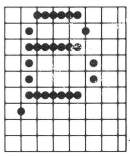
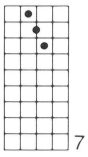
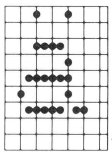
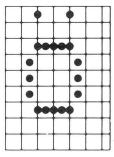
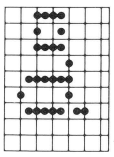
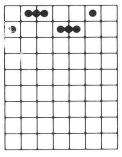
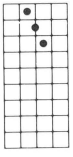
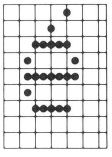
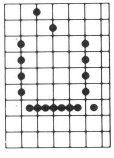
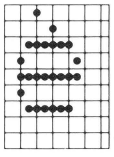
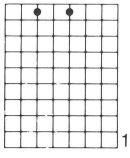
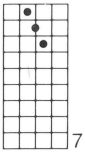
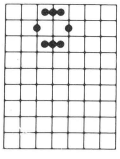
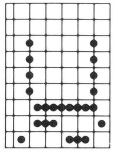
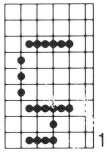
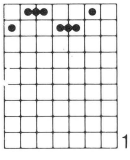
 7	 10	 7	 10	 13
 12	 12	 12	 12	 8
 7	 10	 7	 10	 13
 7	 12	 12	 12	 14
 7	 12	 12	 12	 13
 7	 12	 12	 12	 13
 7	 13	 12	 10	 13

Printer Specifications

Print Method	Dot matrix, logic seek (line by line)
Printing Speed	At 10 characters per inch: 120 characters per second 63 lines per minute
Character Format	Standard characters: Up to 7 dots wide by 8 dots high Custom (down-loaded) characters: Up to 16 dots wide by 8 dots high
Standard Characters	96 ASCII (alphanumeric and symbols) 25 European language characters
Vertical Dot Spacing	1/72 of an inch
Line Length	8 inches maximum

Horizontal Pitches

Characters Per Inch	Characters Per Line	Dots Per Inch (Approx.)
17	136	136
15	120	120
12	96	96
10	80	80
9	72	72
8.5	68	136
7.5	60	120
6	48	96
5	40	80
4.5	36	72
variable	variable	160
variable	variable	144

Paper Feed Direction	Forward and reverse
Line Spacing	1/144 to 99/144 of an inch, selectable in increments of 1/144 of an inch
Line Feed Method	Stepper motor drive
Line Feed Speed	Maximum 10 per second at 6 lines per inch
Paper Width	4.5 to 10 inches

Paper Thickness	0.05 - 0.28 millimeters (0.002 - 0.011 inches) Original + 3 copies maximum
Paper Feed Method	Selectable, friction or sprocket/pin feed
Paper Types	Single sheets Rolled paper Fan-fold sprocketed paper (hole centers 4.0 - 9.5 inches)
Paper Entry	Top rear of printer
Ribbon	Cassette containing inked fabric ribbon (black recommended), 13 millimeters wide by 13,000 millimeters long, automatically reversing
Power Options	115 Volts AC ± 10%, 60 Hertz 100 Volts AC ± 10%, 50/60 Hertz 220 Volts AC ± 10%, 50 Hertz 240 Volts AC ± 10%, 50 Hertz
Power Consumption	Operating: 180 Watts maximum Standby: 16 Watts maximum
Data Interface	8 bit parallel (see Appendix E)
Weight	8.5 kilograms (18.75 pounds)

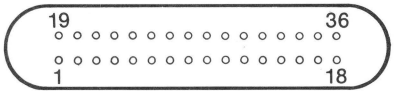
Dimensions	Width	Depth	Heigh	
	398	285	125	millimeters
	15.7	11.3	5.3	inches

Ambient Temperature	
Operating	5 to 40 degrees Celsius (41 to 104 degrees Fahrenheit)
Storage	−25 to +60 degrees Celsius (−13 to + 140 degrees Fahrenheit)
Maximum Humidity	
Operating	85% relative humidity, non-condensing
Storage	90% relative humidity, non-condensing

Interface Specifications

Data Input Form	8 bit parallel
Data Input Codes	Characters: ASCII, 8 or 7 bit Graphics: 8 bit binary bytes
Control Inputs	$\overline{\text{ACK}}$, $\overline{\text{INPUT-PRIME}}$, $\overline{\text{DATA.STB}}$, $\overline{\text{FAULT}}$, BUSY, SELECT, PE, INPUT.BUSY
Input Buffer Size	3K bytes
Printer Connector	Japanese AMP 552742-1 or equivalent (DDK 57L-40360-27CB or equivalent)
Mating Connector	Japanese AMP 552470-1 or equivalent (DDK 57-40360-1 or equivalent)
Pin Assignments	**Figure F-1**
Interface Signals	**Table F-1**
Timing Charts	**Figure F-2 through F-4**

Figure F-1. Connector Pin Assignments



Pin No.	Signal Name	Pin No.	Signal Name
1	$\overline{\text{DATA STB}}$	19	GROUND (twisted pair — pin 1)
2	DATA 1	20	GROUND (twisted pair — pin 2)
3	DATA 2	21	GROUND (twisted pair — pin 3)
4	DATA 3	22	GROUND (twisted pair — pin 4)
5	DATA 4	23	GROUND (twisted pair — pin 5)
6	DATA 5	24	GROUND (twisted pair — pin 6)
7	DATA 6	25	GROUND (twisted pair — pin 7)
8	DATA 7	26	GROUND (twisted pair — pin 8)
9	DATA 8	27	GROUND (twisted pair — pin 9)
10	$\overline{\text{ACK}}$	28	GROUND (twisted pair — pin 10)
11	INPUT-BUSY	29	GROUND (twisted pair — pin 11)
12	PE	30	GROUND (twisted pair — pin 31)
13	SELECT	31	$\overline{\text{INPUT-PRIME}}$
14	OV	32	$\overline{\text{FAULT}}$
15	NC	33	OV
16	OV	34	NC
17	CHASSIS GROUND	35	NC
18	+5 vdc	36	INPUT-BUSY

NOTE: Pin 11 can be used for BUSY signal on the CPU PC board (jumper selectable)

Jumper No. J3: J:12 INPUT BUSY
J2: J13 BUSY

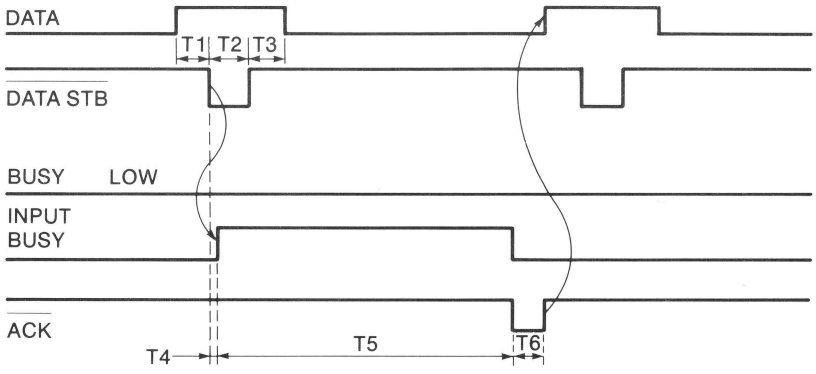
Table F-1 Interface Signals

Signal	Function
DATA 1-8	8-bit parallel input data signal (also used in graphics mode). • Logic 1 represents HIGH level • Minimum data pulse width is 3 microseconds
DATA.STROBE or DATA.STB	Synchronizing signal for reading-in the data signal. • This signal is normally HIGH. The data signal is clocked-in when DATA.STB is set LOW by the host computer. • Minimum pulse width is 1 microsecond
INPUT.PRIME	This input signal brings the electronic controls of the printer to the initial state. (This signal will not affect SELECT/DESELECT or the pre-set VFU conditions.) • Upon receipt of this signal, all data stored in the DATA BUFFER will be printed; the printer will then return to the initial state. • This signal is normally HIGH. INPUT.PRIME is activated when the signal is LOW. • Minimum pulse width is 1 microsecond. • After receiving an INPUT.PRIME, allow a delay time (5 ms.) until next data is received.
ACKNOWLEDGE ACK	The printer transmits this signal to the host computer after it has received and processed input data and performed any function commands. (This signal indicates that the printer is ready to receive additional data or function codes.) • When the DESELECT state changes to the SELECT state, an ACK signal is also output. • The printer will not transmit this signal when a DC1 code is entered during PE status, nor in the case where a DC3 code is received under a SELECT state. • Nominal pulse width is 5.5 microseconds • This signal is normally HIGH. ACK is activated when the signal is LOW.
PAPER EMPTY (PE)	Output signal from the printer indicating that the paper end is near (less than 25mm from the end). PE status is also created when no paper is present. • This signal is activated by a microswitch located below the platen. • This signal is HIGH when activated.
FAULT	Output signal from the printer indicating printer FAULT state. • This signal is LOW during a FAULT state.

Signal	Function
	• FAULT state occurs under any of the following conditions: 1. Under a PE state. (However, if the SEL switch is depressed during a FAULT state, the FAULT signal will temporarily become HIGH, enabling the printing of one line before returning to LOW.) 2. Under a DESELECT state. 3. An error or malfunction has occurred in the printer. (e.g., no timing pulses are generated) 4. Cover Open is detected.
INPUT BUSY	Output signal is similar to the BUSY signal. When HIGH, INPUT.BUSY indicates that the printer is not ready to receive data. • INPUT.BUSY becomes HIGH whenever DATA.STB or BUSY is activated. • INPUT.BUSY becomes LOW when ACK is activated, either simultaneously with ACK or immediately after.
+5V DC	+5V DC power source to an outside device. (The maximum output amperage is 5OmA.)
BUSY	Output signal from the printer. When the signal is HIGH, no input codes or data except DC1 may enter the printer. • This signal will be HIGH (BUSY) under any of the following conditions: 1. The RECEIVE BUFFER is full. 2. The printer is in the DESELECT state. 3. The printer is in the FAULT state. 4. An INPUT PRIME code is received. (The BUSY status in this case will be cancelled after a specified period of time if the INPUT PRIME signal is HIGH). 5. Reception is not ready during the operation.
SELECT	Output signal from the printer, indicating whether the printer is in a SELECT or DESELECT state. • The signal is HIGH under SELECT and LOW under DESELECT. • SELECT state occurs under any of the following conditions:

Signal	Function
	1. The SEL switch is depressed under a DESELECT state. (However, if the SEL switch is depressed during a PE state, the printer will temporarily assume the SELECT state and print one line of data before returning to the DESELECT state. This override function enables the printing of the last few lines of a report, even under a PE state. 2. The DC1 code is received under a DESELECT state 3. The power switch is turned-on while the selector switch is closed. • DESELECT state will occur under any of the following conditions: 1. The SEL switch is depressed under a SELECT state. 2. A DC3 code is received. 3. The printer is in the PE state. 4. The power switch is turned-on while the selector switch is open. 5. The printer is in a FAULT state.

Figure F-2. Timing Chart — Data Received



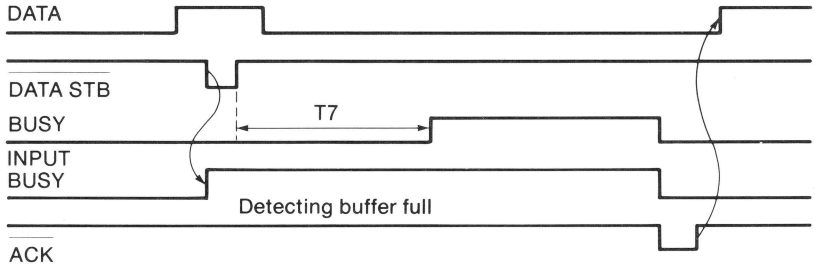
T1∽T3 = MIN 1 μs

T4 = MAX 400 ns

T5 = MAX 2 ms

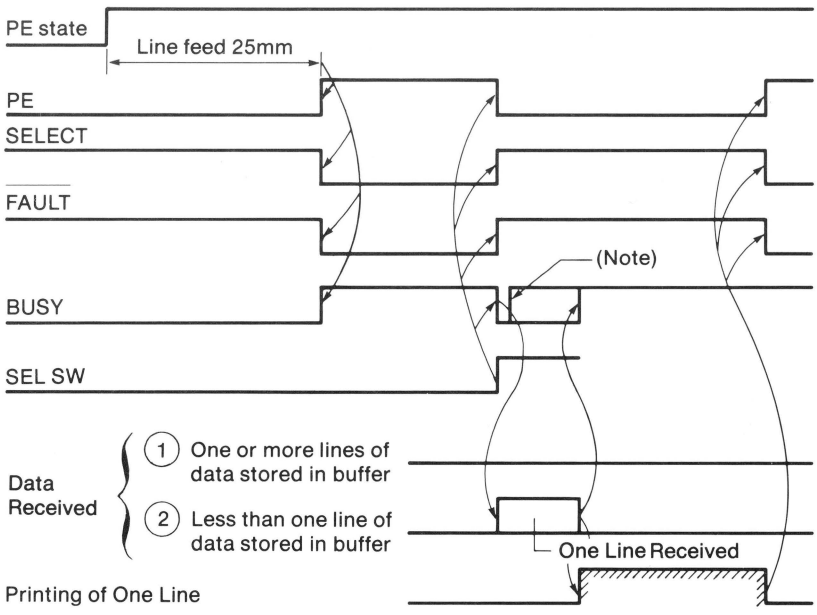
T6 = 5.5μs

Figure F-3. Timing Chart — Data Buffer Full



T7 = MAX 2 ms

Figure F-4. Timing Chart — PE Detected in SELECT Status



Note: One or more lines of data are stored in the buffer.

Glossary

ASCII Acronym for American Standard Code for Information Interchange, the code in which information is sent to the Apple Dot Matrix Printer. It assigns a unique binary number to each character. See Appendix C.

binary The number system used by most digital computers. Every binary number consists of a string of zeros and ones; the farthest right (least significant) digit has a value of 1, the next a value of 2, then 4, 8, 16, and so on.

bit A single binary digit, consisting of either a zero or a one.

boot disk A disk containing the programs and data that the Apple Computer needs to get started when power is turned on.

buffer A memory area that holds information until it can be processed. The Apple Dot Matrix Printer has an input buffer, which stores excess incoming text until the mechanism has time to print it.

byte A binary number of fixed length. In the Apple Dot Matrix Printer, bytes are eight bits long. Every character processed by the printer can be expressed as one byte, using the ASCII code.

character Any letter, number, punctuation mark, or control code that can be acted upon by the printer. There are 256 possible characters, corresponding to the range of eight-bit binary numbers.

character pitch The number of characters per inch printed along a horizontal line.

character set The entire set of characters that can be printed by a device such as the Apple Dot Matrix Printer.

clear To erase information or commands from a memory, as when the Apple Dot Matrix Printer clears its horizontal tab stops.

command structure The nature and interrelations of all the possible instructions that can be sent to a device such as a computer or printer. The Apple Dot Matrix Printer's command structure is summarized in Appendix B.

compile To convert a program (source file) written by a human being into a file of commands that the computer can follow to make the program work.

control character A non-printing ASCII character that allows you to perform special functions with the Apple Dot Matrix Printer.

control code One or more characters whose function is to change the way the printer acts (as opposed to text, which is simply printed).

device A piece of equipment connected to a computer. The Apple Dot Matrix Printer is a device, along with the video monitor, disk drives, and so on.

DIP switch A small switch, which can be operated manually. There are 16 DIP switches located inside the case of the Apple Dot Matrix Printer. See Chapter 4, Controlling Your Printer. DIP stands for Dual In-Line Package.

disk drive A device that records and reads computer disks, somewhat like a phonograph.

dot matrix The method by which the Apple Dot Matrix Printer prints.

Each character is formed by a pattern of dots, each of which is located at one of the intersections of a fixed grid.

editor A program that helps the user create and change text files by providing commands to insert and delete text, and perform other functions.

end-of-line character (EOL) Any character that tells the printer that the preceding text constitutes a full line and may now be printed.

ESCAPE character An ASCII character that allows you to perform special functions with the Apple Dot Matrix Printer.

escape code A sequence of characters, beginning with ESCAPE, that constitutes a complete command to the printer (see Chapter 4, Controlling Your Printer).

EVFU, Electronic Vertical Form Unit A section of memory in the Apple Dot Matrix Printer that holds vertical tab commands for an entire page.

execute To perform the actions specified by a program command or sequence of commands.

fanfold paper Special paper supplied for computer printers such as the Apple Dot Matrix Printer. One continuous sheet, perforated and folded like the letter Z so that it lies in a stack.

file In a computer, a collection of data with a name. Similar to the files in a file cabinet. Apple computer files are normally stored on disks.

font A complete set of type in one size and style of characters.

format The general shape and appearance of the printer's output, including page size, character width and spacing, line spacing, and other factors.

function In a programming language, an instruction that converts data from one form to another. The CHR or CHR$ function, for example, converts an ASCII code number into its corresponding character.

graphics Designs and pictures as opposed to written text, when referring to the capabilities of a device such as a printer.

hardware In computer technology, the physical machinery; opposed to **software**, the program instructions.

hex, hexadecimal The base-16 number system. (Ordinary decimal numbers are base-10.) Hexadecimal numerals consist of 0, the numerals 1-9, and the capital letters A-F. See Appendix C.

high ASCII characters ASCII characters with decimal value of 128 to 255. Called *high* ASCII because their high bit (first binary digit) is set to *1* (for on) rather than 0 (for off).

integer BASIC The simplest version of the BASIC programming language that can be used with Apple computers. BASIC stands for Beginners All-Purpose Symbolic Instruction Code.

interface In computer hardware, the equipment that accepts electrical signals from one part of a system and renders them into a form that can be used by another part.

interlock In a machine such as a printer, a safety device that prevents operation under certain conditions, such as when the cover is open.

leading zero A zero occurring at the beginning of a number, deleted by most computing programs.

LF, Line Feed An ASCII character (hex code ØA) that instructs a device such as a printer to feed one line of paper.

line feed pitch The number of lines printed per vertical inch.

memory Any part of a computer system that stores data.

microprocessor A small circuit component (about the size of a postage stamp) that performs a complete set of basic computing functions.

operating system The most fundamental program in a computer, which organizes the actions of the various parts of the computer and allows it to use other programs.

overflow The condition that exists when an attempt is made to put more data into a memory than it can hold.

override To modify or cancel a long-standing instruction with a temporary one.

Pascal A higher-level programming language with statements that resemble English sentences. Named after the philosopher and mathematician, Blaise Pascal.

pin-feed paper Special paper that has sprocket holes along both edges, for printers such as the Apple Dot Matrix Printer.

platen The rubber roller in a printer, which provides a backing for the printing action.

procedure In the Pascal programming language, a set of instructions that work as a unit; equivalent to the subprogram in BASIC.

SEL, Select A command to a device such as a printer to place it into a condition to receive data.

6502 Language The programming language actually used by the components of Apple computers; also called "machine code."

software In general, programs and program instructions; as opposed to **hardware**, the machinery that runs software.

sprocket In the Apple Dot Matrix Printer, either of the toothed wheels at the back that engage pin-feed paper and push it through the machine.

stack In a computer, a memory that is used for temporary storage of operating data during operation of a program.

standard instruction An instruction automatically present when no superseding instruction has been received. The Apple Dot Matrix Printer assumes a set of standard instructions every time power is turned on. These are listed in Appendix B.

TAB An ASCII character that commands a device such as a printer to start printing at a preset location (called a tab stop). There are two such characters: horizontal tab (hex Ø9) and vertical tab (hex ØB). Corresponds to tab on a typewriter.

TOF, Top of Form In the Apple Dot Matrix Printer, a command for the printer to feed paper until it has advanced a certain number of lines from the last TOF position.

typehead In the Apple Dot Matrix Printer, the part that moves horizontally along the platen and performs the actual printing.

wires In the Apple Dot Matrix Printer, the nine strikers in the typehead, each of which prints one dot.

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Apple Dot Matrix Printer, User's Manual, Part I

Reference
Reader Response Card

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- ☐ extensive

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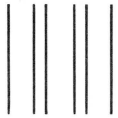

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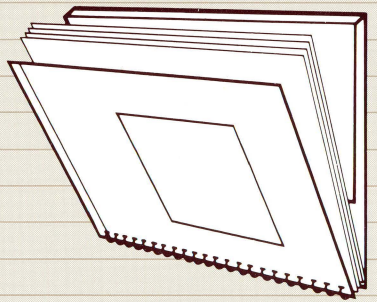

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