

EPSON®
LX-86™ PRINTER
User's Manual

FCC COMPLIANCE STATEMENT FOR AMERICAN USERS

This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna
- Relocate the printer with respect to the receiver
- Plug the printer into a different outlet so that printer and receiver are on different branch circuits.

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

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

This booklet is available from the U.S. Government Printing Office, Washington DC 20402. Stock No. 004-000-00345-4.

WARNING

The connection of a non-shielded printer interface cable to this printer will invalidate the FCC Certification of this device and may cause interference levels which exceed the limits established by the FCC for this equipment. If this equipment has more than one interface connector, do not leave cables connected to unused interfaces.

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Introduction

The Epson IX-86 printer combines low price with the high quality and advanced features formerly available only on more expensive printers.

LX-86 Features

In addition to the high performance and reliability you've come to expect from Epson printers, the LX-86 offers:

- Draft mode for quick printing of ordinary work
- Near Letter Quality mode for top quality printing
- Selection of typesyles with the control panel
- Fast printing (120 characters per second in draft pica)
- A variety of print styles, including Roman, italic, six widths, and two kinds of bold printing
- User-definable characters so you can create and print your own symbols or characters
- High-resolution graphics for charts, diagrams, and illustrations
- Easy paper loading
- Ribbon cassette for quick and clean ribbon changing
- Epson Standard Character Graphics set, which includes character graphics that are used on IBM® and compatible computers as well as international characters used by IBM software. These characters are shown below:

[illegible]

About This Manual

We're not going to waste your time with unnecessary information, but we won't neglect anything you need to know about the Ix-86 and its many features.

You can read as much or as little of this manual as you wish. If you have used printers before and have a specific program that you want to use with the LX-86, a quick reading of the first chapter may be all you need. If, on the other hand, you are new to computers and printers, you will find this manual easy to follow and the LX-86 easy to use. No matter what your background, if you want to learn about and experiment with all the advanced features of the LX-86, the information you need is here.

For a preview of what your LX-86 can do, look at the following samples of a few of its typestyles.

* N E A R L E T T E R Q U A L I T Y

NLQ standard	ABCDEFGHIJ.KLMnopqrstuvwxyz
NLQ emphasized	ABCDEFGHIJKLMnopqrstuvwxyz

* D R A F T M O D E

P i c a	ABCDEFGHIJKLMnopqrstuvwxyz
E l i t e	ABCDEFGHIJKLMnopqrstuvwxyz
Condensed	ABCDEFGHIJKLMnopqrstuvwxyz
I t a l i c	ABCDEFGHIJKLMnopqrstuvwxyz
Underlined	ABCDEFGHIJKLMnopqrstuvwxyz
E m p h a s i z e d	ABCDEFGHIJKLMnopqrstuvwxyz
d o u b l e - w i d t h	ABCDEFGHIJKLMnopqrstuvwxyz

Chapter 1

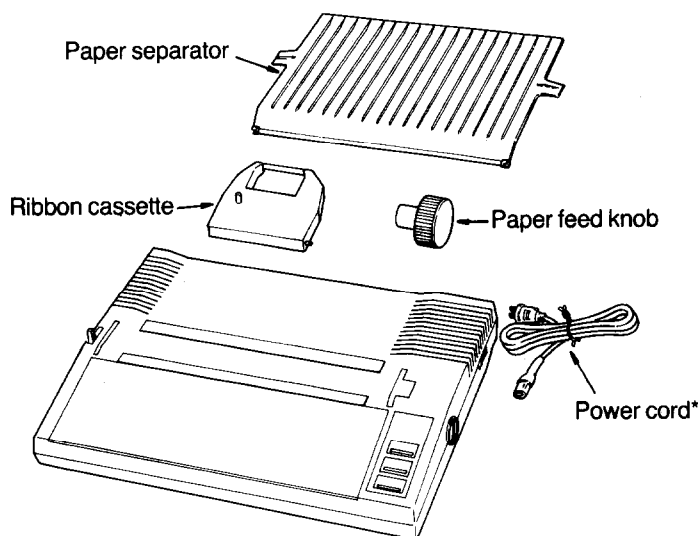
Setting Up Your LX-86 Printer

Setting up your LX-86 printer is a simple matter of attaching two parts, putting in the ribbon and paper, and connecting the printer to your computer.

This chapter will have you printing a test pattern within fifteen to twenty minutes and doing more complicated work not long after.

Printer Parts

First, see that you have all the parts you need. In addition to this manual, the printer box should contain the items shown in Figure 1-1.



* In the United States, the printer is delivered with the power cord attached.

Figure 1-1. Printer parts

In addition to the items in the box, you need a cable and possibly an interface board. The cable connects the printer to your computer, and the interface board is necessary only for those computers that can't use the LX-86's Centronics® parallel interface. Your computer manual or your dealer will tell you which cable you need and whether or not you need a special interface.

Printer Location

Now that you have unpacked your printer, you should choose a suitable location for it. The main requirement, of course, is that the printer be close enough to your computer for the cable to reach. Also remember the following:

- Use a grounded outlet, and do not use an adapter plug.
- Avoid using electrical outlets that are controlled by wall switches. Accidentally turning off a switch can wipe out valuable information in your computer's memory and disrupt your printing.
- Avoid using an outlet on the same circuit breaker with any large electrical machines or appliances. These can cause disruptive power fluctuations.
- Keep your printer and computer away from base units for cordless telephones.
- Protect the printer from direct sunlight, excessive heat, moisture, and dust. Make sure that it is not close to a heater or other heat source.

Paper Feed Knob Installation

Now that you have chosen where to set up your LX-86, the first and simplest piece to install is the paper feed knob, which you use to manually advance the paper-just as you do on a typewriter. To install the knob, merely push it onto the shaft found in the hole on the right side of the printer. (See Figure 1-2.) The shaft has one flat side that must be matched with the flat side of the hole in the knob.

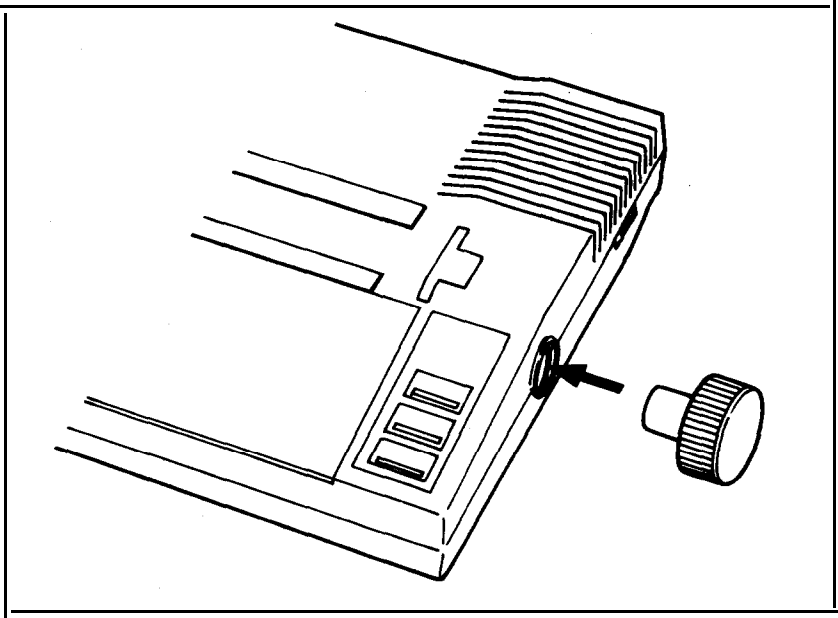


Figure 1-2. Paper feed knob installation

Ribbon Installation

The LX-86 printer uses a continuous-loop, inked fabric ribbon, which is enclosed in a cassette that makes ribbon installation and replacement a clean and easy job. The parts of this cassette are labelled in Figure 1-3.

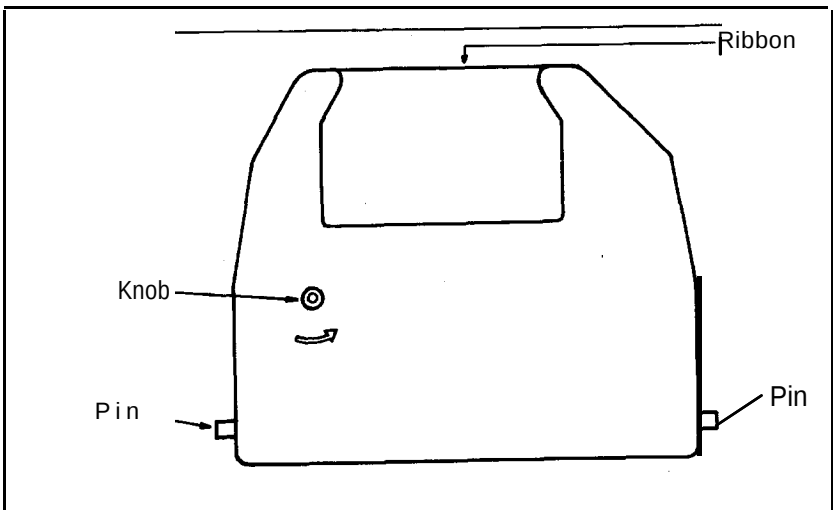


Figure 1-3. Ribbon cassette

To install the ribbon, first open the lid at the front of the LX-86 so that you can see the print head assembly shown in Figure 1-4. Move the assembly by hand to the center of the printer so that the other parts of the printer will not get in your way. Also be sure that the paper bail is against the black roller so it too will not be in your way.

Note: Moving the print head by hand when the printer is turned on can harm the printer. Always be sure that the printer is turned off before you move the print head.

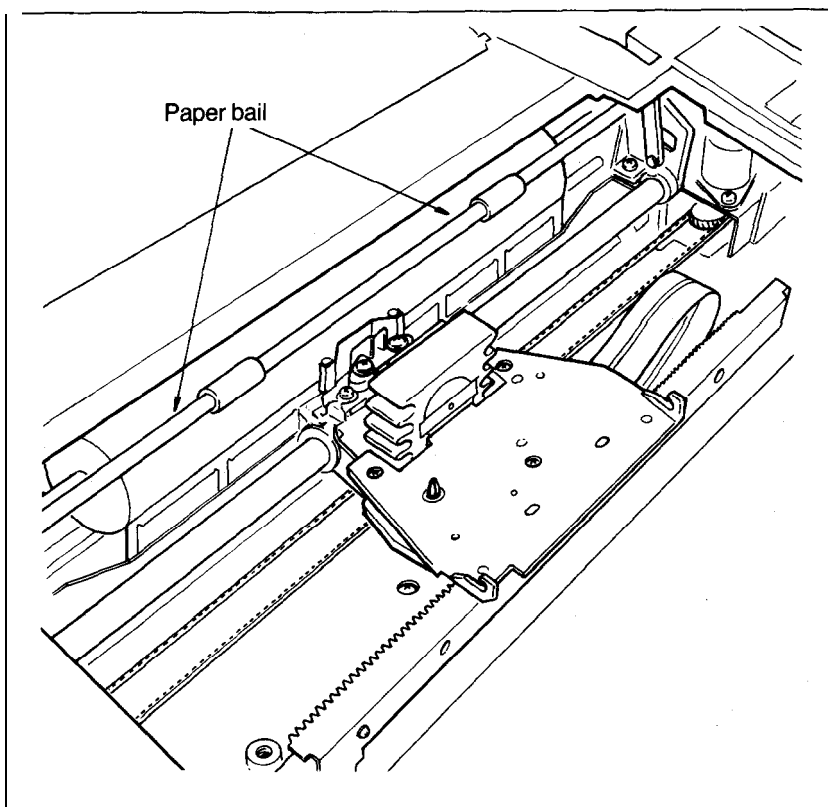


Figure 1-4. Print head assembly

Then hold the ribbon cassette so that the small knob is **on** top and the exposed section of ribbon is away from you. Insert the cassette in its holder by first sliding the pins at the back of the ribbon cassette under the small hooks on the holder. (See Figure 1-5.) Then lower the front of the cassette so that the exposed section of ribbon can fit between the print head nose and the silver ribbon guide. Push down until the cassette fits firmly in place.

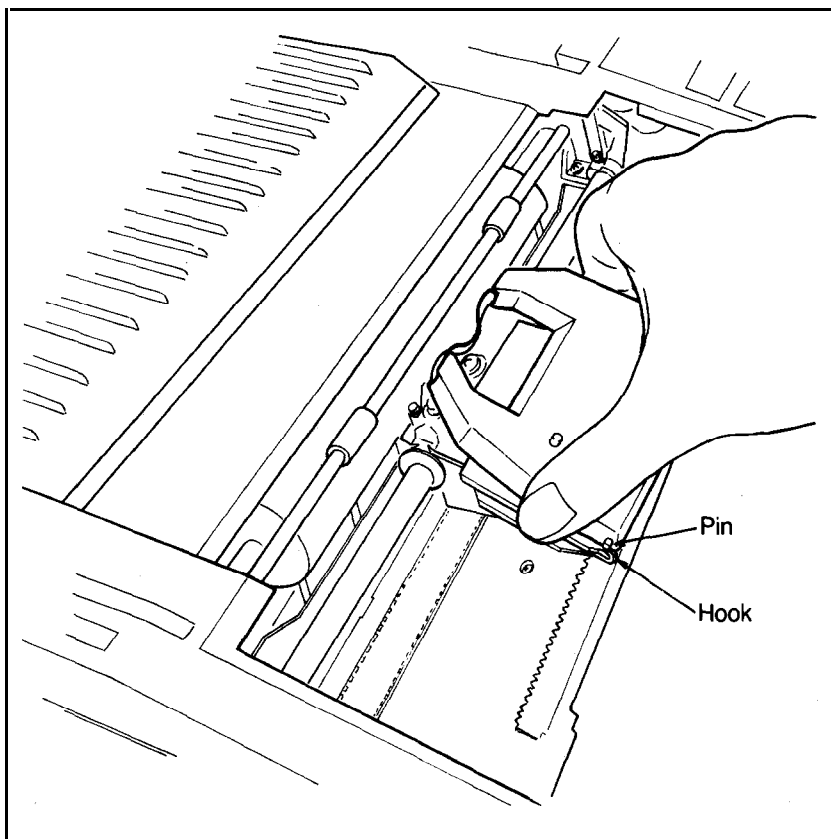


Figure 1-5. Ribbon cassette installation

Now turn the knob on the cassette in the direction of the arrow to tighten the ribbon. As you turn the knob, see that the ribbon slips down into its proper place between the print head nose and the silver ribbon guide (Figure 1-6). If it doesn't, guide it with a pen or a pencil.

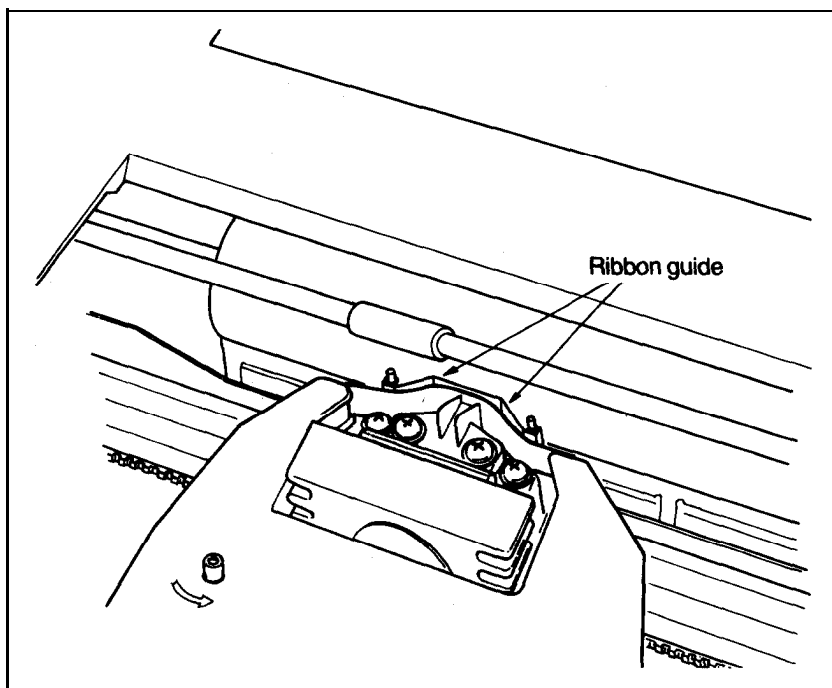


Figure 1-6. Ribbon placement

Ribbon Replacement

When your printing begins to become light and you need to replace the ribbon, lift the front of the cassette to remove it and then follow the above instructions with a new cassette. If you have been using your printer just before you change cassettes, be aware that the print head becomes hot during use. Be careful not to touch it. Also remember never to move the print head by hand when the printer is turned on.

Paper Loading

Now put a sheet of paper in your LX-86 so you can test it. Figure 1-7 shows the names of the parts that you need to know.

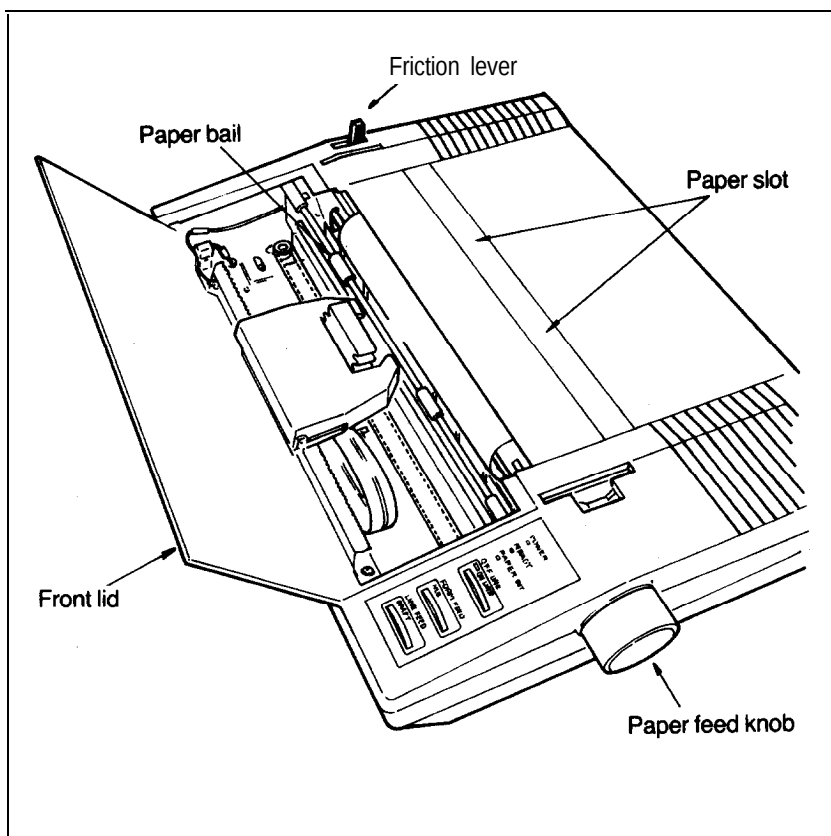


Figure 1-7. LX-86 ready for paper loading

See that the printer is turned off, open the front lid, and push the friction lever back and the paper bail forward. Then move the print head by hand to the center of the printer and feed the paper into the paper slot in the top of the printer.

When the paper will not go any farther, turn the paper feed knob to advance it as you would with a typewriter. Turn the knob until the top of the paper is at least 3/4-inch above the ribbon guide. Then push the paper bail against the paper. If the paper becomes crooked, pull the friction-release lever forward, straighten the paper, and push the friction lever back.

If you have the optional tractor unit for continuous pin-feed paper, see Appendix E for instructions on its use.

Control Panel

Now that your paper is loaded, it is time to plug in the printer and see what the buttons on the control panel do. First, see that the power switch on the right side of the printer is off. Then plug in the power cord. Now turn on the power switch and look at the control panel.

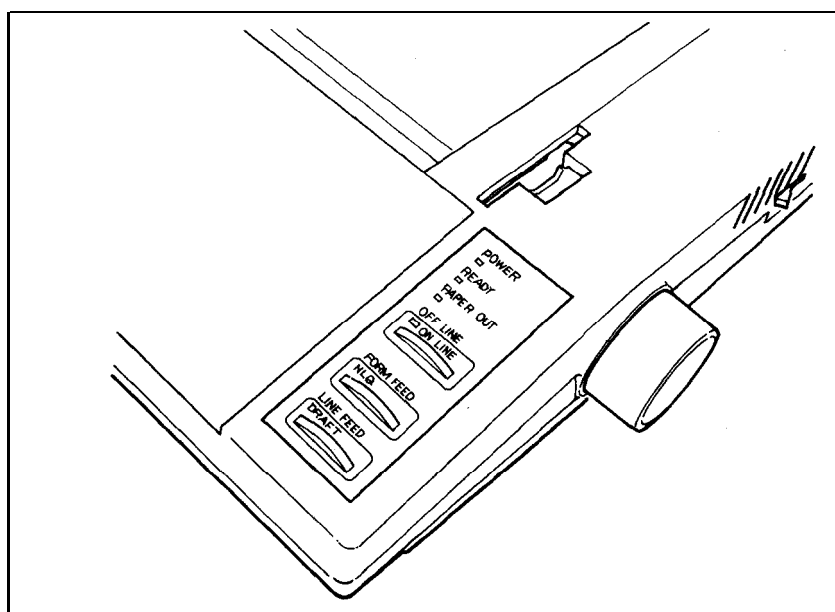


Figure 1-8. Control panel

There are three buttons and four indicator lights on the control panel.

Lights

- The POWER light glows green when the power is on.
- The READY light glows green when the printer is ready to accept data. This light flickers somewhat during printing.
- The PAPER OUT light glows red to indicate that the printer is out of paper or the paper is loaded incorrectly.
- The ON LINE light glows green when the printer can receive data.

Buttons

The buttons have several functions, including selecting draft or NLQ (Near Letter Quality) printing. Draft is good for quick printing of ordinary work, and NLQ has more fully-formed characters for final copies or special purposes.

This is high-quality NLQ printing.
This is fast draft printing.

- ON LINE/OFF LINE. This button switches the printer between on-line and off-line status. When the printer is on line, the ON LINE light glows and the printer is ready to accept data.
- FORM FEED/NLQ. When the printer is on line, pressing this button turns on NLQ. When the printer is off line, this button advances the paper to the top of the next page.
- LINE FEED/DRAFT. When the printer is on line, this button turns on draft printing. When the printer is off line, this button advances the paper one line at a time.

Test Pattern

Now you'll see your Lx-86 print something even though it's not connected to a computer yet. Make sure that your printer has paper in it and that the power switch is off. Now, hold down the LINE FEED button on the control panel while you turn the printer on with the power switch. The Lx-86 will begin printing all the letters, numbers and other characters that are stored in its ROM (Read Only Memory) for the draft mode. When the printing starts, you can release the LINE FEED button; the printing will continue until you turn the printer off or until the print head gets near the end of the page. To see the same test in the NLQ (Near Letter Quality) mode, turn the printer on while holding down the FORM FEED button. Partial results of both tests are shown in Figure 1-9.

```
<Draft>
123456789 : <=> ?@ABCDEFGHIJKLMNQRSTUUVWXY
2 3 4 5 6 7 8 9 : ; <=> ?@ABCDEFGHIJKLMNQRSTUUVWXYZ
3456789 ; <=> ?@ABCDEFGHIJKLMNQRSTUUVWXYZ[
4 5 6 7 8 9 : ; <=> ?@ABCDEFGHIJKLMNQRSTUUVWXYZ[\
5 6 7 8 9 : ; <=> ?@ABCDEFGHIJKLMNQRSTUUVWXYZ[\]
6 7 8 9 : ' <=> ?@ABCDEFGHIJKLMNQRSTUUVWXYZ[\]^
789 : ; <=> ?@ABCDEFGHIJKLMNQRSTUUVWXYZ[\]^_
8 9 : ; <=> ?@ABCDEFGHIJKLMNQRSTUUVWXYZ[\]^_`
9 : ; <=> ?@ABCDEFGHIJKLMNQRSTUUVWXYZ[\]^_`a
; <=> ?@ABCDEFGHIJKLMNQRSTUUVWXYZ[/]^_`ab
; <=> ?@ABCDEFGHIJKLMNOPQTRSTUUVWXYZ[\]^_`abc
<=> ?@ABCDEFGHIJKLMNOPQTRSTUUVWXYZ[\]^_`abcd

<NLQ>
123456789: ; <=>?@ABCDEFGHIJKLMOPQPSTUUVWXY
23456789: ; <=>?@ABCDEFGHIJKLMHOPQRSTUUVWXYZ
3456789: ; <=>?@ABCDEFGHIJKLMNQRSTUUVWXYZ[
456789: ; <=>?@ABCDEFGHIJKLMNQRSTUUVWXYZ[\
56789: ; <=>?@ABCDEFGHIJKLMHOPQRSTUUVWXYZ[\]
6789: ; <=>?@ABCDEFGHIJKLMNQRSTUUVWXYZ[\]^
789: ; <=>?@ABCDEFGHIJKLMNOPQESTUUVWXYZ[\]^_
89: ; <=>?@ABCDEFGHIJKLMNOPQESTUUVWXYZ[\]^_`
9: ; <=>?@ABCDEFGHIJKLMHOPQRSTUUVWXYZ[\]^_`a
: ; <=>?@ABCDEFGHIJKLMNOPQESTUUVWXYZ[\]^_`ab
; <=>?BABCDEFGHIJKLMNQRSTUUVWXYZ[\]^_`abc
<=> ?@ABCDEFGHIJKLMNOPQESTUUVWXYZ[\]^_`abcd
```

Figure 1-9. Test patterns

Connecting the LX-86 to Your Computer

Now that the test pattern has shown that your printer is working well, it's time to hook it up to your computer. It is best to have both the printer and the computer turned off when you do this.

Remember that each computer system has its own way of communicating with a printer. If your computer expects to communicate through a Centronics parallel interface, all you need is a cable. If your computer requires any other kind of interface, you will also need an interface board.

If you don't know what a Centronics parallel interface is, your computer manual or your dealer will tell you what you need. Then, once you have plugged your printer cable into your printer and computer, you will probably never think about interfaces again. (If you do want the technical specifications, however, you can find them in Appendix I.)

The first three steps in connecting your printer and computer are shown in Figure I-10. Plug one end of your printer cable into the cable connector of your **LX-86** printer. The plug is shaped so that there is only one way it will fit the connector. Now secure the plug to the printer with the wire clips on each side of the connector. These clips insure that your cable will not be loosened or unplugged accidentally. If your cable has a grounding wire, fasten it to the grounding screw below the connector.

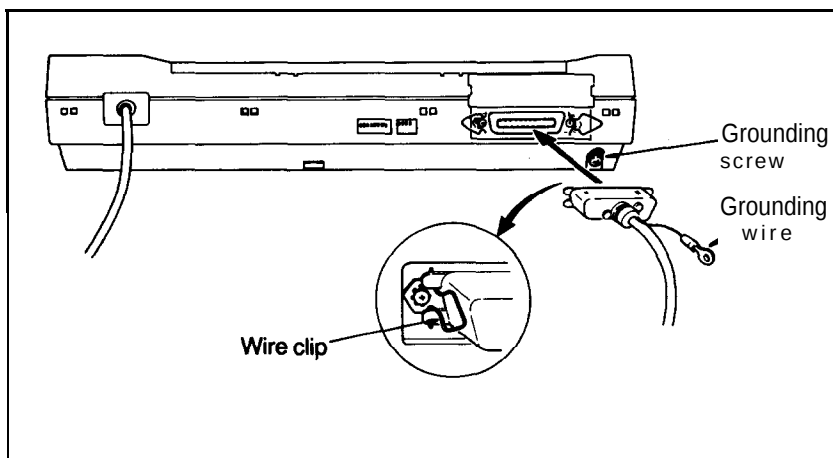


Figure I-10. Cable connection

Next connect the other end of the printer cable to your computer. On most computers you can easily find the correct connector for the printer cable, but if you are not sure, consult your computer manual or your dealer.

First Printing Exercise

Now it is time to see something more interesting than the test pattern from your LX-86 printer. Your next step depends upon what kind of printing you plan to do. If you have a word processing or other commercial software program, just load the program in your computer, follow its printing instructions, and watch your Lx-86 print. If you plan to use your LX-86 for printing program listings, load a program and use your computer system's listing command (LLIST for Microsoft™ BASIC, for example).

Note: If all the lines of your first printing exercise are printed on top of each other, don't worry. There is nothing wrong with your printer. All you have to do is change the setting of a small switch in the back of your printer. See the section on automatic line feeds in Appendix D.

Chapter 2

SelecType

The LX-86's SelecType feature can produce four special typestyles:

This is emphasized printing.

This is in ~~the~~ double-strike mode.

This is condensed printing.

This is in the elite mode.

SelecType Operation

Using SelecType is easy. You turn on SelecType and select a type-style, then turn off SelecType and print.

Note: Each button has two names. For convenience, this chapter uses the top names of the buttons.

Turning SelecType on

1. Make sure that the printer is on and that the POWER, READY, and ON LINE lights are all on.
2. Press both the OFF LINE and FORM FEED buttons at the same time, as illustrated in Figure 2-1. Hold them down for at least a second, then release them.

Note: If the printer beeps twice before you release the buttons, you have pressed the FORM FEED button before the OFF LINE button instead of at the same time and the LX-86 is in the NLQ mode. Press the OFF LINE button to put the printer back on line and press the DRAFT button if you do not want NLQ. Then press both the OFF LINE and FORM FEED buttons to turn on SelecType.

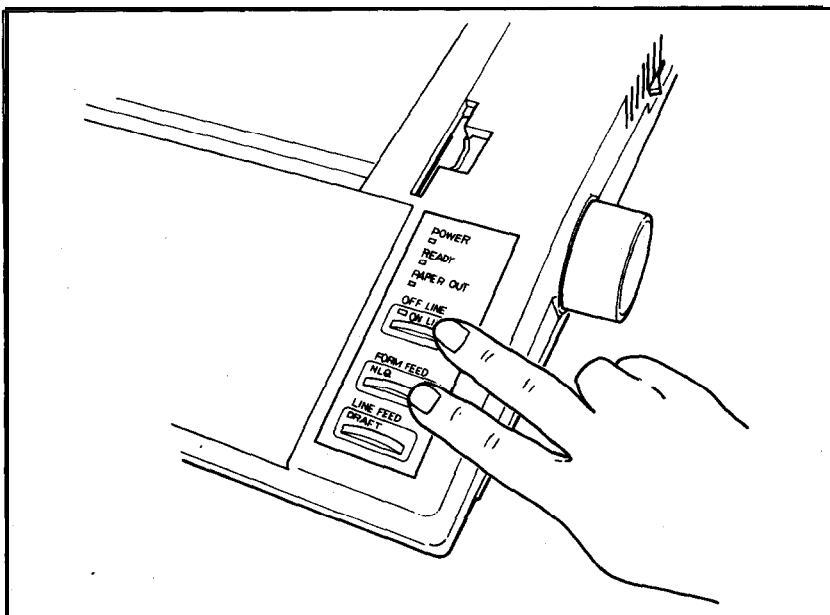


Figure 2-1. Turning SelecType on

When you release the OFF LINE and FORM FEED buttons, the LX-86 signals in three ways that SelecType is on.

- The printer beeps.
- The READY light turns off.
- The ON LINE light begins flashing.

Selecting typestyles

In SelecType, each button has a function:

- OFF LINE selects typestyles.
- *FORM FEED sets the styles.
- LINE FEED turns SelecType off.

After turning on SelecType, follow these three steps to select a typestyle:

1. Find the typestyle you want in Table 2-1.

Table 2-1. SelecType modes

Mode	Typestyle or Function	
1	Emphasized	ABCDEFGHIJKLMNOPQRSTUVWXYZ
2	Double&trike	ABCDEFGHIJKLMNOPQRSTUVWXYZ
3	condensed	ABCDEFGHIJKLMNOPQRSTUVWXYZ
4	Elite	ABCDEFGHIJKLMNOPQRSTUVWXYZ

2. Press the OFF LINE button the number of times indicated in the mode column. Be sure that the printer beeps each time you press the OFF LINE button.
3. Press the FORM FEED button to set the typestyle.
4. Press the LINE FEED button to turn SelecType off. The control panel returns to its normal functions, but the printer is off-line.
5. Press the OFF LINE button, and you are ready to print.

SelecType exercise

You don't need to know anything about programming for this exercise because it is merely for practice. If you would rather not use BASIC, use your word processing or business program to create a short file or document of the type you will usually print.

If you do want to use BASIC for this exercise, simply turn on your computer and printer and load BASIC. Then type the short program listed below. Only the words inside the quotation marks are printed. You can put anything you want there. (If your version of BASIC does not use LPRINT, consult your BASIC manual.)

```
10 LPRINT "This is an example"  
20 LPRINT " of LX printing. "
```

Now, run the program by typing RUN and pressing RETURN, or print your file or document by following the printing instructions of your software. The LX-86 will print your example in standard single-strike printing, as shown below:

This is an example
of LX printing.

Now that you have created a sample, follow these steps to print it in condensed mode:

1. See that both the ON LINE and READY lights are on.
2. Press the OFF LINE and FORM FEED buttons at the same time, then release them. You hear a beep to signal that SelecType is on.
3. As shown in Table 2-1, the code for condensed is three. Therefore, press the OFF LINE button three times. (Remember to make sure you hear a beep each time you press the OFF LINE button when you are in SelecType mode.)
4. Now that you have *selected* the condensed mode, push the FORM FEED button once to set it.
5. Push the LINE FEED button once to return the panel to its standard operation.
6. Press the OFF LINE button so the IX-86 is ready to print.

Now you have set the LX-86 to print in condensed mode. Print your sample once more. It should appear in condensed mode just as you see below:

This is an example
of LX printing.

Turn off your printer to cancel the condensed setting, and-if you wish-try this exercise with other modes.

Note: Some applications programs are designed to control all typestyle functions. These programs cancel all previous typestyle settings by sending an initialization signal before printing. Because this signal cancels SelecType settings, you will have to use the program's print options function instead of SelecType to select your typestyles. Therefore, if SelecType does not work with a particular applications program, consult its manual on how to select typestyles.

SelecType Tips

Once you have learned the simple technique for controlling print styles with SelecType, you can use it whenever you wish. You should be aware of a few restrictions, however.

- SelecType is designed to control the printing of an entire file or document, not an individual line or word.
- If you are using the NLQ mode, remember that the following SelecType modes are not available in NLQ: condensed, double-strike, and elite.
- If there are print codes in the document or file you are printing, those codes will override your SelecType settings. This seldom happens, since you usually won't use SelecType with files that have such codes, but if your IX-86 follows the SelecType instructions for only part of a document, print codes in the document may conflict with the SelecType modes.
- After you turn on a mode with SelecType, it stays in effect until the printer is turned off. If, for example, you use SelecType to print a document in emphasized, anything you print after that will be emphasized unless you first turn the printer off and back on.

Chapter 3

Elements of Dot Matrix Printing

This chapter is for those of you who want to know something about how your printer works. It's a simple, non-technical explanation of the basics of dot matrix printing that will help you understand some of the later chapters.

The Print Head

The IX-86 uses a print head with nine pins or wires mounted vertically. Each time a pin is fired, it strikes the inked ribbon and presses it against the paper to produce a dot. This dot is about $\frac{1}{72}$ nd of an inch in diameter. The size varies slightly depending upon the age of the ribbon and the type of paper used. As the head moves horizontally across the page, these pins are fired time after time in different patterns to produce letters, numbers, symbols, or graphics.

For example, to print a pica capital T, the head fires the top pin, moves $\frac{1}{60}$ th of an inch, fires the top pin again, moves $\frac{1}{60}$ th of an inch, fires the top seven pins, moves $\frac{1}{60}$ th of an inch, fires the top pin, moves another $\frac{1}{60}$ th of an inch, and fires the top pin once more to finish the letter.

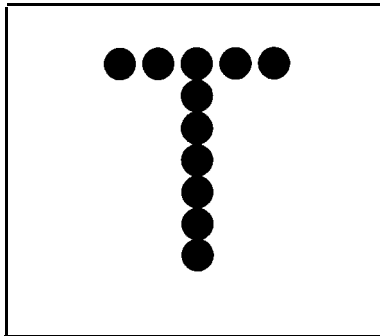


Figure 3-1. A capital T

Bidirectional Printing

In nearly all of our discussions in this manual, we describe the action of the LX-86 print head as moving from left to right, as a typewriter does. During its normal operation while printing in the draft mode, however, the LX-86 prints bidirectionally. That is, the print head goes from left to right only on every other line. On the other lines it reverses everything and prints right to left.

By reversing both the dot patterns and the printing direction, the LX-86 produces a line that is correct and looks no different from a line printed from left to right. It does this to save time. Otherwise, the time the print head takes to go from the right margin back to the left would be wasted.

The intelligence of the printer takes care of all the calculations necessary for this bidirectional printing, so you don't have to be concerned about it. You simply do your part of the work as if the printer will be printing from left to right on each line and let the LX-86 do all the necessary calculations so that you can enjoy the increased speed.

Changing Pitches

In addition to pica, in which there are **10** characters per inch, the LX-86 can also print in other widths, or pitches. It does so by reducing the distance between pin firings. In the elite mode it prints 12 characters per inch and in the compressed mode it prints 17 characters per inch. The pattern of the dots is not changed, but the horizontal space between them is reduced.

In Figure **3-2** are enlargements of four sample letters in each of the three pitches. These letters are chosen to show how the LX86 prints letters that are uppercase and lowercase, wide and narrow, and with and without descenders (the bottom part of the y).

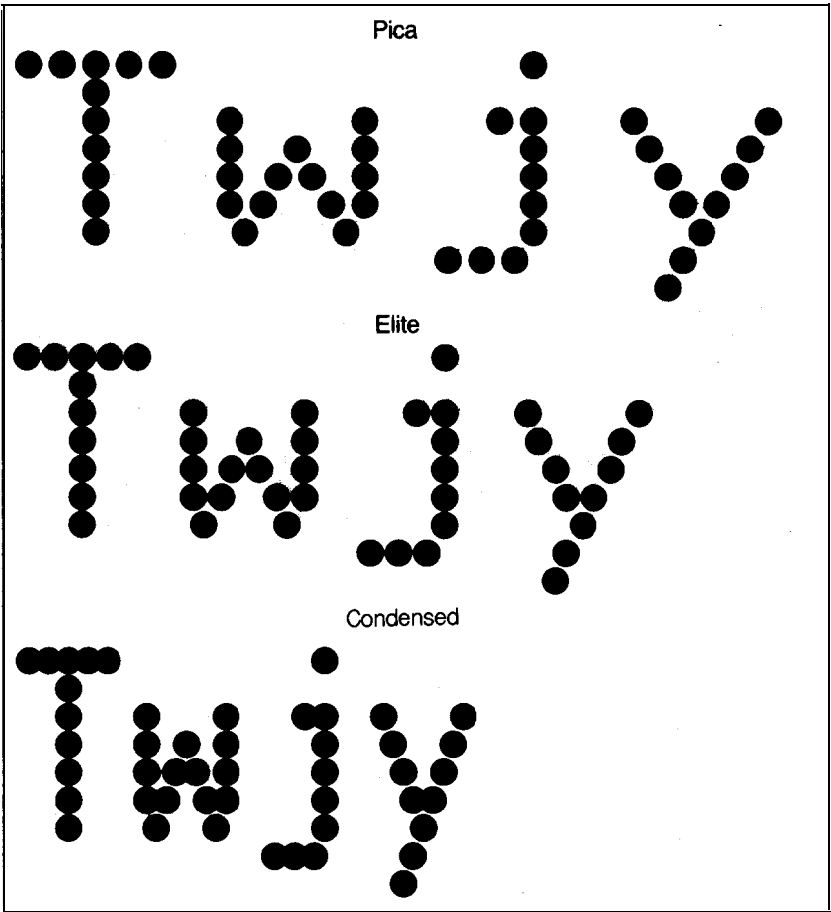


Figure 3-2. The three pitches of the LX-86

The dot pattern of each character is carefully designed so that in pica mode no dot overlaps another. The reason is that in normal high-speed printing of pica the pins cannot fire and retract and fire again quickly enough to print one dot overlapping another.

In Figure 3-3 there is a grid of lines behind the pica characters so that you can more easily see how they are designed. As you look at these characters you can see three rules that govern their design: the column on the right side is always left blank so that there will be spaces between the characters on a line; no character uses both the top and the bottom row; and a dot can be placed on a vertical line only when the columns next to that line are not used.

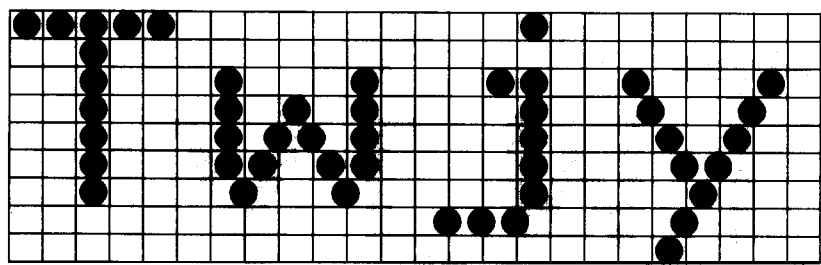


Figure 3-3. LX-86 dot matrix characters

NLQ Mode

The preceding examples are in the LX-86's draft mode, but the LX-86 also has the high-quality NLQ (Near Letter Quality) mode that you have seen in previous chapters.

The NLQ letters are more fully formed than the draft letters because they are made up of many more dots. Two differences between draft and NLQ printing enable the IX-86 to print such a large number of dots for each character. In the NLQ mode, the head moves more slowly, so that dots can overlap horizontally, and each character is printed with two passes of the print head.

To further ensure the quality of NLQ characters, both passes of the print head are in the same direction so the alignment of the dots is exact.

Because the NLQ mode uses two passes for each line and prints only in one direction, your printing does take longer in this mode.

With the two modes, draft and NLQ, the IX-86 lets you choose high speed or high quality each time you print. You can print your ordinary work or preliminary drafts quickly in the draft mode and use the NLQ mode for final copies or special purposes.

The panel buttons make it especially easy to change from draft to NLQ, but you can also select and cancel the NLQ mode with a software command which you can find in Chapter 5.

Chapter 4

Printer Control Codes

The LX-86 printer is easy to use, especially with commercial software that has print control features. This chapter explains some of the basics of printer control and communications to help you understand how a computer communicates with your printer. This information should also help you understand the terms used in your software or computer manual.

If you are an advanced user or a programmer, you may want to turn to Appendix C, which has a full summary of all the lx-86 commands.

ASCII Codes

When you write a document with a word processing program, you press keys with letters on them. When you send the document to a printer, it prints the letters on paper. The computer and the printer, however, do not use or understand letters of the alphabet. They function by manipulating **numbers**. Therefore, when you press the A key, for example, the computer sends a number to its memory. When the computer tells the printer to print that letter, it sends the number to the printer, which must then convert the number to a pattern of pins that will fire to print the dots that make up that letter.

The numbers that computers and printers use are in binary form, which means that they use only the digits 0 and **1**. In this manual, however, we use decimal numbers in our explanations because most users are more familiar with these numbers and because most programming languages and applications programs can use decimal numbers. The computer system or the program takes care of changing the decimal numbers to binary form for you.

Computer and printer interaction would be terribly confusing if different kinds of computers and printers used different numbers for the same letter of the alphabet. Therefore, most manufacturers of computers, printers, and software use the American Standard Code for Information Interchange, usually referred to as ASCII (pronounced ASK-Key). The ASCII standard covers the decimal numbers from 0 through 127 and includes codes for printable characters (letters, punctuation, numerals, and mathematical symbols) and a few control codes, such as the codes for sounding the beeper and performing a carriage return.

Although other codes are not standardized in the computer industry, the ASCII system means that at least the alphabet is standardized. A programmer or engineer knows, for example, that **72** is the decimal code for a capital H and **115** is the code for a lowercase s no matter what system he or she is using.

ESCAPE Code

Although the original ASCII standard was designed to use the decimal numbers 0 through 127, computer and printer manufacturers soon extended this range (to 0 through 255) in order to make room for more features. On the IX-86, for example, the codes from 160 through 254 are used for italic or character graphics characters. Because even this extended range is not enough for all the features used on modern printers, the range is further extended with a special code called the Escape code. This code is often printed with the first three letters capitalized (ESCAPE) or abbreviated as ESC or <ESC> .

With the ESCAPE code, for which decimal 27 is used, printers and computers are not restricted to only 256 instructions. The ESCAPE code is a signal that the next code will be a printer control code instead of text to print. For example, if the printer receives the number 69, it prints a capital E because 69 is the ASCII code for that letter. If, however, the printer receives a 27 just before the 69, it turns on emphasized mode, because ESCAPE “E” is the code for emphasized.

You can see how important the ESCAPE code is by looking at Appendixes B and C. There you will see that nearly every code the **LX-86** uses is an ESCAPE code.

Printer Codes

To take advantage of the many print features of the IX-86, you can use a software program that sends the correct codes or you can use another method to send codes. It's not possible to be as precise and specific as we would like in the rest of this chapter because the IX-86 works with so many different applications programs and computer systems. If we gave precise instructions on how to use your LX-86 with every one of them, this manual would fill at least four volumes and would have to be updated every month.

We will, therefore, give you the general principles of how software communicates with your printer, plus several ways the codes of the LX-86 are used by applications programs such as word processing and business programs. With this information and possibly some help from your dealer or the manual for your applications program, you can take advantage of all the features of the LX-86 that you want to use. Incidentally, there is no standard terminology for software codes; thus, the terms in your software manual may be different from the ones we use here.

In general there are three ways you send printer codes with commercial software:

- Using SelecType, the feature described in Chapter 2.
- Instructing the program during an installation or setup procedure so that you can then use codes that are typed in along with your text or numbers; we call these embedded codes.
- Inserting LX-86 printer codes in your text along with a special code that tells the printer that the inserted codes are not text or data.

There are three common formats for sending printer codes. Your applications software or its manual should tell you which one to use.

- Decimal numbers—for example, **27** is the decimal number for the ESCape code, and 13 is the decimal number for a carriage return.
- Hexadecimal numbers, in which the ESCape code is **1B** and a carriage return is **0D**. You don't have to understand hexadecimal numbers to use them. If your software calls for hex numbers, just consult Appendix B or the Quick Reference Card for the appropriate number.

- The ESCape and control keys on your computer's keyboard. With this system you send the ESCape code by pressing the ESCape key and a carriage return by pressing the control key and the M at the same time. (See Appendix B or the Quick Reference Card for the control key codes.)

Embedded codes

A program that uses embedded codes usually has its own set of codes that you type into your document or file. When the program receives one of these codes, it sends the proper code to the LX-86. For example, one popular word processing program has you turn italic mode on and off by pressing the control key and P and then pressing the Q. So if you want to italicize a word, you type Control-PQ before it and after it. When the program reaches the first Control-PQ, it sends the code to turn italic mode on, and when it reaches the second, it sends the code to cancel italic. Please note that these are not the same as the control key codes mentioned above.

Once you tell such a program that you are using an Epson printer, it will know which codes to send. (Often you don't even need to specify which Epson printer you are using.) You usually tell the program what printer you are using through an installation or set-up procedure. The instructions should be in your software manual. In addition, your software or computer dealer may be able to help you.

Many programs that use embedded codes also have a few commands that the user can define. If you are new to using printers, don't worry about these yet. Just use the standard features. Later, when you are more familiar with your software and with your LX-86, you may want to investigate the user-defined commands and customize your program.

Inserted codes

To take advantage of some of the advanced features of the IX-86, some programs require inserted codes. Those codes allow you to send commands to the printer in the middle of text or data. In most of these programs one code signals that the next numbers are printer instructions, not text or data. In one such program, for example, you type Control-V (pressing V while holding down the control key) to signal the beginning of printer instructions. Then you enter your print codes and type Control-V again to signal the end of the printer instructions.

If your word processing program allows inserted codes, it will probably do standard printing without such codes. It is only for special features that you will need to use inserted codes. For example, if you want to have headings in wide bold printing (called double-width emphasized), you would probably have to use inserted codes. For the program we mentioned above you would type Control-V, then the code for double-width emphasized, Control-V again, and then the text of the heading. The codes for double-width emphasized are in Chapter 6 and Appendix C.

Again, if this sounds terribly complicated, don't worry. Use your LX-86 with the standard features of your word processing program until you become more familiar with both of them. Then you can decide whether or not you need or want to learn to use inserted codes.

See your software documentation for further information.

Programming Languages

If neither of the methods described above seems appropriate for your application, you can write a program in BASIC or any other programming language to send control codes to your printer. In the chapter on page formatting you will find examples of such programs. Just remember that with this method your printer control code stays in effect for the whole document you print. This method is good for setting margins, for example, but does not work for italicizing a word.

Now you have some background on how printers work and how software can communicate with them. Turn to the next chapters to learn about the specific features of your LX-86 printer.

Chapter 5

IX-86 Features

Beginning with this chapter we describe many of the printing features of the LX-86. Although we include programs that demonstrate these features, you don't have to be a programmer to learn about the features from these chapters. How much of the rest of this manual you use depends upon your expertise, your interest, and the software you plan to use.

(Demonstration Programs)

Along with our discussion and examples of the LX-86 features, we include demonstrations in the BASIC programming language so that you can see these features in action. Although we know that you will probably not do much of your printing using BASIC, we chose it for our demonstrations because most computer systems include some form of BASIC, so our examples are ones that almost every one of you can try.

You don't need to know anything about BASIC to type in and run these programs. Just check your BASIC manual to see how to load BASIC in your computer and how to run a program. As you run the programs (or even as you read the explanations and look at the printed examples), you learn how the LX-86 responds to the messages your computer sends it by printing letters, numbers, symbols, and graphics in various print modes.

Even if you never use BASIC again, you will know the capabilities of your printer, capabilities that can often solve your printing problems. For example, if you need a special symbol you will know that you can turn to the chapter on user-defined characters and create such a character.

If you don't want to do the exercises in **BASIC**, you don't have to. Many users are quite happy with their printers without ever learning any more about them than how to turn them on and off and how to load paper. Therefore, you shouldn't be intimidated by the information in this manual. In most cases the software that you use for word processing, business, or graphics does the calculating and communicating with the printer for you.

In fact, because of Epson's long-standing popularity, many programs are designed to use Epson printers quite easily. Often all you need to do is specify in an installation program that you are using an Epson printer. Then the program sends the correct codes for the various printing functions. The installation process, if there is one, is explained in the manual for your software program.

We have designed these chapters so that you can concentrate on using the features of the LX-86 instead of on programming, but a few instructions are necessary. Because the examples in this manual are in Microsoft BASIC (MBASIC), one of the most widely used types of BASIC in personal computers, most users can enter and run the programs exactly as they appear in these pages.

If your computer system uses any other kind of BASIC, you may have to make a few changes. Probably the only item you will need to change is the instruction LPRINT, which is the MBASIC command to send something to the printer. Some forms of BASIC use PR#1 at the beginning of a program to route information to the printer and PR#0 at the end to restore the flow of information to the screen. If you have such a system, just put PR#1 at the beginning of your program and then use PRINT instead of LPRINT in the programs. If you have any other system, consult its manual to see if any modifications to our programs are necessary.

In Chapter 3 you saw the enlargements of the three LX-86 pitches. Now you'll learn how to produce them.

Pica Printing

The first exercise is a simple three-line program to print a sample line of characters in pica, the standard pitch. Just type in this program exactly as you see it:

```
40 FOR X=65 TO 105
50 LPRINT CHR$(X);
60 NEXT X: LPRINT
```

Now run the program. You should get the results you see below, **10** pica characters per inch.

```
ABCDEFGHIJKLMN OPQRSTUVWXYZ[\]^_`abcdefghijkl
```

Changing Pitches

Now you can try other pitches. As we explained in Chapter 3, the IX-86 uses the same pattern of dots for pica, elite, and condensed characters, but it changes the horizontal spaces between the dots to produce the three different widths.

In elite mode there are 12 characters per inch, and in condensed there are **17**. The LX-86 prints in elite when it receives the ESCape “M” command and prints in condensed when it receives the ASCII **15** command. Print a sample line of elite characters by adding this line **to** your previous program:

```
20 LPRINT CHR$ (27) “M” ;
```

This line uses the command for elite, ESCape “M”, to turn on that mode. Your printout should look like the one below.

```
ABCDEFGHI IJKLMNOPQRSTUVWXYZ[\I^_`abcde fghi
```

The next addition to the program cancels elite with ESCape “P” and turns on condensed with ASCII **15**:

```
30 LPRINT CHR$ (27) “P” CHR$ (15) ;
```

Now run the program to see the line printed in condensed mode.

```
ABCDEFGHIKLMNOPQRSTUVWXYZ[\]^_`abcdefghijkl
```

Cancelling Codes

As you saw in the third version of the print pitch program, you must cancel a code when you do not want it any more. With very few exceptions, the LX-86 modes stay on until they are cancelled. It is important to remember this because an **LX-86** mode can stay on even if you change from BASIC to another type of software. For example, if you print a memo with a word processing program after you run the program above, the printer will still be in condensed mode; therefore, the memo will be in condensed print. To cancel, use ASCII **18**.

To avoid having one program interfere with the printing modes of another, you can cancel a mode one of two ways:

- With a specific cancelling code, such as the ESCape “P” that we used above to cancel elite. Each mode has a cancelling code, which you can find in the discussion of the code and in Appendix B. Pica is an exception to this rule. To cancel pica, turn on elite.
- By resetting the printer, a method explained in the next section.

Resetting the Printer

Resetting your LX-86 cancels all modes that are turned on. You can reset the printer with one of two methods:

- Sending the reset code (ESCape “@”)
- Turning the printer off and back on.

Either one of these methods returns the printer to what are called its defaults, which are the standard settings that are in effect every time you turn the printer on. The two effects of resetting the printer that you should be concerned with are: it returns the printing to single-strike pica, thus cancelling any other pitches or enhancements you may have turned on with control codes or SelecType, and the current position of the print head becomes the top of page setting.

Some of our demonstration programs end with a reset code so that the commands from one program will not interfere with the commands in the next one. After you run a program with a reset code in it, remember to change the top of page setting before you begin printing full pages.

Pitch Comparison

Now that you have used three short programs to produce samples of the main pitches, you can choose the pitch that you prefer or the one that best fits a particular printing job. Most people use either pica or elite for printing text and condensed for spreadsheets or other applications in which it is important to get the maximum number of characters on a line.

In fact, if you need even more than the **132** characters per line that condensed gives you, you can combine elite and condensed for a mode we call condensed elite. It is not really another pitch, because the size of the characters is the same as in the condensed mode; only the *space* between the characters is reduced. You can see this mode, which allows 160 characters to fit on a line, if you replace line **30** in your last program with this line:

```
30 LPRINT CHR$(15);
```

With this addition, the program turns on condensed but doesn't turn off elite, giving you the printout below:

```
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
```

If your printout is different, you may need a **WIDTH** statement such as the one below:

```
5 WIDTH LPRINT 255
```

The format for your system will probably be different. Consult your **BASIC** manual.

Near Letter Quality Mode

The examples so far in this chapter are in the draft mode, and you have already learned how to turn on the NLQ mode with a panel button, but you can also see the NLQ mode with the following program:

```
10 LPRINT CHR$(27) "x" CHR$(1) ;  
20 FOR X=65 TO 105  
30 LPRINT CHR$(X);  
40 NEXT X: LPRINT
```

Note that you use a lowercase x, not a capital X, in line **10**. Because of the high resolution of the NLQ mode, it prints only in pica, not in elite or condensed.

All the modes demonstrated in this chapter are compared in Table 5-1.

Table 5-1, Summary of LX-86 pitches

Print sample	CPI	Codes	
← 1 inch →		on	oft
Near Letter Quality	10.00	ESC "x" 1	ESC "x" 0
Pica print	10.00	ESC "P"	ESC "M"
Elite print	12.00	ESC "M"	ESC "P"
Condensed print	17.16	ESC "P" 15	18
Condensed elite print	20.00	ESC "M" 15	ESC "P" 18

Remember that you don't have to use BASIC to change modes; you can use any method that sends the printer the proper codes.

Chapter 6

Print Enhancements and Special Characters

Now that you have seen how you can change the pitch of your IX-86 printing, we can show you many more ways to vary and enhance your printing. So that you won't have to type in dozens of programs to try all the features, we give you just one master program that can demonstrate any feature.

Bold Modes

Besides the pitches (pica, elite, and condensed) that we covered in Chapter 5, the LX-86 offers many other typestyles, including two for bold printing-emphasized and double-strike.

Emphasized mode

In the emphasized mode the IX-86 prints each dot twice, with the second dot slightly to the right of the first. In order to do this, the print head must slow down so that it has time to fire, retract, and fire the pins quickly enough to produce the overlapping dots. As you can see in Figure 6-1, this method produces better-looking, more fully-formed characters that are darker than single-strike ones.

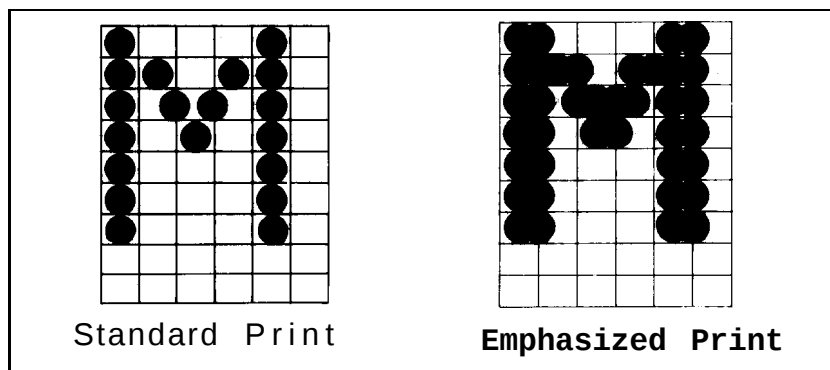


Figure 6-1. Emphasized and standard print

Emphasized works only in draft pica and NLQ modes. In elite and condensed the dots are already so close together that even with the reduced print speed, the LX-86 cannot fire, retract, and again fire the pins quickly enough to print overlapping dots.

You do sacrifice some print speed and ribbon **life with emphasized**, because the print head slows down and prints twice as many dots, but **the increase in print quality is well worth it. Indeed, you may want to** use emphasized instead of the NLQ mode for some purposes because emphasized printing is faster. than NLQ printing.

Now that you have seen our example of emphasized printing, we will give you **a master program that allows you to test almost any of** the ESCape codes, including the ESCape code to turn on emphasized: ESCape "E".

Master program

First, type in the program below. If you have some programming experience, you can see that the program asks you what codes you want to test and then prints a sample of what the codes do. **Be sure to type in the blank spaces in lines 70 and 80. If you are using** Applesoft™, BASIC, see Appendix F.

```
20 PRINT "Which ESCape code do you "
30 INPUT "want to test" ; A$
40 PRINT ".What kind of printing "
50 INPUT "does it produce" ; B$
60 LPRINT CHR$(27)A$
70 LPRINT "This sample uses ESCape ";A$
80 LPRINT "to produce ";B$; " printing. "
90 LPRINT CHR$(27)@"
```

Now run the program. When the first question appears on the screen, type a capital E and then press the **RETURN** key. Type "emphasized" and press the **RETURN** key in answer to the second question. The program is easy to use. Just remember to press the **RETURN** key after the answer to each question and to use a capital letter in the answer to the first question unless we tell you to use a lowercase letter for a specific code.

You should get the following printout when you run this program and type “E” and “emphasized” in answer to the questions.

**This sample uses ESCape E
to produce emphasized printing.**

The code to turn off emphasized is ESCape “F”.

Double-strike

The other bold mode on the LX-86 is double-strike. For this mode the printer prints each line, then moves the paper up slightly and prints the line again. Each dot is printed twice, with the second one slightly below the first as you can see in Figure 6-2.

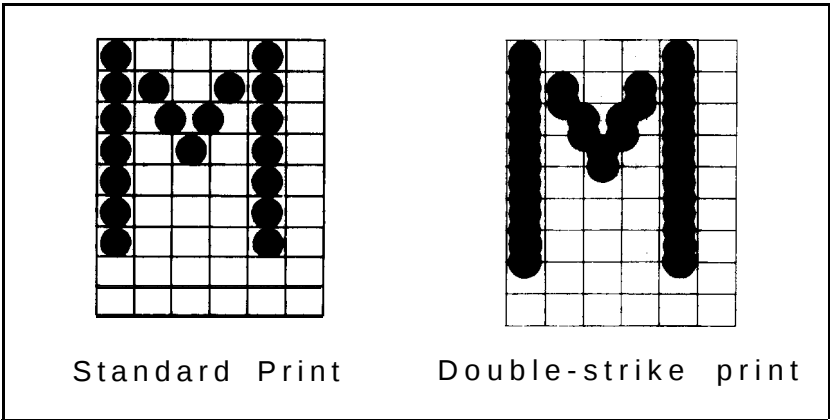


Figure 6-2. Double-strike and standard print

Unlike emphasized, double-strike combines with any draft pitch (but not with NLQ) because it does not overlap dots horizontally. Since each line in this mode is printed twice, the speed of your printing is slowed. The code for double-strike is ESCape “G”. Try it in the the master program if you wish. The code to turn off double-strike is ESCape “H”.

Double-width Mode

Perhaps the most dramatic mode on the LX-86 is double-width. It produces extra-wide characters that are good for titles and headings. For this mode, the dot pattern of each character is expanded and a duplicate set of dots is printed one dot to the right. You can see the difference between pica and double-width pica in Figure 6-3.

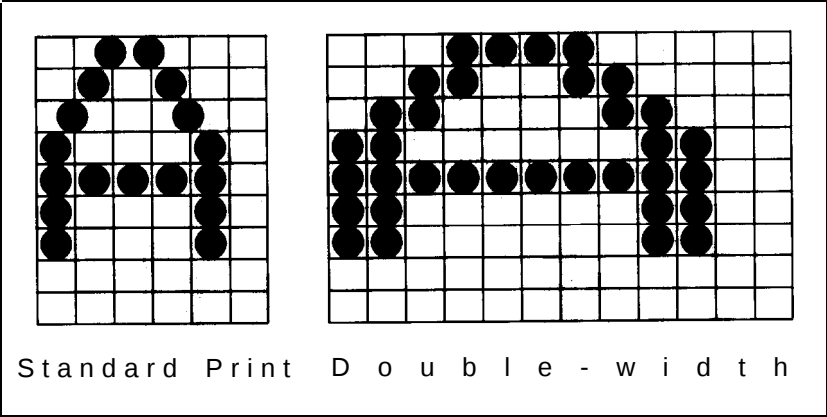


Figure G-3. Double width and standard characters

You can try double-width yourself by using the code "W1" in the master program. Notice that double-width uses an ESCape code format that is slightly different from the previous ones. You must use the numeral one as well as a capital W to turn on double-width. For this mode the letter and the numeral one together turn on the mode and the letter and the numeral zero together turn it off. Thus ESCape "W1" turns on double-width and ESCape "W0" turns it off.

Those of you who are programmers may be interested in another form of double-width. In this alternate form, called one-line double-width, the printing is the same as that in Figure 6-3, but it is turned on by ASCII 14 and is turned off by a line feed, ASCII 20, or ESCape "W0".

Mode Combinations

You can combine nearly all of the print modes on the LX-86. Indeed, your Ix-86 printer can print such complicated combinations as double-strike emphasized double-width underlined italic subscript, although we're not sure that you would ever want to use such a combination. The point is, however, that the LX-86 has the ability to produce almost any combination you can think of; it's up to you to decide which ones you want to use.

To see a few combinations, remove line 90 from the master program. (In MBASIC simply type 90 and press RETURN to delete the line.) Now run the program once and enter "E" and "emphasized" in response to the questions on the screen. This will give you the same results as the first time you ran the program, but it will leave the printer in emphasized mode so that you can add another mode. Then run the program again (without turning off the printer). The second time enter "W1" and "emphasized double-width."

Your printout should be in the typestyle below, showing that the two modes combine with no trouble. You can experiment with other combinations if you wish or you can wait for the section later in this chapter that explains a special ESCape code, Master Select, which allows you to combine as many as seven features with one ESCape code.

e m p h a s i z e d d o u b l e - w i d

When you are through trying combinations, be sure to replace line 90 in the master program so that you can again try one feature at a time.

Italic Mode

You may occasionally want to print italic words for emphasis, titles, or other uses. The LX-86 has italic mode to enable you to use italic characters for any purpose. Although characters produced by the previous modes in this manual are modifications of the standard pica characters, the LX-86 uses completely different characters for the italic mode. In the printer's Read Only Memory (ROM) is a complete set of draft italic characters. You can see the difference between standard and italic draft characters in Figure 6-4.

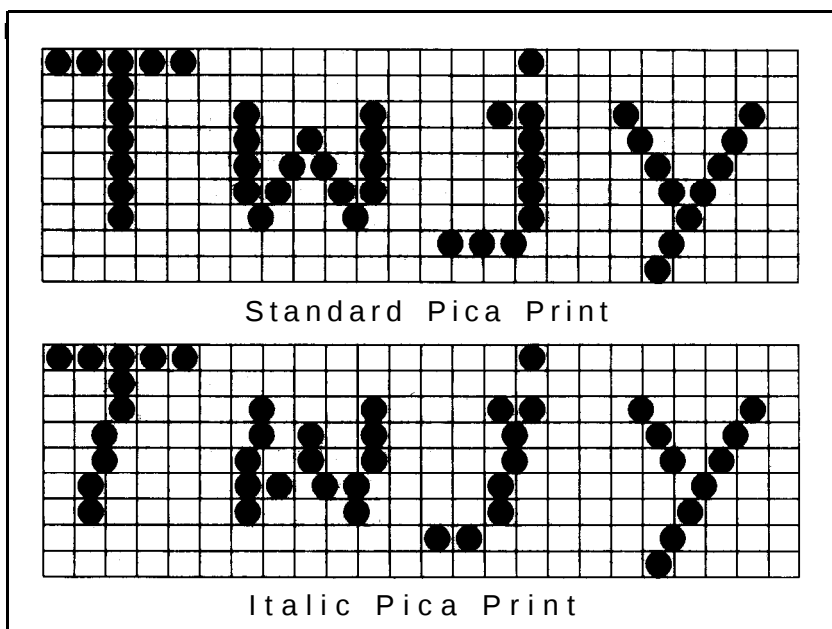


Figure 6-4. Italic and pica

The code to turn italic mode on is ESCape “4”. Try it in the master program if you wish. When you use this code in the master program, enter “4” in answer to the first question just as if it were a letter of the alphabet instead of a number. ESCape “5” turns off italic mode.

Those of you who use this code in an applications program should remember that any character in quotation marks in our discussions of ESCape codes is an alphanumeric character, not a numerical value.

Underline Mode

The LX-86 also has a mode that will underline characters and spaces. You turn it on with ESCape “-1” and off with ESCape “-0”. Note that the underline code is like the expanded code in that it uses a character, in this case the hyphen or minus sign, combined with numeral one to turn it on and a character combined with the numeral zero to turn it off. As you can see in Figure 6-5, this mode prints a dot in the bottom row of each column, thus producing a continuous underline.

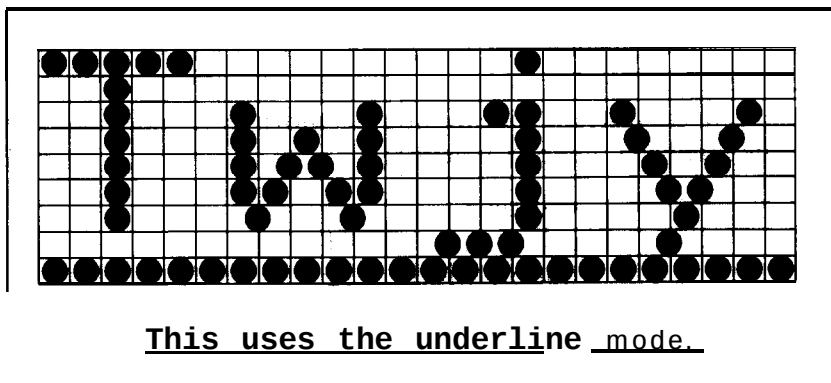


Figure 6-5. The underline mode

As shown in Figure 6-5, the underline mode is continuous, but some word processing and other applications programs produce an underline that leaves spaces between characters as demonstrated in the printout below.

This uses **the under-line** character

If your software prints this type of underline, it is using the LX-86's underline character (ASCII %), not the underline mode. Because the underline character is only five dots wide, it does not fill the spaces between characters. If you prefer a continuous underline, you may be able to use the underline mode through one of the methods we discussed in Chapter 4.

Master Select

The LX-86 has a special ESCape code called Master Select that allows you to choose any possible combination of eight different modes: pica, elite, condensed, emphasized, double-strike, double-width, italic, and underline. The format of the Master Select code is ESCape '!' followed by a number that is calculated by adding together the values of the modes listed below:

underline	128
italic	64
double-width	32
double-strike	16
emphasized	8
condensed	4
elite	1
pica	0

For any combination,, just add up the values of each of the modes you want and use the total as the number after ESCape “!”. For example, to calculate the code for double-width italic underlined pica, add the following numbers together:

underline	128
italic	64
double-width	32
pica	0
	224

To print this combination, therefore, you use ESCape “!” followed by the number 224. In BASIC the command is CHR\$(27)“!” CHR\$(224).

To try this number or any other, enter and run this short program, which will ask you for a Master Select number and then give you a sample of printing using that code. Again, if you are using Applesoft BASIC, see Appendix F.

```

10 INPUT "Master Select number" ;M
20 LPRINT CHR$ (27) "!" CHR$(M)
30 LPRINT "This sample of printing uses "
40 LPRINT "Master Select number";M
50 LPRINT CHR$(27) "@"

```

In this program, you can use any number you calculate with the formula above, but remember that emphasized can't combine with condensed or elite. If you try to combine emphasized with either of the two narrow pitches, you won't harm your printer; it will simply use a priority list in its memory to determine which **mode to use. This priority list causes a combination of emphasized and elite to produce elite only, a combination of emphasized and condensed to produce emphasized only, and a combination of all three to produce condensed elite.**

Master Select is a powerful code that gives you an easy way to produce multiple combination's with a single command. To see double-strike emphasized italic printing, for example, you need only **one ESCape code instead of three.**

Indeed, Master Select is such a powerful feature that it may occasionally be more powerful than you want it to be. Because it controls eight different modes, a Master Select code will cancel any of those eight that are not selected. For example, suppose that you have a page in elite and want part of it printing in italic. If you use ESCape "!" **64** to turn on italic, your LX-86 will begin printing in italic pica instead of italic elite because the **64** code does not include elite. Use **65** for italic elite.

Superscript and Subscript

Your LX-86 can also print superscripts and subscripts, which you can use for mathematical formulas, footnotes, and other items that require numbers or letters above or below the usual print line. ESCape "SO" turns on superscript and ESCape "**S1**" turns on subscript. ESCape "T" turns off either one. You can enter either ESCape "SO" or ESCape "**S1**" in the master program, but that will print the whole sentence in superscript or subscript. Some more realistic examples are below:

E=MC²

H₂O

This fact is found in three sources.7

As you can see, you can use superscript or subscript for an individual character. Just find out how to send printer codes in your applications program; then send the proper codes to the printer.

Special Characters

The LX-86 has three groups of special characters that can add distinction to your printing. Character Graphics, international characters, and the special graphics set.

Epson character graphics set

The Character Graphics set includes characters used by IBM and compatible computers as well as international characters used by IBM software. The characters in the set are shown on the next Page.

You select the Character Graphics set in one of two ways: with an ESCape code or with a DIP switch.

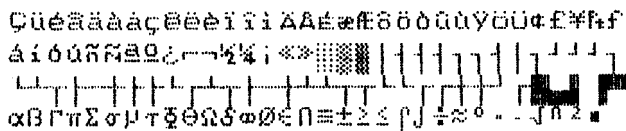
The ESCape code in BASIC has the following format:

LPRINT CHR\$(27)"t"CHR\$(n)

If `n` is 1, the command turns the Character Graphics set on; if `n` is 0, the command turns that set off.

If you prefer to have the Character Graphics set on most of the time, see Appendix D for instructions on using the DIP switches.

The Character Graphics set is actually two sets, the standard and the international. The standard set contains only the characters in the last three rows shown below. The international set contains the characters in all four rows.



In order to print the international set, you must send the ESCape “6” command. In BASIC it has the follwing format:

```
LPRINT CHR$(27)"6"
```

ESCAPE “7” returns you to the standard set.

See your software manual for further instructions on printing these characters. If you need the decimal or hexadecimal codes for them, see Appendix A.

International characters

As you know, you need a few extra characters for languages other than English. The LX-86 has provided for printing in many languages by having 96 international characters in its ROM (Read Only Memory). This total includes characters in three sets: draft italic, and NLQ (Near Letter Quality).

In order to print any of these characters, first select one of the following character sets and then use the individual characters within that set.

0	USA	6	Italy
1	France	7	Spain
2	Germany	8	Japan
3	United Kingdom	9	Norway
4	Denmark I	10	Denmark II
5	Sweden		

You select the character set in one of two ways: with an ESCape code or with a switch in the back of your printer. The ESCape code in BASIC has the following format:

```
LPRINT CHR$(27)“R”CHR$(n)
```

in which n stands for the appropriate number from the list above. In other words, the BASIC command to select the French character set is

```
LPRINT CHR$(27)“R”CHR$(1)
```

The other method of selecting an international character set is with the small switches, called DIP switches, in the back of the printer. If you plan to use one of the international sets quite a bit, see Appendix D for instructions for using the DIP switches.

Once you have selected a character set, whether you do it with the ESCape code or the DIP switches, you will be able to print several new characters. The character sets are shown in Tables 6-1, 6-2, and 6-3.

Table 6-1. International characters in NLQ mode

	3 5	3 6	6 4	9 1	9 2	9 3	9 4	9 6	1 2 3	1 2 4	1 2 5	1 2 6
USA	#	\$	@	[	\	]	^	`	{		}	~
FRANCE	#	\$	à	•	ç	§	^	`	é	ù	è	..
GERMANY	#	\$	§	À	Ö	Ü	^	`	ä	ö	ü	ß
UK	£	\$	@	[	\	]	^	`	{		}	~
DENMARK I	#	\$	@	Æ	Ø	Å	^	`	æ	ø	å	~
SWEDEN	#	¤	£	À	Ö	Å	U	é	ä	ö	å	ü
ITALY	#	\$	@	•	\	é	^	ù	à	ò	è	ì
SPAIN	¤	\$	@	í	ñ	¿	^	`	..	ñ	}	~
JAPAN	#	\$	@	[	¥	]	^	`	{		}	~
NORWAY	#	¤	£	Æ	Ø	Å	U	é	æ	ø	å	ü
DENMARK II	#	\$	£	Æ	Ø	Å	U	é	æ	ø	å	ü

Table 6-2. International characters in draft mode

	3 5	3 6	6 4	9 1	9 2	9 3	9 4	9 6	1 2 3	1 2 4	1 2 5	1 2 6
USA	#	\$	@	[	\	]	^	`	{		}	~
FRANCE	#	\$	à	•	ç	§	^	`	é	ù	è	..
GERMANY	#	\$	§	À	Ö	Ü	^	`	ä	ö	ü	ß
UK	£	\$	@	[	\	]	^	`	{		}	~
DENMARK I	#	\$	@	Æ	Ø	Å	^	`	æ	ø	å	~
SWEDEN	#	¤	£	À	Ö	Å	Ü	é	ä	ö	å	ü
ITALY	#	\$	@	•	\	é	^	ù	à	ò	è	ì
SPAIN	¤	\$	@	í	ñ	¿	^	`	..	ñ	}	~
JAPAN	#	\$	@	[	¥	]	^	`	{		}	~
NORWAY	#	¤	£	Æ	Ø	Å	Ü	é	æ	ø	å	ü
DENMARK II	#	\$	£	Æ	Ø	Å	Ü	é	æ	ø	å	ü

Table 6-3. *International characters in draft italic*

	35	36	6 4	91	92	93	9 4	9 6	123	124	125	126
USA	#	\$	@	[	\	]	^	`	{	/	}	~
FRANCE	#	\$	à	•	ç	š	^	`	é	ù	è	..
GERMANY	#	\$	š	ä	ö	ü	^	`	ä	ö	ü	ß
U K	£	\$	@	[	\	]	^	`	{	/	}	~
DENMARK	#	\$	@	Æ	Ø	Å	^	`	æ	ø	å	~
SWEDEN	#	š	é	ä	ö	å	ü	é	ä	ö	å	ü
ITALY	#	\$	@	•	\	é	^	`	à	ò	è	ì
SPAIN	Æ	\$	@	í	ñ	¿	^	`	..	ñ	¿	~
JAPAN	#	\$	@	[	¥	]	^	`	{	/	}	~
NORWAY	#	š	é	Æ	Ø	Å	ü	é	æ	ø	å	ü
DENMARK II	#	\$	é	Æ	Ø	Å	ü	é	æ	ø	å	ü

The number at the top of each column in the tables is the ASCII code that prints the characters in that column.

Once you have selected an international character set with the DIP switches or the ESCape “R” code, you can use the tables to see which characters on your standard USA keyboard will produce the international characters you want. Simply type the character from the top row of one of the figures in order to print the corresponding character in the row of the set you have chosen. For example, if you have reset the DIP switches for the UK character set and you press the # key, the £ symbol will be generated. Even though you will see the # symbol on the screen, the £ symbol will be printed on the paper. For another example, if you have selected the Swedish character set and you press the @ key, the É symbol will be generated.

If your keyboard does not have one of the keys that you need, you will have to send the proper ASCII number to the printer in another way, such as a programming language or inserted or embedded codes.

Graphics character set

The Lx-86 printer's Read Only Memory (ROM) also contains the 32 graphics characters that you see in Figure 6-6.

128	129	130	131	132	133	134	135	136	137	138
+	┌	┐	└	┘	─	▏	┐	└	┌	┘
139	140	141	142	143	144	145	146	147	148	149
▒	■	▓	█	░	◻	⬤	⬢	⬣	⬡	⬠
150	151	152	153	154	155	156	157	158	159	
⬤	⬢	⬣	⬡	⬠	↑	↓	×	÷	±	

Figure 6-6. Special graphics characters

Undoubtedly you can think of uses for many of the shapes and symbols available in this set, and you can combine the line graphics characters (the ones on the first row) to form various sizes and shapes of boxes and other figures that use straight lines.

To print these graphics characters you must use either a programming language or a computer with a graphics shift or other special key that allows you to send graphics codes.

Sending the codes for these characters to the printer is a two-step process just as it is for the international characters. In BASIC, first you send CHR\$(27)“m”CHR\$(4) to turn on the graphics character set, then you send the code numbers given in Figure 6-6. After you have used the ESCape code to turn on the graphics character set, the LX-86 prints the codes from 128 through 159 as graphics characters.

You can change pitch and weight with the graphics characters just as you can with the other characters in the ROM of the LX-86. The characters in Figure 6-6 are printed in double-width elite. The printout below shows the characters in pica:

+	┌	┐	└	┘	─	▏	┐	└	┌	┘
▒	■	▓	█	░	◻	⬤	⬢	⬣	⬡	⬠
⬤	⬢	⬣	⬡	⬠	↑	↓	×	÷	±	

The next printout shows the characters in emphasized double-width pica:



Because normal line spacing leaves space between the lines of graphics characters just as it does between lines of text, you must change the line spacing when you combine line graphics characters to form boxes or other figures. For most programs ESCape “1” gives you the best line spacing for combinations of graphics characters. Further details on line spacing are in Chapter 7.

In addition, there are commands to specify the line spacing in 72nds of an inch and **216ths** of an inch. If you need to make such fine adjustments in the line spacing see Appendix C for the proper commands. In the chapter on dot graphics you will see how useful ESCape “1” can be.

Chapter 7

Page Formatting

Although the LX-86 printer has many sophisticated commands to set margins, line spacing, and horizontal and vertical tabs, we won't take up your time with extensive discussions of these because most of these functions are taken care of by applications programs. This chapter merely describes a few commands that the average user might need. If you want more information, you can find all the commands in Appendixes B and C.

Margins

The LX-86 allows you to set the left and right margins with simple ESCape sequences. The left margin command is ESCape "1" followed by the number of the column you choose for the left margin. The right margin command is ESCape "Q" followed by the column number of the right margin you want. For the left margin command, be sure to use a lowercase letter 1, not the numeral one.

If your word processing program does not allow you to change the margins, you can send margin commands to your IX-86 with BASIC or another programming language before you print your documents. For example, if you prefer wider margins than your word processing program gives you, run the following BASIC program before printing. This program gives you a left margin of **10** and a right margin of 60, but you can use any numbers you prefer for the margin commands.

```
10 LPRINT CHR$(27)"1"CHR$(10);  
20 LPRINT CHR$(27)"Q"CHR$(60);
```

Such a program will also allow you to choose the margins you prefer for program listings. Just remember that once you run a program that sets margins, those margins are in effect until you change them with new margin commands or turn off or reset the printer.

You should be aware that a few applications programs reset the printer before each document or file they print. These programs will, of course, cancel your new margin settings. See Chapter 2 to find out how to test for a reset code in your program.

The maximum right margins on the LX-86 printer are 80 in pica, 96 in elite, 137 in condensed, and **160** in condensed elite. For further information on this command see Appendix B.

Justification with NLQ

The NLQ (Near Letter Quality) mode offers a justification command that will give you four choices in the formatting of your text. The command is ESCape “a” followed by one of these numbers:

- | | |
|---|---------------------|
| 0 | Left justification |
| 1 | Centering |
| 2 | Right justification |
| 3 | Full justification |

Left justification is the standard format, in which the left margin is even and the right margin is not. This is the way most typewritten pages look.

The centering command centers a line of text between the margins. This is handy for headings, titles, and captions.

Right justification is the opposite of left justification. The right margin is even and the left is not.

Full justification puts extra spaces between words where necessary so that both the left and right margins are even. This is the way most magazines, newspapers, and books (including this one) are printed. With this command, you may need a WIDTH statement. Since different systems use different WIDTH statements, see your computer or programming language manual for the proper format. Remember also to use carriage returns only at the end of paragraphs when you are using auto justification.

When you use any of the justification commands, be sure that you send NLQ command first.

The justification command is designed to be used with BASIC or another programming language, not with word processing programs.

Skip Over Perforation

If you are using continuous pin-feed paper for printing program listings or other material not controlled by an applications program, you may find that the LX-86 prints right over the perforations between pages. The LX-86 has an ESCape code to prevent this: the ESCape “N” command. You send ESCape “N” followed by the number of lines you want the LX-86 to skip at the bottom of a page. For example, in BASIC the following line will make the Lx-86 skip six lines after each **60** lines:

```
10 LPRINT CHR$(27) “N” CHR$ (6) ;
```

Since a standard page is **66** lines, this will give you one inch of blank space at the bottom of each page. If you prefer to have half of the blank space at the top of the page and half at the bottom, simply set the top of page approximately three lines (1/2 inch) below the perforation. (See Appendix E if you need to refresh your memory on setting the top of page.)

Line Spacing

Ordinarily you don’t have to worry about how the printer moves the paper so that it doesn’t print lines of text on top of each other; the LX-86 takes care of this without any special instructions. If, however, you want to understand how line spacing works or you need to change the line spacing for a special application such as graphics, you’ll want to read this brief explanation of line spacing on the Lx-86.

The movement of the paper between lines is called a line feed and the distance the paper moves is called a line space. In ordinary printing the line spacing is 1/6-inch, which produces six lines of print per inch. Figure 7-1 will help you visualize this spacing. As you can see in the figure, the standard (default) spacing is the same as 12 rows of dots. Since the Lx-86 characters use nine rows of dots, the 12-dot line spacing leaves three blank rows between the lines of text.

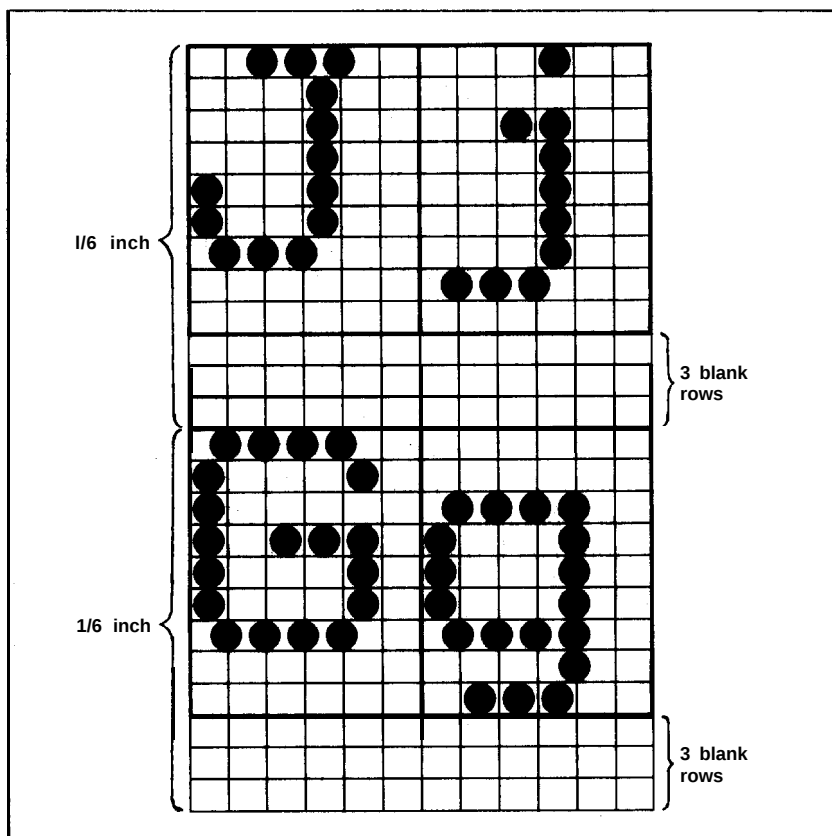


Figure 7-1. Standard line spacing

The default line spacing illustrated in Figure 7-1 is the only one you need for almost all printing of text, but in some cases you may want to increase or decrease the space between lines. The LX-86 has several commands to do this. ESCape “0” decreases the line spacing to 9-dot (9/72-inch), ESCape “1” decreases it to 7-dot, and ESCape “2” returns it to 12-dot.

In addition, there are commands to specify the line spacing in 72nds of an inch and 216ths of an inch. If you need to make such fine adjustments in the line spacing see Appendix C for the proper commands. In the chapter on dot graphics you will see how useful ESCape “1” can be.

Paper-Out Sensor

Under the platen (the black roller) of your LX-86 printer is a small switch that senses whether or not paper is in the printer. When the end of the paper passes this switch, it sends a signal that sounds the beeper and stops your printing. This saves wear on your print head, ribbon, and platen, but because of the distance between the switch and the print head, it stops the printing about 2 inches from the end of the page. Therefore, if you use single-sheet paper in your IX-86, you can't print on the last 2 inches of each page without an adjustment.

For most computer systems, you merely send the printer an ESCape "8" to deactivate the paper-out sensor or change one of the DIP switches described in Appendix D. Then you can print to the end of the page with single-sheet paper. Some systems, however, ignore the ESCape code and the DIP switch setting. If ESCape "8" or the DIP switch setting does not solve this problem for you, see Appendix F for other solutions.

Chapter 8

User-Defined Characters

The LX-86 has several hundred different characters stored in its ROM (Read Only Memory). Although this number includes draft, italic, international, character graphics, special graphics, and Near Letter Quality characters, sometimes you would like to have a few more. For those occasions when you need a special character or a few letters in a different typeface, the LX-86 allows you to create your own characters and print them just as if they were ordinary letters.

Defining Your Own Characters

The printout below displays a few such characters to give you an idea of what can be done, but remember that these characters are truly user-defined-you create what you need or want.

⌘ ↑ Ⓢ

It may seem that designing a character and telling the LX-86 how to print it would be extremely complicated, but we have reduced the task to a simple three-step process: planning your character, running one program that tests your work and calculates the required DATA numbers, and running another program to put the character in your printer's RAM (Random Access Memory) for use whenever you need it.

Because the high-resolution NLQ (Near Letter Quality) mode uses many more dots per character than the draft mode, defining NLQ characters is somewhat more complex than defining draft characters. You will find the programs for defining NLQ characters at the end of this chapter.

After you have created your own characters with our programs, certain keys that you seldom use will generate the user-defined characters. For example, you will be able to type < to print $\frac{3}{4}$.

Your user-defined characters can be utilitarian or imaginative, anything from a scientific symbol to script letters for your initials. Just follow the simple steps below.

The only restriction on your creativity is that the characters you define must follow the same rules that govern the rest of the characters printed by the LX-86. They must fit into an **11** X 9 matrix, no dot can overlap another, and either the top or the bottom row must be empty. Look at the enlargements of sample letters in Chapter 3 to see how the standard IX-86 characters are designed.

Designing Process

Suppose that you want to print the scientific symbol for the planet Mercury. Although the LX-86 has a number of special symbols, that is not one of them. You can, however, create and print such a symbol with ease. First, use a grid like the one in Figure 8-1 to plan where to place the dots.

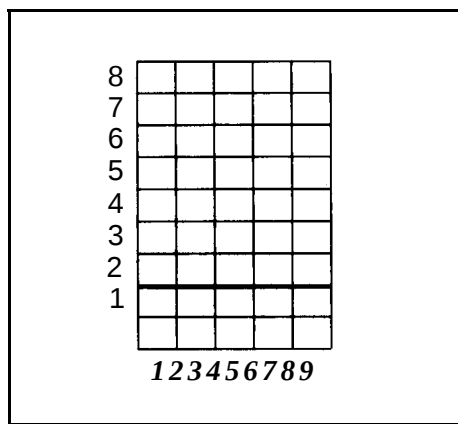


Figure 8-1. Grid for designing draft characters

Because the last two columns are reserved for the space between characters, we have not included them in the grid. And since most characters do not use the bottom two rows, we have used a heavy line to indicate the usual lower limit for an IX-86 character.

When you place your dots on this grid, remember that dots cannot go on horizontal lines, but they can go on vertical lines so long as they do not overlap any other dots. As you design your characters, draw the dots as large as you see them in the example on the left in Figure 8-2. If you draw them smaller, you may have overlapping dots without realizing it.

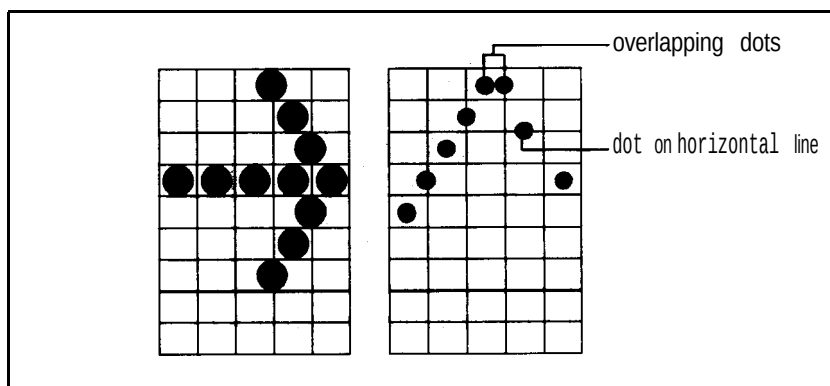


Figure 8-2. Correct and incorrect designs

If you do accidentally call for overlapping dots, don't worry. The program will still work, but only one of the dots will be printed.

First definition program

Once you have drawn your dots on the grid, type in the following BASIC program and run it. If you are using Applesoft BASIC, see Appendix F.

```

100 DIM F(9)
110 FOR I=1 TO 9
120 PRINT "WHICH ROWS HAVE DOTS IN COLUMN";I
130 INPUT R: IF R=0 THEN 150
140 F(I)=F(I)+2^(R-1)
150 IF R=0 THEN NEXT I ELSE GOTO 130
160 LPRINT CHR$(27)": "CHR$(0)CHR$(0)CHR$(0);
170 LPRINT CHR$(27)"%"CHR$(1)CHR$(0);
180 LPRINT CHR$(27)"&"CHR$(0)CUR$(60)CHR$(60);
190 LPRINT CHR$(128);
200 FOR X=1 TO 9
210 LPRINT CHR$( F( X) );:NEXT X
220 LPRINT CHR$(0) CHR$(0);
230 LPRINT "YOUR CHARACTER IN PICA: < < <"
240 LPRINT "IN DOUBLE-WIDTH EMPHASIZED PICA ";
250 LPRINT CHR$(27)"! *< < <"
260 LPRINT CHR$(27)"! "CHR$(0)"YOUR DATA NUMBERS:"
270 FOR K=1 TO 9: LPRINT F(K);: NEXT K
300 LPRINT: END

```


Now wait a moment for your computer to calculate the dot patterns and your LX-86 to print the new character in two different typestyles. Your printout also gives you nine numbers, which you will use in the next program. You should get the printout you see below:

```
YOUR CHARACTER IN PICA:  ̣ ̣ ̣
IN DOUBLE-WIDTH EMPHASIZED PICA: ̣̣ ̣̣ ̣̣
YOUR DATA NUMBERS:
  0  80  170  0  47  0  170  80  0
```

When you get to this point with a character of your own, you see how it looks and whether or not you like it. If you want to make any changes, move the dots as needed and re-run the program.

If you want to put dots in the bottom row, change the number in line 190 from 128 to 0. Then the usable rows will be as shown in Figure 8-4 below.

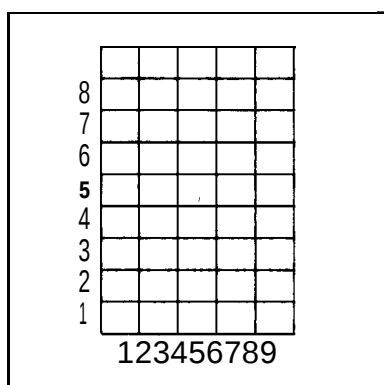


Figure 8-4. Using the bottom eight rows

Second definition program

Once the character looks the way you want it to, enter, modify, and run the next program. The program as listed creates the Mercury character, but you can use it for any characters you create if you make one or two changes that we explain after the program listing.

```

90 FOR P=58 TO 63: LPRINT CHR$(P);" ";: NEXT P
95 LPRINT
100 K=1: IF K>3 THEN A=58 ELSE A=60
110 LPRINT CHR$(27)"": "CHR$(0)CHR$(0)CHR$(0);
120 LPRINT CHR$(27)%"CHR$(1)CHR$(0);
130 LPRINT CHR$(27)"&"CHR$(0)CHR$(A)CHR$( A-1+K);
140 FOR Z=1 TO K
150 LPRINT CHR$(128);
160 FOR X=1 TO 9
170 READ R
180 LPRINT CHR$(R);: NEXT X
190 LPRINT CHR$(0)CHR$(0);
200 NEXT Z
210 DATA 0,80,170,0,47,0,170,80,0
290 FOR P=58 TO 63: LPRINT CHR$(P);" ";: NEXT P

```

To use this program for your own character or characters, change the DATA numbers in line 210 by substituting the numbers generated by the first program when you created your own character. If you have created more than one character, put the DATA numbers for each character on a separate line as you see in the example below:

```

210 DATA 112,8,0,138,116,138,0,8,112
220 DATA 56, 68, 146, 40, 130, 40, 130, 68, 56

```

Check your work by making sure that there are nine numbers in each line and that the numbers are separated by commas.

To define more than one character, use the total number of characters you are defining instead of the 1 in line 100. (You can define as many as six characters at a time. Just run the first program several times and enter all the DATA numbers in this program.)

Running the program

When you run this second program, it prints six characters, then re-defines some or all of them and prints them again, as in the example below.

```

; < = > ?
; $ Ψ © ?

```

The two lines when printed by your own program provide you with a key to the characters your LX-86 will now print. When you press the key for one of the characters in the top row, the printer will print the corresponding character in the bottom row. In the example above, if you type < your LX-86 will print $\frac{2}{3}$ (although your screen will continue to show the character <).

Because the program puts these new definitions in your printer's Random Access Memory (RAM), it will print the new characters (the ones in the bottom row) unless it is turned off or receives the reset code.

If you have designed a few characters and want to use them with your word processing program, for example, just run the second definition program before you start using your word processing program. Then use the two-line printout as your guide to tell you which keys to press for your new characters.

Defining NLQ Characters

Since NLQ characters use many more dots than draft characters, defining NLQ characters is more complex than designing draft ones. If you use the grid and the programs in this section, however, you will be able to design your own NLQ characters.

NLQ grid

Because the NLQ characters can use as many as **18** dots vertically and 12 dots horizontally, you plan your designs on a different grid than the one you used for draft characters.

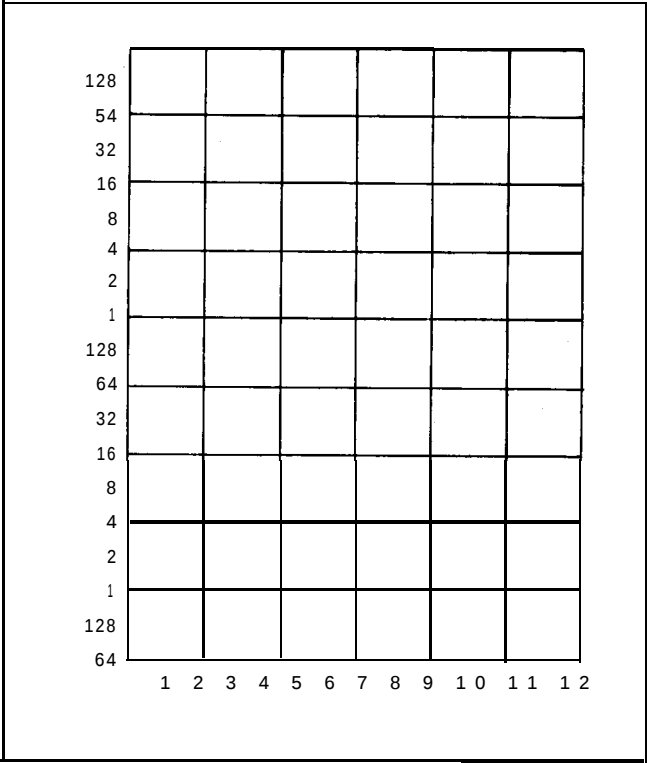


Figure 8-5. Grid for NLQ characters

On this grid you can use any numbered line or space. As you can see, that includes the bottom line and the line on the right side. You should remember to leave one or two columns blank for space between characters, however.

Each NLQ character definition requires 36 data numbers. Therefore, each vertical column must be divided into three sections for the calculation of data numbers. The process is not difficult once you get some practice using it.

Figure 8-6 shows a single column to make clear how the data numbers are calculated. Notice that in designing NLQ characters we suggest using circles instead of dots to make it easier to keep track of overlapping dots.

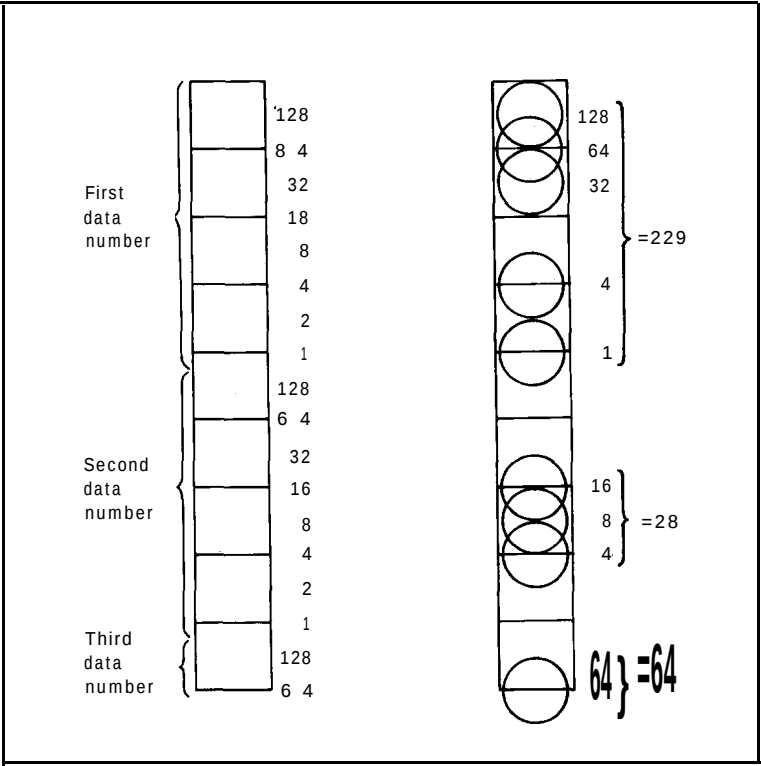


Figure 8-6. Data numbers for one column

To calculate the data numbers for this column, you see which dots are used in the top group (the top eight positions) and add their values together. Then you go down to the middle group (the next 8 positions) and add the values of any dots that are used there.. Finally, you look at the bottom group (2 dot positions) and add together the values used there.

If no dots are used in a group, the data number for that group is zero. All zeros must be entered in the DATA statements for the NLQ definition programs.

Now we'll show you how to use the NLQ character definition with a simple arrow design. Figure 8-7 shows the design drawn on a grid and the data numbers printed at the top or bottom of each column.

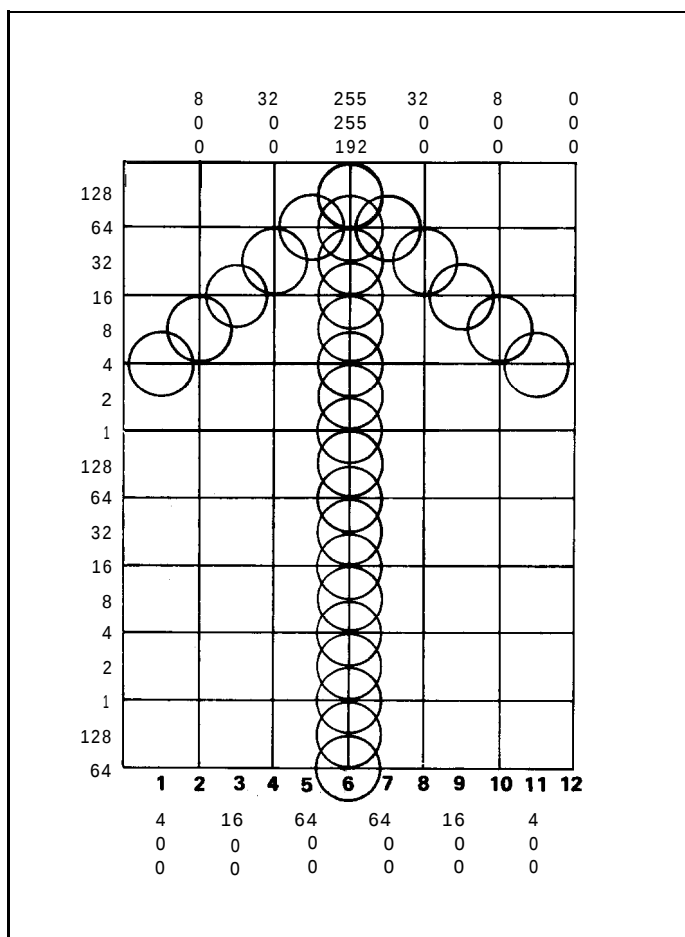


Figure 8-7. Arrow design and data numbers

If you look at each column individually, you can see how the data numbers were calculated.

First NLQ definition program

Now type in and run the following program. It has the data numbers for the arrow design. For a character of your own, change the data numbers in lines 130-150.

```

10 LPRINT CHR$(27);"x1";
20 LPRINT CHR$(27);".";CHR$(0);CHR$(0);CHR$(0);
30 LPRINT CHR$(27);"%";CHR$(1);CHR$(0);
40 LPRINT CHR$(27);"&";CHR$(0);"<<";
50 LPRINT CHR$(0);CHR$(12);CHR$(0);
60 FOR X=1 TO 36
70 READ C: LPRINT CHR$(C);
80 NEXT X
90 LPRINT "YOUR CHARACTER IN PICA: < < <"
100 LPRINT "IN DOUBLE-WIDTH EMPHASIZED PICA: ";
110 LPRINT CHR$(27);"!*< < <"
120 LPRINT CHR$(27);"!";CHR$(0);
130 DATA 4,0,0,8,0,0,16,0,0,32,0,0
140 DATA 64,0,0,255,255,192,64,0,0,32,0,0
150 DATA 16,0,0,8,0,0,4,0,0,0,0,0

```

YOUR CHARACTER IN PICA:↑ ↑ ↑
IN DOUBLE-WIDTH EMPHASIZED PICA: ↑ ↑ ↑

When you run this program for your own character, you find out whether or not it looks right to you. If it doesn't, move the dots as needed, recalculate and change the data numbers, and run the program again.

Second NLQ definition program

When you are satisfied with the character you have created, enter and run the next program. Use your data numbers instead of the ones in lines 130-150. If you want to define more than one character, change line **10** so that J equals the total number of characters you are defining (the maximum is six) and enter the extra **data** numbers (36 for each character).

```

10 J=1: IF J>3 THEN A=58 ELSE A=60
20 LPRINT CHR$(27)"x"CHR$(1)
30 FOR X=58 TO 63: LPRINT CHR$(X)" ";: NEXT X
40 LPRINT
50 LPRINT CHR$(27)": "CHR$(0)CHR$(0)CHR$(0);
60 LPRINT CHR$(27)%"CHR$(1)CHR$(0);
70 LPRINT CHR$(27)%"&"CHR$(0)CHR$(A)CHR$(A-1+J);
80 FOR Y=1 TO J
90 LPRINT CHR$(0)CHR$(12)CHR$(0);
100 FOR X=1 TO 36
110 READ C: LPRINT CHR$(C);
120 NEXT X: NEXT Y
130 FOR X=58 TO 63: LPRINT CHR$(X)" ";: NEXT X
140 DATA 4,0,0,8,0,0,16,0,0,32,0,0
150 DATA 64,0,0,255,255,192,64,0,0,32,0,0
160 DATA 16,0,0,8,0,0,4,0,0,0,0,0

```

When you run this program it prints six characters, then redefines one or more of them and prints them again. As with the draft characters, you use this two-line printout as a guide to the new characters your IX-86 will print. You can use them with an applications program or a program you write yourself.

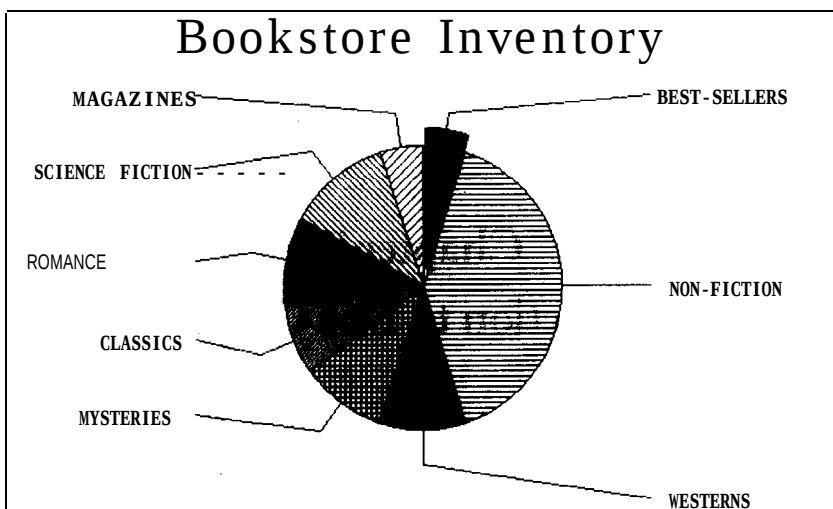
Chapter 9

Introduction to Dot Graphics

The Epson dot graphics mode allows your LX-86 printer to produce pictures, graphs, charts, or almost any other illustrative or creative material you can devise. Instead of using the standard letters, numerals, and symbols stored in the LX-86's ROM (Read Only Memory), the graphics mode prints dots column by column and line by line. You plan where you want the dots to appear and then use a program to tell the LX-86 where to put them.

Because many software programs take advantage of Epson dot graphics, you may be able to print graphics like the ones on this page and the next by simply giving your software a few instructions. The chart on the next page, for example, was created and printed in about **10** minutes.





If you have a program that produces graphics, all you need to know about Epson dot graphics is how to use the software. If, on the other hand, you wish to do your own programming or merely wish to understand how the LX-86 prints graphics, read on.

Dot Patterns

The Lx-86 forms graphic images approximately the same way that pictures in newspapers and magazines are printed. If you look closely at a newspaper photograph, you can see that it is made up of many small dots. The Ix-86 also forms its images with patterns of dots. In fact, the resolution of Epson graphics is higher than that of standard newspaper photographs because the LX-86 graphics mode allows as many as 240 dot positions per inch horizontally and 72 vertically. The images you print on the Ix-86 can, therefore, be as finely detailed as the one on the first page of this chapter.

If you plan carefully where you want the dots to appear and then use or create a program that gives the proper instructions to the printer, your LX-86 will print nearly any pattern or figure you can imagine.

Print Head

The graphics mode on the LX-86 is quite different from the text modes. Instead of sending codes for letters and printing functions, you send codes for dot patterns, one number for each column in a line. Since none of the predefined characters or symbols in the printer's memory is used, your program controls where each dot is printed.

For each column on a print line, the print head prints the pattern of dots you have specified. In the standard graphics mode it uses only the top eight pins on the print head because the computer uses eight data lines to communicate with the printer. Therefore, each of the top eight pins of the print head corresponds to one of the **data** lines.

To print figures taller than eight **dots**, the print head makes more than one pass. It prints one line, then advances the paper and prints another, just as it does with text. To keep the print head from leaving gaps between the graphics lines as it does between the text lines, the line spacing must be adjusted to eliminate the space between lines. When the line spacing is properly adjusted, the LX-86 prints finely detailed graphics images that give no indication that they are made up of separate lines, each no more than **1** / 8 of an inch high.

To ensure the proper alignment of dots in figures that use more than one pass of the print head, the LX-86 abandons the bidirectional printing it uses for draft text. Instead it prints graphics from left to right only.

Each pass of the print head contains one piece of the total pattern, which can be as tall or short and as wide or narrow as you desire. You don't have to fill the whole page or even an entire line with your graphics figures. In fact, you can use as little or as much space as you like for a figure and put it anywhere on the page.

Graphics Mode

The graphics mode command is quite different from the other commands covered so far in this manual. For most of the other LX-86 modes, such as italic and emphasized, one ESCape code turns the mode on and another turns it off. For graphics, the command is more complicated because the code that turns on a graphics mode also specifies how many columns it will use.

The LX-86 has several different graphics densities, but we'll keep things simple by using only one in the first exercises. The code for entering single-density graphics mode is ESCape "K" $n_1 n_2$. In Microsoft BASIC the command is given in this format:

```
LPRINT CHR$(27)"K"CHR$(N1)CHR$(N2);
```

ESCape "K" specifies single-density graphics, and the next two numbers (n_1 and n_2) specify the number of columns reserved for graphics.

The graphics command requires more than one number to specify how many columns to reserve because as many as **1920** columns are possible in graphics printing. Since the LX-86 uses eight digit binary numbers, it can't accept decimal numbers larger than 255. Therefore, the graphics mode command uses two numbers for reserving columns.

The number of columns reserved is the first number plus 256 times the second number. Since the command is set up for two numbers, you must supply two even if you only need one. When you need less than 256 columns, just make n_1 the number of columns you are reserving and make n_2 a zero.

Pin Labels

Once you put the printer into graphics mode and reserve the number of columns you want, your next step is to tell the print head which pins to fire in each column. There are 256 possible combinations of eight pins, and you send only one number for each column. The numbering system that allows you to use a single number to specify which of the 256 possible patterns you want is shown in Figure **9-1**.

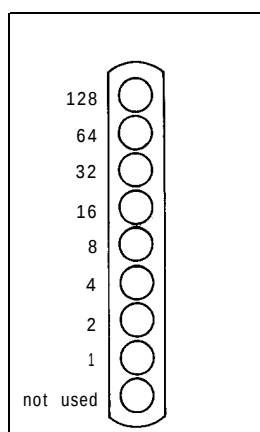


Figure 9-1. Pin labels

To fire one pin, you send its number. To fire more than one pin at the same time, add up the numbers of the pins and send the sum to the printer. With these labels for the pins, you fire the top pin by sending **128**. To fire the bottom graphics pin, you send 1. If you want to fire only the top and bottom pins, you simply add **128** and 1, then send 129.

By adding the appropriate label numbers together, you can fire any combination of pins you want. Figure 9-2 shows you three examples of how to calculate the number that will fire a particular pattern of pins.

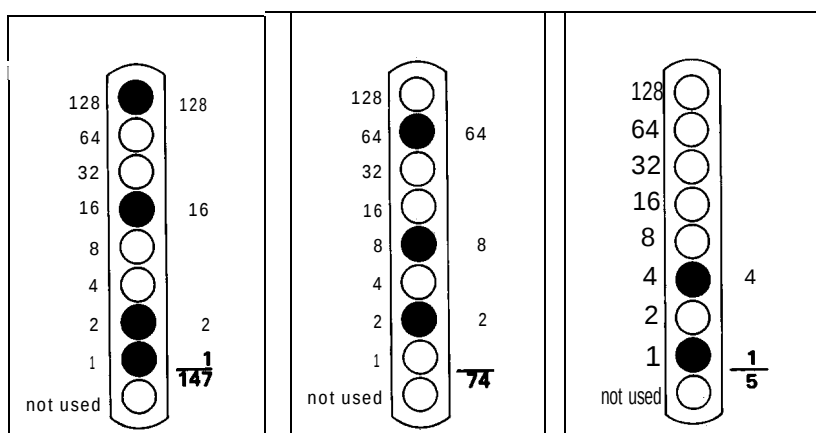


Figure 9-2. Calculating numbers for pin patterns

With this numbering system any combination of the eight pins adds up to a unique decimal number between 0 and 255. Although you use a decimal number, it is, of course, converted to a binary number before it goes to the printer.

Now that you know the principles of Epson graphics, we'll give you two simple exercises, more densities, and then something more complex as a basis for writing your own programs.

First Graphics Program

For your first graphics exercise we could give you a program that prints a single column of dots, but it is difficult to see the pattern of a single column of dots, so your first graphics program prints the same pattern 40 times.

The first line is the code for 40 columns of single-density graphics. As usual, our example is in Microsoft BASIC, but you can adapt it to the programming language you prefer.

```
10 LPRINT CHR$(27)"K"CHR$(40)CHR$(0);
```

The second line is the data that is printed as pin patterns. Be sure that you type in the semicolons in both lines:

```
20 FOR X=1 TO 40: LPRINT CHR$(74);: NEXT X
```

That's it. Run the program to see the result below. Although it is not as interesting as the examples at the beginning of this chapter, it does allow you to see exactly how the mode works.

Multiple-Line Exercise

Now that you've entered and run a simple graphics program, we'll go on to an exercise that shows you how the LX-86 combines several lines of graphics for a figure taller than eight dots.

Start with a line for **100** columns of single-density graphics and lines to print two pin patterns. Notice that since there are two pin patterns in the loop, it is only executed 50 times.

```

30 LPRINT CHR$(27)"K"CHR$(100)CHR$(0);
40 FOR X=1 TO 50: LPRINT CHR$(85)CHR$(42);
50 NEXT X

```

If you run the program now, you'll see how one line of the pattern looks:



To see a how more than one line combines to form a figure, enter and run the following program, which uses two of the lines you have already typed and adds several more.

```

10 LPRINT CHR$(27)"1";
20 FOR R=1 TO 3
30 LPRINT CHR$(27)"K"CHR$(100)CHR$(0);
40 FOR X=1 TO 50: LPRINT CHR$(85)CHR$(42);
50 NEXT X: LPRINT
60 LPRINT CHR$(27)"K"CHR$(100)CHR$(0);
70 FOR X=1 TO 50: LPRINT CHR$(42)CHR$(85);
80 NEXT X: LPRINT: NEXT R
90 LPRINT CHR$(27)"@"

```

Now run the program to see the six print lines combine into a pattern:



The short and simple program that produced the pattern demonstrates many elements of graphics programming. Therefore, we'll explain each line. Line **10** changes the line spacing to ‘-/dot, which is the height of the dot patterns used in the program. Therefore, there is no space between the print lines.

Line 20 begins a loop to produce multiple print lines. Lines 30 and 40 were covered above, but an LPRINT is added to line 50 to produce a line feed after line 40. Lines 60 and 70 are like lines 30 and 40 except that lint! 70 uses a reversal of the patterns in line 40. As the loop is executed, the program prints lines 40 and 70 alternately so that the patterns of the print lines will fit together well.

Notice that the graphics command can be in effect for only one print line. The command is in lines 30 and 60 so that it is issued each time a new print line is begun. You cannot print more than one line of graphics without having the graphics command issued more than once.

Line 90 is the reset code to return the printer to its defaults.

Density Varieties

Although all the examples so far in this chapter have been in the single-density graphics mode, the *LX-86* offers five other eight-pin density modes and two nine-pin ones. Nine-pin graphics is not necessary for most uses, but you can find its command (Escape “ ^ “) in Appendix C. All the eight-pin densities and their commands are described in Table 9-1.

Table 9-1. Graphics modes

Mode	Density	Alternate code	Description
0	Single	ESC "K"	60 dots/inch; 480 dots/8" line
1	Low-Speed Double	ESC "L"	120 dots/inch 960 dots/8 line
2	High-Speed Double	ESC "Y"	120 dot positions/inch Faster than Mode 1; does not print consecutive dots in a row.
3	Quadruple	ESC "Z"	240 dot positions/inch; 1920 dot positions/8" line. Does not print consecutive dots in a row.
4	CRT	none	80 dots/inch; 640 dots/8" line
5	One-to-one (plotter)	none	72 dots/inch; 576 dots/8" line Produces the same density horizontally as vertically, which makes circles look round.
6	90 dots/inch	none	90 dots/inch; 720 dots/8" line

You are familiar with the command format that uses the ESCape code and a letter, but LX-86 graphics commands can also be in the following format:

```
LPRINT CHR$(27)“*“CHR$(M)CHR$(N1)CHR$(N2);
```

with m being the mode number found in the left column of Table 9-1. As usual, n_1 and n_2 reserve the number of columns for graphics. The seven modes include six densities, with two speeds for double-density.

Reassigning Code

The IX-86 has a graphics command that changes one graphics mode to another. You can use it with many commercial graphics software programs to change the density and shape of your printouts. The code is ESCape “?s” n, where s is one of the four alternate graphics codes (K, L, Y, or Z) and n is the number of the new code (0-6).

For example, if you send the following code before you run a graphics program, it will change every instance of mode “Y” (high-speed double-density) to mode 5 (one-to-one).

```
LPRINT CHR$ (27) “?Y” CHR$ (5) ;
```

As usual, this example is in MBASIC, but you can send the code in any programming language.

Even if you don’t know which code your graphics program uses, a little experimentation should tell you whether the reassigning code can improve your graphics printouts.

Column Reservation Numbers

Now that we’ve introduced you to the rest of the 8-pin graphics densities and the reassigning code, we’ll explain in more detail the part of the graphics command that reserves the number of columns for graphics (the numbers n_1 and n_2 in our examples).

If you need fewer than 255 columns of graphics, n_1 , is the number of columns you want and n_2 is zero. As you can see in Table 9-1, however, a single line will hold as many as 1920 columns in quadruple-density. Specifying more than 255 is where the second number slot (n_2) fits in. The first number that you send (n_1) indicates a number of columns, but the second does not represent a number of columns; it is multiplied by 256 and added to n_1 . The command for

the maximum number of dots you can reserve on the IX86, then, is:

```
CHR$(27)"Z"CHR$(128)CHR$(7);
```

or, in the other format:

```
CHR$(27)"*"CHR$(3)CHR$(128)CHR$(7);
```

which is **128** dots plus 7 times 256 dots, for a total of 1920 dots in one row.

Once you have chosen the number of columns you want to use, you can have your program do the calculations for you with the following format:

```
CHR$ (27) "L" CHR$ (N MOD 256) CHR$ (INT(N/256));
```

N is the total number of columns you want to specify. The MOD (modulus) function calculates the value for n_1 , and the INT (integer) function calculates the value for n_2 . For programming languages other than BASIC, consult your manual for the proper form for these functions.

This format can be used with any graphics density and with any value of N up to the maximum number of columns per line for that density.

WIDTH Statements

Many computer systems automatically insert the control codes for a carriage return and a line feed after every 80 characters. This insertion is usually no problem with text, but it can spoil your graphics. In the graphics mode they may insert the control codes after 120 columns, which could be in the middle of a line.

You can usually prevent these unwanted control codes with a WIDTH statement such as the one below:

```
WIDTH LPRINT 255
```

The format for your system may be different. Consult your computer or computer language manual to find the correct format for your system. Then put a WIDTH statement in one of the first lines of all your graphics programs. It is easier to put a WIDTH statement in all but the simplest of your programs than to examine each one to see whether or not such a statement is necessary.

Design Your Own Graphics

In this section we take you through the development of a graphics program. The example is not especially complicated, but it does include the same steps you would use for a more complex figure so that you have the basis for designing graphics on your LX-86.

You will plan your figure with dots on graph paper, but before beginning to place the dots, you should decide which graphics density you want. Figure 9-3 shows the differences between the three most-used graphics modes so that you can choose the one you want.

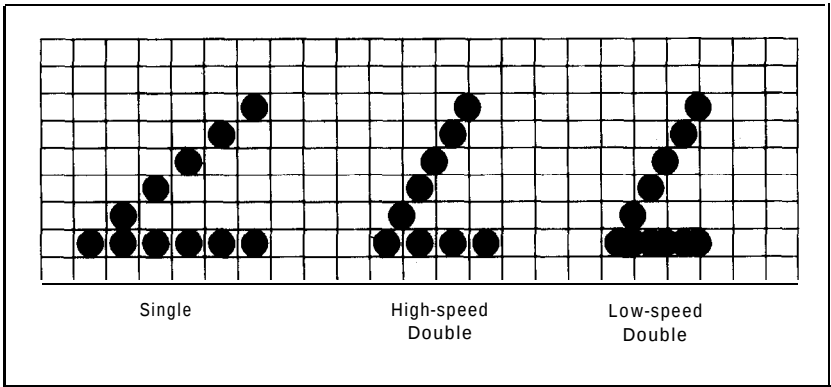


Figure 9-3. Designing in different densities

In this figure you can see the main rules for graphics design in the three densities. In single density no dots can be placed on vertical lines. In high-speed double density dots can be placed on vertical lines, but no dots can overlap. In low-speed double density dots can be placed on vertical lines and they can overlap.

Now look at our figure designed for high-speed double density. It should point you in the right direction for your own designs.

The numbers for the second and third lines were calculated in the same manner. Once the numbers for the pin patterns are calculated, they go in DATA statements, separated by commas.

First we'll give you the whole program and its printout; then we'll explain two techniques we have not used before:

```

90 WIDTH LPRINT 255
100 LPRINT CHR$(27)"1"
590 FOR K=1 TO 3
600 LPRINT CHR$(27)"Y"CHR$(50)CHR$(0);
610 READ N: IF N=128 THEN 650
620 IF N>=0 THEN LPRINT CHR$(N);: GOTO 610
630 READ P,R: FOR J=1 TO -N
632 LPRINT CHR$(P)CHR$(R);: NEXT J
640 GOTO 610
650 LPRINT: NEXT K: LPRINT CHR$(27)"@": END
800 DATA 8, 4, 10, 1, -6, 8, 0, 4, 0, 2, 0, 1, -9, 0, 0, 0
805 DATA 23, 8, 4, 2, 1, -2, 0, 0, 0, 128
810 DATA 0, 0, 0, 0, 84, 32, 17, 10, 4, 0, -6, 0, 0, -10
815 DATA 64, 0, 0, 0, 0, 84, 32, 17, 10, 4, 128
820 DATA 2, 4, 10, 18, 34, 64, -5, 2, 0, 4, 0, 8, 0, 16
825 DATA 0, -9, 32, 0, 61, 2, 4, 8, 16, 32, 64, 0, 0, 0, 128

```



In this program we used the number 128 in the DATA statements to signal the end of a print line. This is the reason for the IF-THEN statement in line 610 that skips to line 650 and causes a line feed.

The other special technique used in this program is found in lines 620 and 630. Since some of the data numbers are repeated many times, we save typing by using negative DATA numbers for repetitions. Line 620 tests for a negative number, and if it finds one, reads the next two numbers and prints their pin patterns the number of times indicated by the negative number.

For example, when the minus 6 in line 800 is read, the program then reads the next two numbers (8 and 0) and sends them to the printer six times. This feature is not a necessary part of the program, but it does allow you to type fewer data numbers.

Otherwise the program is a straightforward graphics program that uses 7-dot line spacing and reads numbers from DATA statements and sends them to the printer. If you want to see the figure in other densities, change the "Y" in line 600 to "L" or "Z".

Graphics Programming Tips

Now that we’ve shown you how to design your own graphics, we’ll review and emphasize a few elements of graphics programming. As usual, we use MBASIC in the examples, but the principles apply to any programming language.

Semicolons and command placement

After the graphics command is issued, every number sent to the IX-86 is interpreted as a pin pattern and printed on paper. Therefore, you must be careful where you put graphics commands in your program.

For example, suppose you want a SO-column graphics line with the line spacing set to T-dot. You might enter the following program:

```
20 LPRINT CHR$( 27) "K"CHR$( 50)CHR$(0)
30 LPRINT CHR$( 27) "1"
40 FOR G=1 TO 50: LPRINT CHR$(74): NEXT G
```

This program has all the necessary elements. Line 20 has the command for single-density graphics and specifies **50** columns. (Remember that you must use two numbers to reserve columns even if you only need the first one.) Line 30 has the correct command for T-dot line spacing, and line **40** calls for the printing of a pin pattern 50 times. (If you wish, refer back to Figure **9-2** to see a representation of the pin pattern that 74 produces.)

Although this program has all the necessary elements, it will not give you the single pin pattern that you want, as you can see in the partial printout in Figure **9-6**.

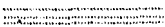
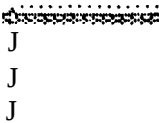
	
Expected pattern	Actual result

Figure 9-6. Result of incorrect program

What went wrong? To help you understand the graphics command and avoid some of the more common errors made with it, we'll examine this program in detail.

First look at line 20. ESCape "K" calls for single-density graphics, and the two CHR\$ numbers specify 50 columns of dots. Once that command is given, every number sent to the printer is interpreted as a pin pattern and printed on the paper. Since there is no semicolon at the end of the line, the numbers 13 and 10-the codes for carriage return and line feed-are sent to the printer after CHR\$(0). Because the graphics command has been issued, these codes are printed as pin patterns.

Line 30 would normally be the command for 7-dot line spacing, but since the graphics mode is still in effect, the command is interpreted by the printer as two pin patterns: 27 and 49 (the ASCII codes for ESCape and "1"). Since there is no semicolon at the end of this line, the numbers 13 and 10 are sent again, and again they are printed as pin patterns.

In line 40 nothing is sent to the printer until after the LPRINT. Then the desired pin pattern-74-is finally sent, but since no semicolon is after it, 13 and 10 are sent next each time the loop is executed.

Figure 9-7 is an enlarged representation of the first 13 columns of the printout. In this figure you can see exactly how the printer reacted to the first part of the incorrect program.

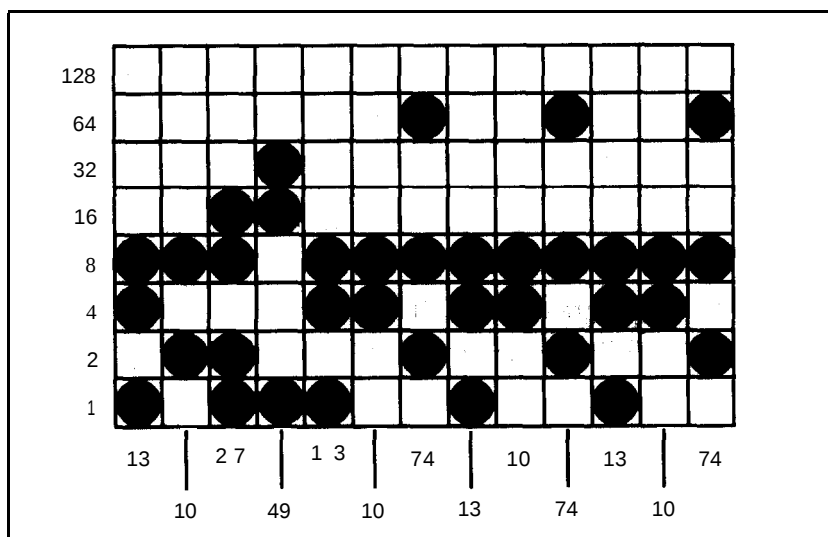


Figure 9-7. Pin patterns of incorrect program

You may also wonder why the program prints not only the different pin patterns but also the character “J” a number of times. The reason lies in the number of columns you reserved with the graphics command. After the LX-86 receives all the numbers reserved by a graphics command-50 in this case-it leaves the graphics mode and resumes interpreting numbers as printable characters or print commands.

Since the incorrect program has sent many extra numbers, mainly **10s** and **13s**, the 50 columns reserved are filled before the loop in line 40 has been executed 50 times. Therefore, during the last passes of the loop the Ix-86 interprets **CHR\$(74)** as the ASCII code for “J” and prints that character each of the last 35 passes of the loop.

If you want to make the program work correctly, put the line-spacing command in line 10, delete line 30, and add two semicolons: one at the end of line 20 and one between **CHR\$(74)** and the colon in line 40.

We have explained this incorrect program in detail so that you will remember two important tips about using the graphics command:

- Use semicolons to prevent the LX-86 from printing carriage return and line feed codes as pin patterns.
- Do not put any other commands between the graphics command and its data.

Our example should help you understand the graphics mode better and may help you find the problem when one of your own programs gives you unexpected results.

String variables

In a long and complicated graphics program, typing in the graphics command or repetitive data numbers over and over can become time-consuming. **You** can avoid much of the repetitive typing by storing commands and data in string variables.

Look at the program below. It is the same as the multiple-line exercise earlier in the chapter except for the string variables.

```

10 G$=-CHR$( 27) + "K" + CHR$( 100) + CHR(0)
20 A$=CHR$(85)+CHR$(42)
30 B$=CHR$(42)+CHR$(85)
40 LPRINT CHR$( 27  "1" ;
50 FOR R=1 TO 3
60 LPRINT G$;
70 FOR X=1 TO 50: LPRINT A$;; NEXT X
80 LPRINT
90 LPRINT G$;
100 FOR X=1 TO 50: LPRINT B$;; NEXT X
110 LPRINT: NEXT R
120 LPRINT CHR$( 27) "@"

```

Notice that the first line stores the whole graphics command in a single string variable. In order to do this you must put plus signs between the elements of the command. Once you have done this at the beginning of the program, each time you enter LPRINT G\$; you have issued the graphics command. Lines 20 and 30 do the same thing with the data used in this program. As you can see, the use of string variables saves some typing even in this short program. In a long program it can save you much more time and effort.

Graphics and low ASCII codes

Sending a few of the codes between 0 and 31 with BASIC or another programming language can cause problems on some computer systems. The problem is that most computer systems handle some of these codes in a special way instead of delivering them to the printer.

For example, one computer system handles form feeds by itself. It counts lines to keep track of the top of page. If a program sends the ASCII code for form feed (12) to the printer, the computer system intercepts it and sends instead the code for line feed (10) several times. If you are in a graphics mode with this system and send a 12 to fire pins 3 and 4, the computer system will intercept that 12 and send several 10s instead. You can see how this would ruin your graphics. You would get pins 2 and 4 (whose sum is 10) several times instead of pins 3 and 4 only once.

If your computer system screens out or changes any codes sent to it, you can often design around these problems by using other numbers with similar patterns, and you can see Appendix F for a method to determine which codes may cause problems and for some ideas on overcoming those problems.

Appendix A

IX-86 Characters

This appendix gives the control codes and characters for each code from **0** through **255** decimal (**00** through FF hex). Page A-3 shows the characters in the Epson Character Graphics set.

Further information on the character sets is in Chapter 6.

Dec	Hex	CHR	Dec	Hex	CHR	Dec	Hex	CHR	Dec	Hex	CHR
0	00	none	64	40	@	128	80	↑	192	co	@
1	01	none	65	41	A	129	81	↓	193	C1	A
2	02	none	66	42	B	130	82	↑	194	C2	B
3	03	none	67	43	C	131	83	↑	195	C3	C
4	04	none	68	44	D	132	84	↑	196	C4	D
5	05	none	69	45	E	133	85	↑	197	C5	E
6	06	none	70	46	F	134	86	↑	198	C6	F
7	07	BEL	71	47	G	135	87	↑	199	C7	G
8	08	BS	72	48	H	136	88	↑	200	C8	H
9	09	HT	73	49	I	137	89	↑	201	C9	I
10	0A	LF	74	4A	J	138	8A	↑	202	CA	J
11	0B	VT	75	4B	K	139	8B	⊗	203	CB	K
12	0C	FF	76	4C	L	140	8C	■	204	CC	L
13	0D	CR	77	4D	M	141	8D	■	205	CD	M
14	0E	SO	78	4E	N	142	8E	↑	206	CE	N
15	0F	SI	79	4F	O	143	8F	●	207	CF	O
16	10	none	80	50	P	144	90	●	208	D0	P
17	11	none	81	51	Q	145	91	♣	209	D1	Q
18	12	DC2	82	52	R	146	92	♥	210	D2	R
19	13	none	83	53	S	147	93	♦	211	D3	S
20	14	DC4	84	54	T	146	94	♣	212	D4	T
21	15	none	85	55	U	149	95	♪	213	D5	U
22	16	none	86	56	V	150	96	♫	214	D6	V
23	17	none	87	57	W	151	97	+	215	D7	W
24	18	CAN	88	58	X	152	98	⌘	216	D8	X
25	19	EM	89	59	Y	153	99	⌘	217	D9	Y
26	1A	none	90	5A	Z	154	9A	⌘	218	DA	Z
27	1B	ESC	91	5B	[	155	9B	↑	219	DB	[
28	1C	none	92	5C	\	156	9C	↓	220	DC	\
29	1D	none	93	5D	]	157	9D	⌘	221	DD	]
30	1E	none	94	5E	^	158	9E	↑	222	DE	^
31	1F	none	95	5F	~	159	9F	±	223	DF	~
32	20	SP	96	60		160	A0		224	E0	
33	21	!	97	61	a	161	A1	/	225	E1	a
34	22	"	98	62	b	162	A2	"	226	E2	b
35	23	*	99	63	c	163	A3	#	227	E3	c
36	24	\$	100	64	d	164	A4	\$	228	E4	d
37	25	%	101	65	e	165	A5	%	229	E5	e
38	26	&	102	66	f	166	A6	&	230	E6	f
39	27	'	103	67	g	167	A7	'	231	E7	g
40	28	(	104	68	h	168	A6	(	232	E8	h
41	29	)	105	69	i	169	A9	)	233	E9	i
42	2A	*	106	6A	j	170	AA	*	234	EA	j
43	2B	+	107	6B	k	171	AB	+	235	EB	k
44	2C	,	108	6C	l	172	AC	,	236	EC	l
45	2D	-	109	6D	m	173	AD	-	237	ED	m
46	2E	.	110	6E	n	174	AE	.	238	EE	n
47	2F	/	111	6F	o	175	AF	/	239	EF	o
48	30	0	112	70	p	176	B0	0	240	F0	p
49	31	1	113	71	q	177	B1	1	241	F1	q
50	32	2	114	72	r	178	B2	2	242	F2	r
51	33	3	115	73	s	179	B3	3	243	F3	s
52	34	4	116	74	t	180	B4	4	244	F4	t
53	35	5	117	75	u	181	B5	5	245	F5	u
54	36	6	118	76	v	182	B6	6	246	F6	v
55	37	7	119	77	w	183	B7	7	247	F7	w
56	38	8	120	78	x	184	B8	8	246	F8	x
57	39	9	121	79	y	185	B9	9	249	F9	y
58	3A	:	122	7A	z	186	BA	:	250	FA	z
59	3B	;	123	7B	{	187	BB	;	251	FB	{
60	3C	<	124	7C		188	BC	<	252	FC	
61	3D	=	125	7D	}	189	BD	=	253	FD	}
62	3E	>	126	7E	~	190	BE	>	254	FE	~
63	3F	?	127	7F	DEL	191	BF	?	255	FF	DEL

Epson Character Graphics

Standard

International

Dec	Hex	CHR	Dec	Hex	CHR	Dec	Hex	CHR	Dec	Hex	CHR
128	80	none	192	C0	À	128	80	À	192	C0	À
129	81	none	193	C1	Á	129	81	Á	193	C1	Á
130	82	none	194	C2	Â	130	82	Â	194	C2	Â
131	83	none	195	C3	Ã	131	83	Ã	195	C3	Ã
132	84	none	196	C4	Ä	132	84	Ä	196	C4	Ä
133	85	none	197	C5	Å	133	85	Å	197	C5	Å
134	86	none	198	C6	Ä	134	86	Ä	198	C6	Ä
135	87	BEL	199	C7	Å	135	87	Å	199	C7	Å
136	88	BS	200	C8	Ä	136	88	Ä	200	C8	Ä
137	89	HT	201	C9	Å	137	89	Å	201	C9	Å
138	8A	LF	202	CA	Ä	138	8A	Ä	202	CA	Ä
139	8B	VT	203	CB	Å	139	8B	Å	203	CB	Å
140	8C	FF	204	CC	Ä	140	8C	Ä	204	CC	Ä
141	8D	CR	205	CD	Å	141	8D	Å	205	CD	Å
142	8E	SO	206	CE	Ä	142	8E	Ä	206	CE	Ä
143	8F	SI	207	CF	Å	143	8F	Å	207	CF	Å
144	90	none	208	DO	Ä	144	90	Ä	208	DO	Ä
145	91	none	209	D1	Å	145	91	Å	209	D1	Å
146	92	DC2	210	D2	Ä	146	92	Ä	210	D2	Ä
147	93	none	211	D3	Å	147	93	Å	211	D3	Å
148	94	DC4	212	D4	Ä	148	94	Ä	212	D4	Ä
149	95	none	213	D5	Å	149	95	Å	213	D5	Å
150	96	none	214	D6	Ä	150	96	Ä	214	D6	Ä
151	97	none	215	D7	Å	151	97	Å	215	D7	Å
152	98	CAN	216	D8	Ä	152	98	Ä	216	D8	Ä
153	99	EM	217	D9	Å	153	99	Å	217	D9	Å
154	9A	none	218	DA	Ä	154	9A	Ä	218	DA	Ä
155	9B	ESC	219	DB	Å	155	9B	Å	219	DB	Å
156	9C	none	220	DC	Ä	156	9C	Ä	220	DC	Ä
157	9D	none	221	DD	Å	157	9D	Å	221	DD	Å
158	9E	none	222	DE	Ä	158	9E	Ä	222	DE	Ä
159	9F	none	223	DF	Å	159	9F	Å	223	DF	Å
160	A0	À	224	E0	Ä	160	A0	Ä	224	E0	Ä
161	A1	Á	225	E1	Å	161	A1	Å	225	E1	Å
162	A2	Â	226	E2	Ä	162	A2	Ä	226	E2	Ä
163	A3	Ã	227	E3	Å	163	A3	Å	227	E3	Å
164	A4	Ä	228	E4	Ä	164	A4	Ä	228	E4	Ä
165	A5	Å	229	E5	Ä	165	A5	Ä	229	E5	Ä
166	A6	Ä	230	E6	Å	166	A6	Å	230	E6	Å
167	A7	Ä	231	E7	Ä	167	A7	Ä	231	E7	Ä
168	A8	Ä	232	E8	Å	168	A8	Å	232	E8	Å
169	A9	Ä	233	E9	Ä	169	A9	Ä	233	E9	Ä
170	AA	Ä	234	EA	Å	170	AA	Å	234	EA	Å
171	AB	Ä	235	EB	Ä	171	AB	Ä	235	EB	Ä
172	AC	Ä	236	EC	Å	172	AC	Å	236	EC	Å
173	AD	Ä	237	ED	Ä	173	AD	Ä	237	ED	Ä
174	AE	Ä	238	EE	Å	174	AE	Å	238	EE	Å
175	AF	Ä	239	EF	Ä	175	AF	Ä	239	EF	Ä
176	B0	Ä	240	F0	Ä	176	B0	Ä	240	F0	Ä
177	B1	Ä	241	F1	Å	177	B1	Å	241	F1	Å
178	B2	Ä	242	F2	Ä	178	B2	Ä	242	F2	Ä
179	B3	Ä	243	F3	Å	179	B3	Å	243	F3	Å
180	B4	Ä	244	F4	Ä	180	B4	Ä	244	F4	Ä
181	B5	Ä	245	F5	Å	181	B5	Å	245	F5	Å
182	B6	Ä	246	F6	Ä	182	B6	Ä	246	F6	Ä
183	B7	Ä	247	F7	Å	183	B7	Å	247	F7	Å
184	B8	Ä	248	F8	Ä	184	B8	Ä	248	F8	Ä
185	B9	Ä	249	F9	Å	185	B9	Å	249	F9	Å
186	BA	Ä	250	FA	Ä	186	BA	Ä	250	FA	Ä
187	BB	Ä	251	FB	Å	187	BB	Å	251	FB	Å
188	BC	Ä	252	FC	Ä	188	BC	Ä	252	FC	Ä
189	BD	Ä	253	FD	Å	189	BD	Å	253	FD	Å
190	BE	Ä	254	FE	Ä	190	BE	Ä	254	FE	Ä
191	BF	Ä	255	FF	SP	191	BF	Ä	255	FF	SP

Appendix B

Commands in Numerical Order

This appendix lists all the LX-86 commands in numerical order. The page number column indicates where a complete description can be found.

Note that for commands from ESC SO onwards, the decimal and hexadecimal columns show only the second code; the first code for those commands is the ESCape code.

ASCII	Dec	Hex	Description	Page ref
BEL	7	07	Beeper	C-24
BS	8	08	Backspace	c-9
HT	9	09	Tab horizontally	c-17
LF	10	0A	Line feed	c-11
VT	11	0B	Tab vertically	c-17
FF	12	0C	Form feed	c-13
CR	13	0D	Carriage return	C-23
s o	14	0E	Select double-width (1 line)	c-3
SI	15	0F	Select condensed mode	c-2
DC1	17	11	Select printer	C-6
DC2	18	12	Cancel condensed mode	c-2
DC3	19	13	Deselect printer	C-6
DC4	20	14	Cancel double-width (1 line)	c-3
CAN	24	18	Cancel line	C-24
DEL	127	7F	Delete character	C-24
ESC SO	14	0E	Select double-width (1 line)	c-3
ESC SI	15	0F	Select condensed mode	c-2
ESC EM	25	19	Automatic sheet feeder on/off	c-10
ESC !	33	21	Master select	c-7
ESC %	37	25	Select user-defined set	c-20
ESC &	38	26	Define user-defined characters	c-20
ESC *	42	2A	Select graphics mode	c-22
ESC -	45	2D	Turn underlining on/off	C-6
ESC /	47	2F	Select vertical tab channel	c-17
ESC 0	48	30	Select 1/8 inch line spacing	c-11
ESC 1	49	31	Select 7 / 17 2 inch line spacing	c-12
ESC 2	50	32	Select 1 / 6 inch line spacing	c-12
ESC 3	51	33	Select n/216 inch line spacing	c-12
ESC 4	52	34	Select italic mode	c-7
ESC 5	53	35	Cancel italic mode	c-7
ESC 6	54	36	International character set	c-9
ESC 7	55	37	Select standard character set	c-9
ESC 8	56	38	Disable paper out sensor	c-14
ESC 9	57	39	Enable paper out sensor	c-14
ESC :	58	3A	Copy ROM into RAM	c-19
ESC <	60	3C	Unidirectional mode (1 -line)	c-10
ESC ?	63	3F	Reassign graphics mode	C-23
ESC @	64	40	Initialize the printer	c-7
ESC A	65	41	Select n/ 72 inch line spacing	c-13
ESC B	66	42	Set vertical tabs	C-16
ESC C	67	43	Set page length in lines	c-14
ESC CO	67	43	Set page length in inches	c-15
ESC D	68	44	Set horizontal tabs	C-18
ESC E	69	45	Select emphasized mode	C-4
ESC F	70	46	Cancel emphasized mode	c-4

ASCII	Dec	Hex	Description	Page ref
ESC G	71	47	Select double-strike mode	c-5
ESC H	72	48	Cancel double-strike mode	c-5
ESC J	74	4A	Perform n/ 216 inch line feed	c-13
ESC K	75	4B	Single density graphics	c-20
ESC L	76	4C	Double density graphics	c-21
ESC M	77	4D	Select elite pitch	c-4
ESC N	78	4E	Set skip over perforation	c-15
ESC O	79	4F	Cancel skip over perforation	c-15
ESC P	80	50	Select pica pitch	c-4
ESC Q	81	51	Set right margin	c-19
ESC R	82	52	International character set	C-8
ESC SO	83	53	Select superscript mode	c-5
ESC SI	83	53	Select subscript mode	c-5
ESC T	84	54	Cancel superscript/subscript	c-5
ESC U	85	55	Select unidirectional mode	c-10
ESC W	87	57	Turn double-width on/off	c-3
ESC Y	89	59	High speed dbl. den. graphics	c-21
ESC Z	90	5A	Quadruple density graphics	c-22
ESC \	94	5E	Nine-pin graphics	C-23
ESC a	97	61	Select justification	c-2
ESC b	98	62	Set vertical tabs in channels	C-16
ESC e	101	65	Set tab increments	C-18
ESC f	102	66	Horizontal / Vertical skip	C-18
ESC l	108	6C	Set left margin	c-19
ESC m	109	6D	Special graphic characters	C-8
ESC s	115	73	Half speed mode on/ off	c-11
ESC t	116	74	Set character table	C-8
ESC x	120	78	Select print mode	c-1

Control Key Chart

Some applications programs can use control key codes for decimal values **0-27**. The table below gives you the proper values. The Control key column indicates that you press the control key at the same time you press the key for the letter or symbol in that column. For example, you press the control key and A at the same time to send the value **1**.

Some programs that use this system cannot use control-@, and many programs use the control keys for other purposes.

Decimal	Hexadecimal	Control key
0	00	@
1	01	A
2	02	B
3	03	C
4	04	D
5	05	E
6	06	F
7	07	G
8	08	H
9	09	I
10	0A	J
11	0B	K
12	0C	L
13	0D	M
14	0E	N
15	0F	O
16	10	P
17	11	Q
18	12	R
19	13	s
20	14	T
21	15	U
22	16	V
23	17	W
24	18	X
25	19	Y
26	1A	z

Appendix C

Command Summary

This appendix lists and describes all the commands available on the LX-86. This summary is divided into the following topics:

Near Letter Quality	Forms Control
Character Width	Page Format
Print Enhancement	User-defined Characters
Mode and Character Set	Dot Graphics
Special Features	Miscellaneous Codes
Line Spacing	

Each command has a format section and a comment section. The format section gives the ASCII, decimal, and hexadecimal codes for the command, and the comment section describes and explains the command.

For a list of the commands in numerical order, see Appendix B.

Near Letter Quality

ESC x

Select Print Mode

Format:

ASCII code:	ESC	x	(n)
Decimal:	27	120	(n)
Hexadecimal:	1 B	78	(n)

Explanation:

Selects draft mode if n = 0, or Near Letter Quality (NLQ) mode if n=1 .

ESC a **Select Justification Mode**

Format:

ASCII code: **ESC**
Decimal: **2 7 9 7 (n)**
Hexadecimal: **1B 61 (n)**

Explanation:

See Chapter 7 for information on this command.

Character Width

SI **Select Condensed Mode**

Format:

ASCII code: **SI**
Decimal: **15**
Hexadecimal: **0 F**

Explanation:

This command is only effective in draft mode. It produces characters that are approximately 60% of their normal width.

ESC SI **Select Condensed Mode**

Format:

ASCII code: **ESC SI**
Decimal: **27 1 5**
Hexadecimal: **1B 0F**

Explanation:

Duplicates the SI command.

DC2 **Cancel Condensed Mode**

Format:

ASCII code: **DC2**
Decimal: **18**
Hexadecimal: **1 2**

Explanation:

This command cancels the condensed printing selected by SI and ESC SI.

SO	Select Double-width (one line)
-----------	---------------------------------------

Format:

ASCII code: s o

Decimal: **14**Hexadecimal: **O E****Explanation:**

Double-width mode doubles the width of all characters, including spaces. It is cancelled by a carriage return or DC4.

ESC SO	Select Double-width
---------------	----------------------------

Format:ASCII code: **ESC SO**Decimal: **27 14**Hexadecimal: **1B 0E****Explanation:**

Duplicates the SO command.

DC4	Cancel Double-width (one line)
------------	---------------------------------------

Format:ASCII code: **D C 4**

Decimal: 2 0

Hexadecimal: **1 4****Explanation:**

Cancels the one-line enlarged printing set by SO or ESC SO, but not the enlarged printing set by ESC W or ESC !.

ESC W	Select Double-width
--------------	----------------------------

Format:ASCII code: **ESC W (n)**Decimal: **27 87 (n)**Hexadecimal: **1B 57 (n)****Explanation:**

Double-width doubles the width of all characters, including spaces. This command turns double-width on (when **n=1**) until switched off (when **n = 0**).

ESC M

Select Elite Pitch

Format:

ASCII code:	ESC	M
Decimal:	27	77
Hexadecimal:	1B	4D

Explanation:

Selects elite pitch (12 characters per inch).

ESC P

Select Pica Pitch

Format:

ASCII code:	ESC	P
Decimal:	27	80
Hexadecimal:	1B	50

Explanation:

Selects pica pitch (**10** characters per inch). This is the default character width; so this command is normally used to cancel the elite pitch.

Print Enhancement

ESC E

Select Emphasized Mode

Format:

ASCII code:	ESC	E
Decimal:	27	69
Hexadecimal:	1B	45

Explanation:

Makes text bolder by printing each dot twice, with the second dot slightly to the right of the first.

ESC F

Cancel Emphasized Mode

Format:

ASCII code:	ESC	F
Decimal:	27	70
Hexadecimal:	1B	46

Explanation:

Turns off the emphasized mode selected by ESC E.

ESC G **Select Double-Strike Mode**

Format:

ASCII code:	ESC	G
Decimal:	27	71
Hexadecimal:	1B	47

Explanation:

Makes text bolder by printing each line twice, with the second printing slightly below the first.

ESC H **Cancel Double-Strike Mode**

Format:

ASCII code:	ESC	H
Decimal:	27	72
Hexadecimal:	1B	47

Explanation:

Turns off double-strike mode selected by ESC G.

ESC S **Select Superscript/Subscript**

Format:

ASCII code:	ESC	S	(n)
Decimal:	27	83	(n)
Hexadecimal:	1B	53	(n)

Explanation:

This command either selects superscript (when n = **0**) or subscript (when n= **1**) .

ESC T **Cancel Superscript/Subscript**

Format:

ASCII code:	ESC	T
Decimal:	27	64
Hexadecimal:	1B	54

Explanation:

Turns off either superscript or subscript.

ESC -

Select Underlining

Format:

ASCII code:	ESC	--	(n)
Decimal:	27	45	(n)
Hexadecimal:	1B	2D	(n)

Explanation:

When the value of n = **1**, underlining is turned on, when n = 0, underlining is turned off.

Mode and Character Set Selection

DC3

Deselect Printer

Format:

ASCII code:	DC3
Decimal:	19
Hexadecimal:	1 3

Explanation:

Places the printer into the deselected state until the select printer code **DC1** is received.

DC1

Select Printer

Format:

ASCII code:	D C 1
Decimal:	17
Hexadecimal:	11

Explanation:

Returns the printer to the selected state if it has been switched off by the printer deselect code DC3.

ESC ! Master Select

Format:

ASCII code:	ESC	!	(n)
Decimal:	27	33	(n)
Hexadecimal:	1B	21	(n)

Explanation:

This command enables a number of commands to be added together. Full details of the values and examples are given in Chapter 6.

ESC 4 Select Italic Mode

Format:

ASCII code:	ESC	4
Decimal:	27	52
Hexadecimal:	1B	34

Explanation:

This command causes characters to be printed using the italic character set.

ESC 5 Cancel Italic Mode

Format:

ASCII code:	ESC	5
Decimal:	27	53
Hexadecimal:	1B	35

Explanation:

Cancels the italic printing set by ESC 4.

ESC @ Initialize Printer

Format:

ASCII code:	ESC	@
Decimal:	27	64
Hexadecimal:	1B	40

Explanation:

Resets the printer to the power-on state, including top of form. Clears the buffer of printable data on the print line preceding the command.

ESCR

Select International Character Set**Format:**

ASCII code:	ESC	R	(n)
Decimal:	27	82	(n)
Hexadecimal:	1B	52	(n)

Explanation:

Some character codes produce different characters for different countries. The characters are outlined in Chapter 6. The value of n determines which character set is printed. The countries corresponding to the values of n are the following:

n	Country	n	Country
0	USA	6	Italy
1	France	7	Spain
2	Germany	8	Japan
3	United Kingdom	9	Norway
4	Denmark1	10	Denmark II
5	Sweden		

ESC m

Select Special Graphics Characters**Format:**

ASCII code:	ESC	m
Decimal:	27	109
Hexadecimal:	1B	6D

Explanation:

This code allows ASCII codes 128 to **159** to print special graphics characters. See Chapter 6 for details.

ESC t

Select Character Set**Format:**

ASCII code:	ESC	t	(n)
Decimal:	27	116	(n)
Hexadecimal:	1B	74	(n)

Explanation:

Selects either the character graphics set or the standard character set. The value n = **0** selects the standard character set. The value n = **1** selects the character graphics set. See Appendix A for the tables.

ESC 6 **Select International Character Graphics**

Format:

ASCII code:	ESC	6
Decimal:	27	54
Hexadecimal:	1B	36

Explanation:

When the character graphics set is selected, this code selects the international set. See the table on page A-3

ESC7 **Select Standard Character Graphics**

Format:

ASCII code:	ESC	7
Decimal:	27	55
Hexadecimal:	1B	37

Explanation:

When the character graphics set is selected, this code selects the Standard Character Graphics set. See the table on page A-3. This is the default.

Special Printer Features

BS **Backspace**

Format:

ASCII code:	BS
Decimal:	a
Hexadecimal:	08

Explanation:

The print position is moved one space to the left.

ESC EM**Automatic Sheet Feeder Control****Format:**

ASCII code:	ESC	EM	(n)
Decimal:	27	25	(n)
Hexadecimal:	1B	19	(n)
Control:	Ctrl[	Ctrl Y	(n)

Explanation:

This command is used with the optional automatic-sheet feeder. When n= **0** the feeder is turned off, when n = 4 it is turned on. Using DIP Switch 1-3 produces the same effect.

ESC <**Select Unidirectional Mode (one line)****Format:**

ASCII code:	ESC	<
Decimal:	27	60
Hexadecimal:	1B	3C

Explanation:

Selects unidirectional printing for more accurate positioning during text printing for one line only, It is cancelled by a carriage return. (Graphics printing is always unidirectional.)

ESC U**Select Unidirectional Mode****Format:**

ASCII code:	ESC	U	(n)
Decimal:	27	85	(n)
Hexadecimal:	1B	55	(n)

Explanation:

Selects unidirectional printing for more accurate positioning during text printing. If n = **1** unidirectional mode is enabled, while **n=0** disables the feature. (Graphics printing is always unidirectional.)

ESC s**Select Half Speed Mode****Format:**

ASCII code:	ESC	s	(n)
Decimal:	27	115	(n)
Hexadecimal:	1B	73	(n)

Explanation:

Selects half speed printing if n= 1 or returns to full speed if n=0.

Line Spacing**LF****Line Feed****Format:**

ASCII code:	LF
Decimal:	10
Hexadecimal:	0A

Explanation:

When this command is received, the data in the print buffer is printed and the paper advances one line in the current line spacing.

ESC 0**Select 1/8 Inch Line Spacing****Format:**

ASCII code:	ESC	0
Decimal:	27	48
Hexadecimal:	1B	30

Explanation:

Sets the line spacing to 1/8 of an inch for subsequent line feed commands. The **"0"** is the digit zero and not the character with ASCII code 0.

ESC 1	Select 7/72 Inch Line Spacing
--------------	--------------------------------------

Format:

ASCII code:	ESC	1
Decimal:	27	49
Hexadecimal:	1B	31

Explanation:

Selects the line spacing to **7/72** of an inch for subsequent line feed commands. The “**1**” is the digit one and not lower case L.

ESC 2	Select 1/6 Inch Line Spacing
--------------	-------------------------------------

Format:

ASCII code:	ESC	2
Decimal:	27	50
Hexadecimal:	1B	32

Explanation:

Selects the line spacing to 1/6 of an inch for subsequent line feed commands. The “2” is the digit two and not the character with ASCII code 2. This is the default at power on.

ESC 3	Select n/216 Inch Line Spacing
--------------	---------------------------------------

Format:

ASCII code:	ESC	3	(n)
Decimal:	27	51	(n)
Hexadecimal:	1B	33	(n)

Explanation:

Selects the line spacing to n/216 of an inch for subsequent LF commands. The “3” is the digit three and not the character with ASCII code 3. The value of n should be in the range 0 to 255.

ESC J **Perform $n/216$ Inch Line Feed for One Line**

Format:

ASCII code: **ESC** **J** (n)
Decimal: **27** **74** (n)
Hexadecimal: **1B** **4A** (n)

Explanation:

Advances the paper by one line at a spacing of $n/216$ of an inch. The value of n should be in the range 0 to 255. This command does not send a carriage return with the line feed.

ESC A **Set $n/72$ Inch Line Spacing**

Format:

ASCII code: **ESC** **A** (n)
Decimal: **27** **65** (n)
Hexadecimal: **1B** **41** (n)

Explanation:

Sets the line spacing to $n/72$ of an inch for subsequent line feed commands. The value of n should be in the range 0 to 85.

Forms Control

FF **Form Feed**

Format:

ASCII code: **FF**
Decimal: **11**
Hexadecimal: 0C

Explanation:

When this command is given, the data in the print buffer is printed and the paper advances to the top of the next page according to the current page length.

ESC 8**Disable Paper-Out Sensor**

Format:

ASCII code:	ESC	8
Decimal:	27	56
Hexadecimal:	1B	38

Explanation:

Turns off the paper sensor so that you can print right to the end of a single sheet of paper. This command temporarily duplicates the function of DIP switch 1-5. This command is not effective for computers that monitor pin 12.

ESC 9**Enable Paper-Out Sensor**

Format:

ASCII code:	ESC	9
Decimal:	27	57
Hexadecimal:	1B	39

Explanation:

Turns on paper-out sensor so that the printer beeper sounds when the printer runs out of paper.

ESC C**Set Page Length in Lines**

Format:

ASCII code:	ESC	C	(n)
Decimal:	27	67	(n)
Hexadecimal:	1B	43	(n)

Explanation:

Sets the page length to n lines. The value of n should be in the range **1** to **127**.

ESC CO	Set Page Length in Inches
---------------	----------------------------------

Format:

ASCII code:	ESC	C	NUL	(n)
Decimal:	27	67	0	(n)
Hexadecimal:	1B	43	00	(n)

Explanation:

Sets the page length to n inches where n has a value of **1** to **22**.

ESC N	Select Skip Over Perforation
--------------	-------------------------------------

Format:

ASCII code:	ESC	N	(n)
Decimal:	27	78	(n)
Hexadecimal:	1B	4E	(n)

Explanation:

The variable n is the number of lines between the last line printed one page and the first line on the next page. For example, ESC **N** 6 will cause the LX-86 to print 60 lines and then skip 6.

ESC O	Cancel Skip Over Perforation
--------------	-------------------------------------

Format:

ASCII code:	ESC	O
Decimal:	27	79
Hexadecimal:	1B	4F

Explanation:

Cancels the mode selected by ESC **N**.

Page Format

ESC B

Set Vertical Tabs

Format:

ASCII code:	ESC	B	(n1)	(n2)	. . .	NUL
Decimal:	27	66	(n1)	(n2)	. . .	0
Hexadecimal:	1B	42	(n 1)	(n 2)	... 	00

Explanation:

This command allows setting of up to 16 vertical tabs. The tabs can be set in 8 channels using the ESC b command. This command sets the tabs in channel 0. These are entered as n1, n2, n3, etc. (in the range 1 to 254) with the NUL character as the terminator. The tab settings n1, n2, n3, etc. must be entered in ascending order. The tab settings can be cleared by executing the command giving a value of zero to n1. Altering the line spacing after giving this command does not affect the absolute position of the tab setting.

ESC b

Set Vertical Tabs in Channels

Format:

ASCII code:	ESC	b	(c)	(n1)	(n2)	. . .	NUL
Decimal:	27	66	(c)	(n1)	(n2)	. . .	0
Hexadecimal:	1B	42	(c)	(n1)	(n2)	. . .	00

Explanation:

This command allows setting of vertical tabs in eight channels (the range of c is 0 to 7). These are entered as n1, n2, n3, etc. (in the range 1 to 254) with the NUL character as the terminator. The tab settings n1, n2, n3, etc. must be entered in ascending order. The tab settings can be cleared by executing the command giving a value of zero to n1. Altering the line spacing after giving this command does not affect the absolute position of the tab setting.

ESC /	Select Vertical Tab Channel
--------------	------------------------------------

Format:

ASCII code:	ESC	/	(c)
Decimal:	27	47	(c)
Hexadecimal:	13	2F	(c)

Explanation:

This command is used to set the vertical tab channel, where c has the value 0 to 7.

VT	Tab Vertically
-----------	-----------------------

Format:

ASCII code:	VT
Decimal:	11
Hexadecimal:	0 B

Explanation:

Advances the paper to the next tab setting in the channel selected by ESC /. If no channel has been set, channel **0** is used. If no vertical tabs have been set, the paper advances one line.

HT	Tab Horizontally
-----------	-------------------------

Format:

ASCII code:	HT
Decimal:	9
Hexadecimal:	9

Explanation:

When this command is given, the print position is advanced to the next horizontal tab setting.

ESC D**Set Horizontal Tabs****Format:**

ASCII code:	ESC	D	(n1)	(n2)	. . .	NUL
Decimal:	27	66	(n1)	(n2)	. . .	0
Hexadecimal:	1B	44	(n1)	(n2)	...	00

Explanation:

This command allows setting of up to **32** horizontal tabs. These are entered as n1, n2, n3, etc. (in the range **1** to **137**) with the NUL character as the terminator. The tab settings n1, n2, n3, etc. must be entered in ascending order. The tab settings can be cleared by executing the command with n1 set to zero. The settings on power up or after an ESC @ command are every eight characters.

ESC e**Set Tab Increments****Format:**

ASCII code:	ESC	e	(n)	(s)
Decimal:	27	101	(n)	(s)
Hexadecimal:	1B	65	(n)	(s)

Explanation:

This command sets the horizontal or vertical tab increments. When n is **0**, the horizontal tabs are set at intervals of s spaces. Maximum values are **21** in pica, **25** in elite and 36 in compressed text modes. When n is **1**, the vertical tabs are set to s line feeds.

ESC f**Horizontal/Vertical Skip****Format:**

ASCII code:	ESC	f	(n)	(s)
Decimal:	27	102	(n)	(s)
Hexadecimal:	1B	66	(n)	(s)

Explanation:

Prints spaces or line feeds without carriage returns. When n is **0**, s spaces will be inserted up to a maximum of **127**. If n is set to **1**, s line feeds will be performed.

ESC Q

Set Right Margin

Format:

ASCII code:	ESC	Q	(n)
Decimal:	27	81	(n)
Hexadecimal:	1B	51	(n)

Explanation:

This command sets the right margin to n columns in the current pitch. This command clears previous tab settings and all previous characters in the print line.

ESCI

Set Left Margin

Format:

ASCII code:	ESC	I	(n)
Decimal:	27	108	(n)
Hexadecimal:	1B	6C	(n)

Explanation:

Use a lowercase 1 (for left), not the numeral one. This command should be placed at the beginning of a line. The left margin is set to n columns of the current character width. The value of n should be in the range **0** to **160**, but will be ignored if the setting would give a margin of more than **8** inches. This command clears previous tab settings and all previous characters in the print line.

User-Defined Characters

ESC : Copy ROM Into User-Defined Characters

ESC : Copy ROM Into User-Defined Characters

Format:

ASCII code:	ESC	:	NUL	NUL	NUL
Decimal:	27	58	0	0	0
Hexadecimal:	1B	3A	00	00	00

Explanation:

This code allows the characters in the ROM to be copied into the user-defined character set so that specific characters can be redefined. Select the mode to be used (draft or Near Letter Quality as required) to ensure the correct set is copied.

ESC & Define User-Defined Characters

Format:

ASCII code:	ESC & NUL	(data1) (data2) . . . (data n)
Decimal:	27 38	0 (data1) (data2) . . . (data n)
Hexadecimal:	1B 26 00	(data1) (data2) . . . (data n)

Explanation:

This command allows characters to be re-defined in the currently selected mode.

ESC % Select User-Defined Set

Format:

ASCII code:	ESC	%	(n)
Decimal:	27	37	(n)
Hexadecimal:	1B	25	(n)

Explanation:

This code selects the user-defined set if n = **1** and the normal set if n=0. ESC & is required to define the character set.

Dot Graphics

Note: See Chapter 9 for further information on dot graphics.

ESC K Select Single Density Graphics Mode

Format:

ASCII code:	ESC	K	(n1) (n2) (data1) (data2) . . . (data(d))
Decimal:	27	75	(n1) (n2) (data1) (data2) . . . (data(d))
Hexadecimal:	1B	48	(n1) (n2) (data1) (data2) . . . (data(d))

Explanation:

Turns on Single Density Graphics Mode, printing 480 dots per 8-inch line. If d is the total number of dots required, n1 and n2 are calculated thus:

$n1 = d \text{ MOD } 256$ and $n2 = \text{INT} (d/256)$.

and are followed by d data bytes.

ESC L Select Double Density Graphics Mode

Format:

ASCII code:

ESC L (n1) (n2) (data1) (data2) . . . (data(d))

Decimal:

27 76 (n1) (n2) (data1) (data2) . . . (data(d))

Hexadecimal:

1B 4C (n1) (n2) (data1) (data2) . . . (data(d))

Explanation:

Turns on Low-Speed Double Density Graphics Mode, printing 960 dots per 8-inch line. If d is the total number of dots required, n1 and n2 are calculated thus:

$n1 = d \text{ MOD } 256$ and $n2 = \text{INT}(d/256)$.

and are followed by d data bytes.

ESC Y Select High Speed Double Density Graphics Mode

Format:

ASCII code:

ESC Y (n1) (n2) (data1) (data2) . . . (data(d))

Decimal:

27 69 (n1) (n2) (data1) (data2) . . . (data(d))

Hexadecimal:

1B 59 (n1) (n2) (data1) (data2) . . . (data(d))

Explanation:

Turns on High-Speed Double Density Graphics Mode, printing **960** dots per 8-inch line. Similar to ESC L but cannot print two adjacent dots on the same row. If d is the total number of dots required, n1 and n2 are calculated thus.

$n1 = d \text{ MOD } 256$ and $n2 = \text{INT}(d/256)$.

and are followed by d data bytes.

ESC Z **Select Quadruple Density Graphics Mode**

Format:

ASCII code:

ESC **Z** (n1) (n2) (data1) (data2) . . . (data(d))

Decimal:

27 **90** (n1) (n2) (data1) (data2) . . . (data(d))

Hexadecimal:

1B **5A** (n1) (n2) (data1) (data2) . . . (data(d))

Explanation:

Turns on Quadruple Density Graphics Mode, printing '1920 dots per 8-inch line. If d is the total number of dots required, n1 and n2 are calculated thus:

$n1 = d \text{ MOD } 256$ and $n2 = \text{INT}(d/256)$.

and are followed by d data bytes.

Cannot print adjacent dots.

ESC * **Select Graphics Mode**

Format:

ASCII code:

ESC ***** (m) (n1) (n2) (data1)(data2) . . . (data(d))

Decimal:

27 **42** (m) (n1) (n2) (data1)(data2) . . . (data(d))

Hexadecimal:

1B **2A** (m) (n1) (n2) (data1)(data2) . . . (data(d))

Explanation:

Select Graphics Mode where m is mode 0 to 6. If d is the total number of dots required, n1 and n2 are calculated thus:

$n1 = d \text{ MOD } 256$ and $n2 = \text{INT}(d/256)$.

and are followed by d data bytes.

ESC ?

Reassign Graphics Mode

Format:

ASCII code:	ESC	?	(s)	(n)
Decimal:	27	63	(S)	(n)
Hexadecimal:	1B	3F	(s)	(n)

Explanation:

Change one graphics mode to another. The mode s is the ASCII code for the character K, L, Y, or Z which is reassigned to a mode O-6 as in the ESC * command. Details of the modes are given in Chapter 9.

ESC A

Select 9-Pin Graphics Mode

Format:

ASCII code:					
ESC	^	(m)	(n1)	(n2)	(data1)(data2) . . . (data(d))
Decimal:					
27	94	(m)	(n1)	(n2)	(data1)(data2) . . . (data(d))
Hexadecimal:					
1B	5E	(m)	(n1)	(n2)	(data1)(data2) . . . (data(d))

Explanation:

Turns on Y-Pin Graphics Mode. The variable m defines density of print (**0** for single and **1** for double) and d is the total number of dots required. n1 and n2 are calculated thus:

$n1 = d \text{ MOD } 256$ and $n2 = \text{INT} (d/256)$.

and are followed by two times d data bytes. The printer expects two data items for each column of print.

Miscellaneous Codes

CR

Carriage Return

Format:

ASCII code:	CR
Decimal:	13
Hexadecimal:	0 D

Explanation:

Prints the data in the buffer and returns the print position to the left margin. A line feed may also be added if either 2-3 is ON or the AUTO PEED XT line on the parallel printer interface is held Low.

BEL**Beeper****Format:**

ASCII code: **BEL**
Decimal: **7**
Hexadecimal: **7**

Explanation:

Sounds the beeper.

DEL**Delete****Format:**

ASCII code: **DEL**
Decimal: **127**
Hexadecimal: **7 F**

Explanation:

Removes the previous text character on the print line but does not affect control codes. Does not work at left margin.

CAN**Cancel****Format:**

ASCII code: **CAN**
Decimal: **24**
Hexadecimal:
Control: **Ctrl X**

Explanation:

Deletes all data on the print line previous to this character but does not affect control codes.

Appendix D

The DIP Switches

Several tiny switches called DIP (for Dual In-Line Package) switches are in the back of your LX-86 printer. They control a number of important printer functions. For most uses they can be left as they were set at the factory, but you may want to change some settings.

The design of the LX-86 gives you easy access to the switches. You can see them in the back of the printer as indicated in Figure D-1.

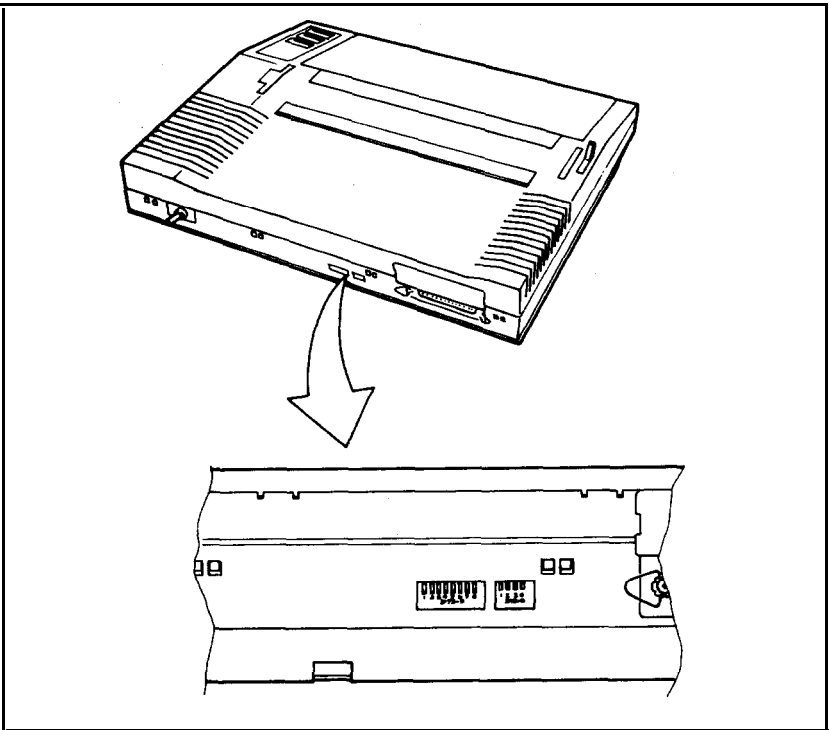


Figure D-1. DIP switch location

Always turn the power OFF (with the switch on the right side of the printer) before you change the setting of any of these switches. Any changes made while the power is on will be ignored until you turn the printer off and back on. So set all switches with the power off.

In Table D-1 we show you the functions of all the switches. Then we explain each of them.

Table D-1. DIP switch functions

Switch 1

No.	ON	Functions	OFF
1-8	ON	International character set	OFF
1-7	ON	International character set	OFF
1-6	ON	International character set	OFF
1-5	Inactive	Paper-out sensor	Active
1-4	12-inch	Form length	11-inch
1-3	Active	Cut-sheet feeder	Inactive
1-2	Char. graphics	Character set	Italics
1-1	Condensed	Print width	Pica

Switch 2

No.	ON	Functions	OFF
2-4	Mute	Beeper	Sounds
2-3	CR + LF	Automatic line feed	CR only
2-2	Active	Printer-select	Inactive
2-1	0	Slashed zero	0

Note: The shaded boxes show the factory settings.

Switches 1-6, 1-7, and 1-8 determine the active international character set as shown in Table D-2.

Table D-2. International DIP switch settings

Country	Switch 1-6	Switch 1-7	Switch 1-8
USA	On	On	On
France	On	On	On
Germany	On	Off	On
United Kingdom	On	Off	Off
Denmark	Off	On	On
Sweden	Off	On	Off
Italy	Off	Off	On
Spain	Off	Off	Off

The use of international sets is discussed in Chapter 6.

Switch 1-5 controls the paper-end detector. When it is ON, the detector is inactive, causing printing to continue even when the printer is out of paper. When it is OFF, the printer stops when the end of the paper passes the paper-end detector. Some computer systems ignore the setting of this switch. See Appendix F.

Switch 1-4 selects the paper length. When it is OFF, the length is 11"; when it is ON, the length is 12".

Switch 1-3 controls the optional cut-sheet feeder. When it is ON, the cut-sheet feeder is enabled. When it is OFF, the cut-sheet feeder is disabled.

Switch 1-2 selects character graphics or italics as the default characters for the upper half of the character set, as shown in the character tables in Appendix A. If switch 1-2 is OFF, italics are selected. If it is ON, character graphics are selected. Even if character graphics are selected, you can still print italics with ESCape 4.

Switch 1-1 selects condensed or pica printing. ON is condensed; OFF is pica. Regardless of the setting, you can still select condensed with SelecType and either condensed or pica with ESCape codes.

Switch 2-4 enables the beeper to sound when it is OFF; when it is ON, the beeper cannot sound.

Switch 2-3 controls line feeds. When it is ON, the LX-86 performs an automatic line feed with each carriage return; when it is OFF, the computer system sends the line feeds. If your printing has an extra space between lines, turn the switch OFF. If all the lines of your printing are on top of each other, turn the switch ON. This switch enables the LX-86 to match either type of computer system.

Switch 2-2 selects the printer. When it is ON, the printer cannot be deactivated by software codes. When it is OFF, the printer is inactive until it receives the proper software code.

Switch 2-1 controls the printing of zeros. When it is ON, the zeros are slashed (ø); when it is OFF, they are not.

Appendix E

Using the Optional Tractor Unit

The optional tractor unit for the LX-86 allows you to use continuous paper with pin feed holes along the sides. The unit is adjustable so that the continuous paper can be any width from 4 to 10 inches. (The LX-86 can also use the LX-80™ tractor unit.)

Printer Location

When you use the tractor and continuous paper, you must put your LX-86 where the paper can flow freely in and out of the printer. Use a printer stand or any other arrangement that fits your working area. Just make sure that the paper coming out of the printer does not interfere with the paper going in and that the paper going in does not catch on the printer cable. Because of the cable, it is usually best for the paper that feeds into the printer to be stacked somewhat behind the printer instead of directly beneath it. Two possible setups are shown in Figures E-1 and E-2.

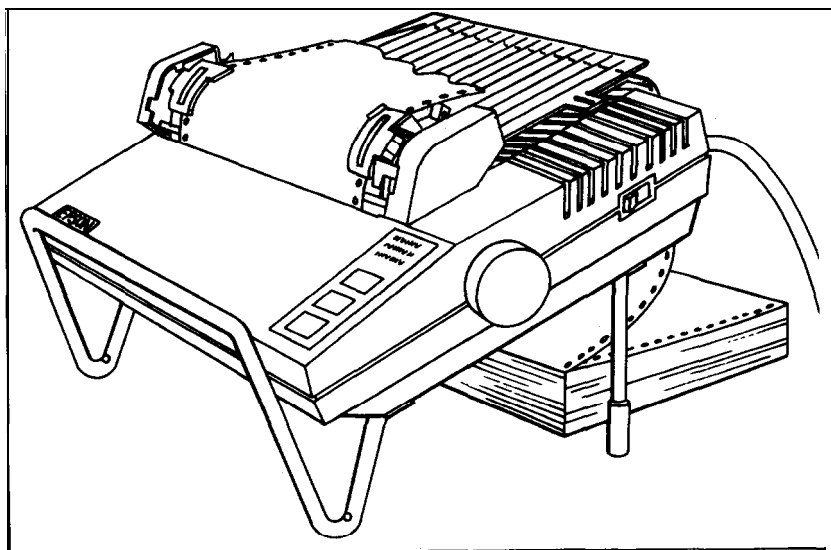


Figure E-1. Continuous paper with printer stand

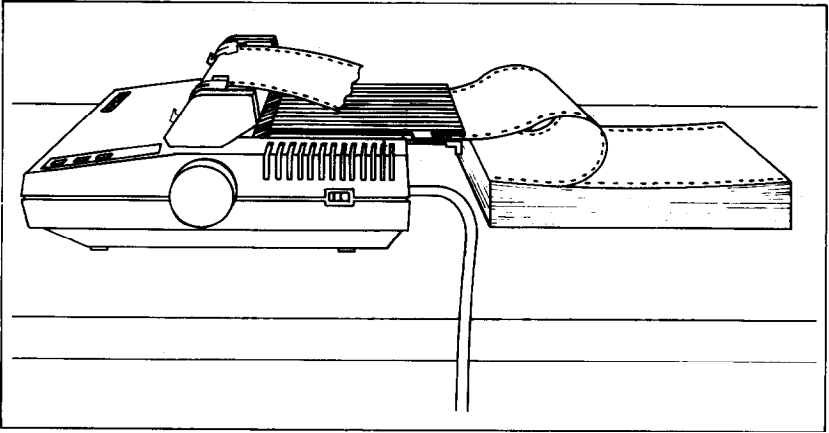


Figure E-2. Continuous paper without stand

Tractor Unit Installation

To install the removable tractor unit, first pull the friction lever toward the front of the printer. Then hold the tractor with the gears to the right as shown in Figure E-3.

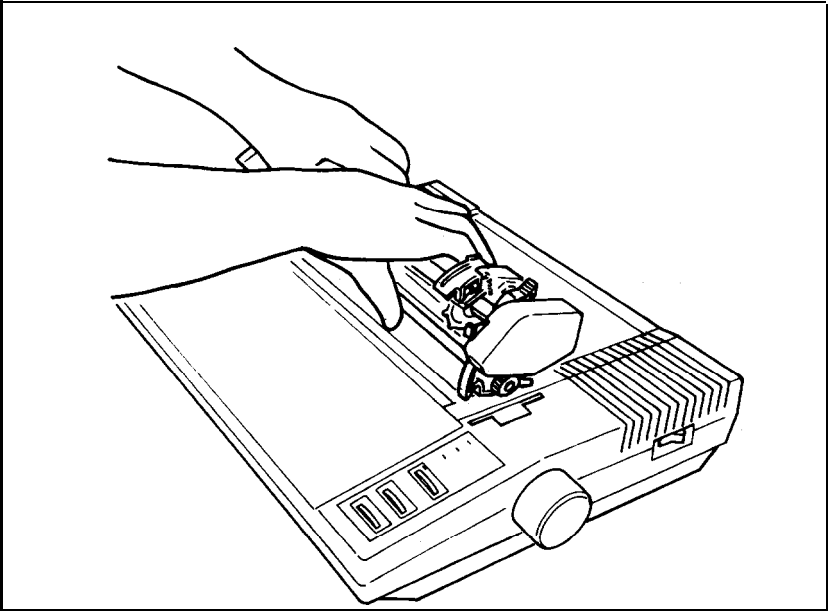


Figure E-3. Tractor placement

In each tractor slot are two pegs that fit into the notches on the tractor fittings. Tilt the tractor back so that the rear notches fit over the rear pegs. Then tilt the unit forward until it clicks into place. That's all there is to it.

Now install the paper separator and pull out the paper guide as shown in Figure E-4. Fit the notches in the bottom corners of the separator over the pins at the front of the paper slot. The separator keeps the paper that is coming out of the printer from being pulled back in. Pull out the paper guide at the back of the printer. This guide helps keep the incoming paper from catching on the printer cable.

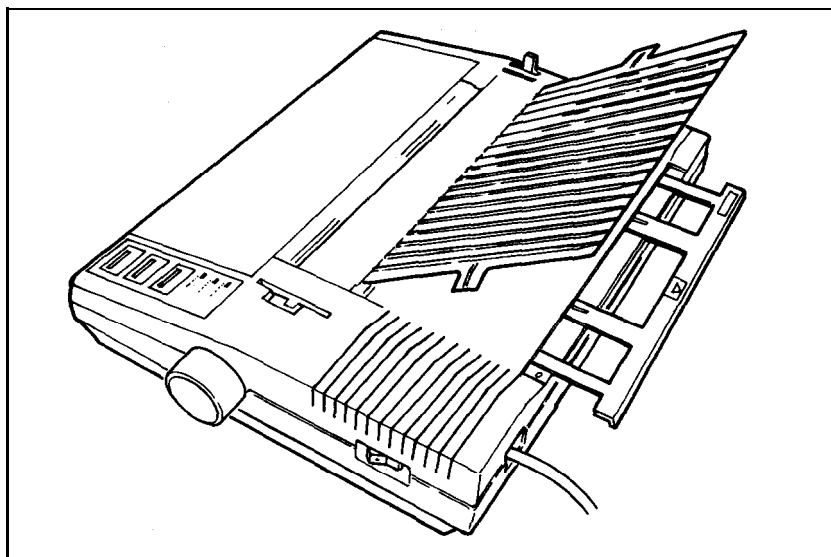


Figure E-4. Paper separator and paper guide

When you want to use single sheet paper in your LX-86, you can remove the tractor unit quite easily. Just push back the two tractor release levers shown in Figure E-5, tilt the unit backwards, and lift it up.

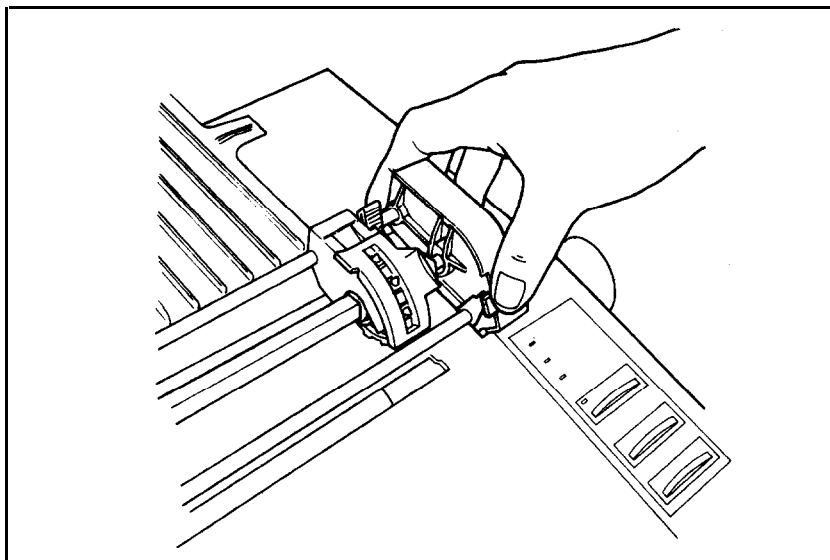


Figure E-5. Tractor release levers

Loading Continuous Paper

Once your tractor is installed, you can load continuous paper. See that the printer is turned off, and open the front lid. Then move the print head to the center of the printer, and pull the paper bail away from the platen (the black roller) just as you did for single sheet loading. (Look back at Figure 1-7 if you need to check on the names of any of these parts.)

Now, using Figure E-6 as your guide, pull the locking levers forward so that you can move the pin feed holders to the left and right. Put the left holder approximately $\frac{3}{4}$ of an inch from the extreme left position and then push the locking lever back to lock that holder in place. Leave the other holder unlocked.

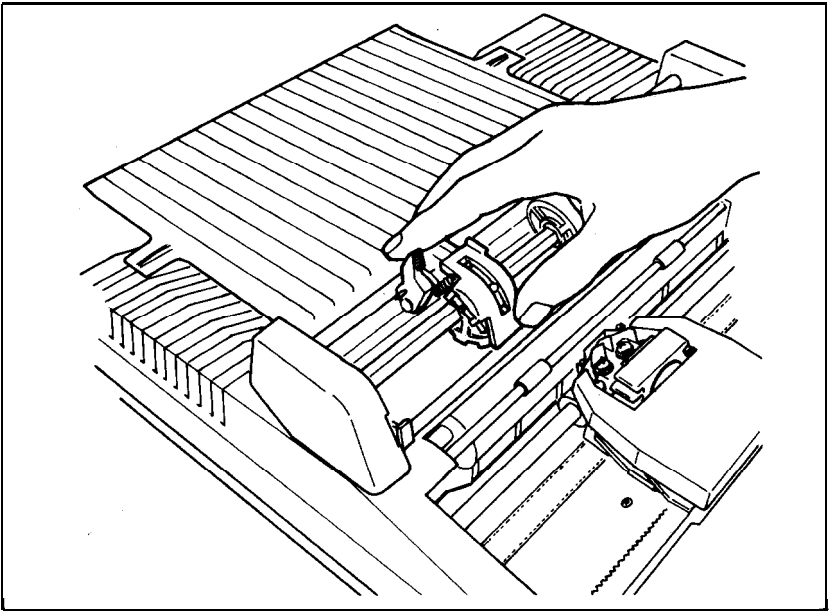


Figure E-6. Pin feed bolder adjustment

Next, open the pin feed covers as shown in Figure E-7 **and feed the** paper under the paper separator and into the paper slot; push the paper through until it comes up between the ribbon guide and the platen.

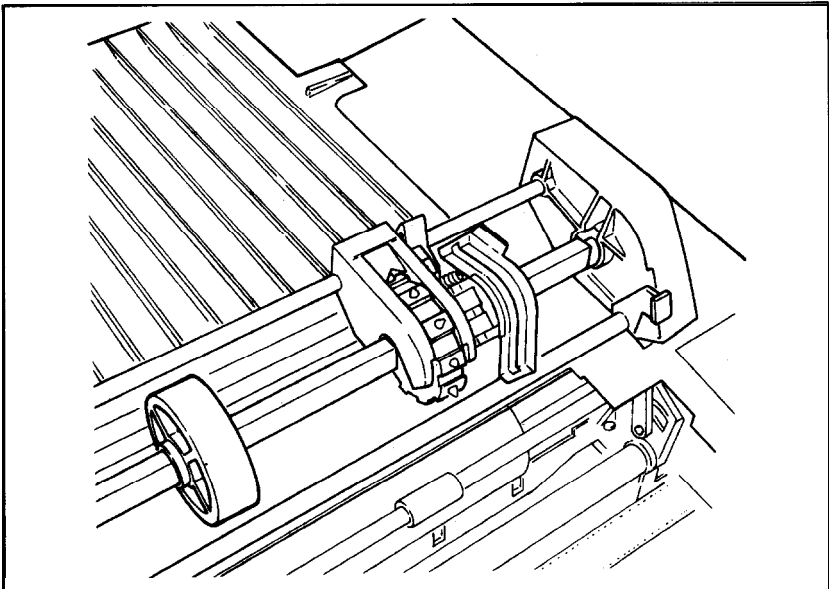


Figure E-7. Open pin feed cover

Next pull the paper up until the top is above the pin-feed holders. Fit the holes on the left side of the paper over the pins in the left holder and close the cover. Now fit the right side of the paper in the right holder, moving the holder as needed to match the width of **the** paper. Close the second cover, make sure the paper has no dips or wrinkles, lock the right holder in place, and push the paper bail against the paper.

Now you are ready to set the top of page position. Turn the paper-feed knob to advance the paper until a perforation between sheets is approximately 1/8 of an inch below the top of the ribbon guide, as you see in Figure E-8.

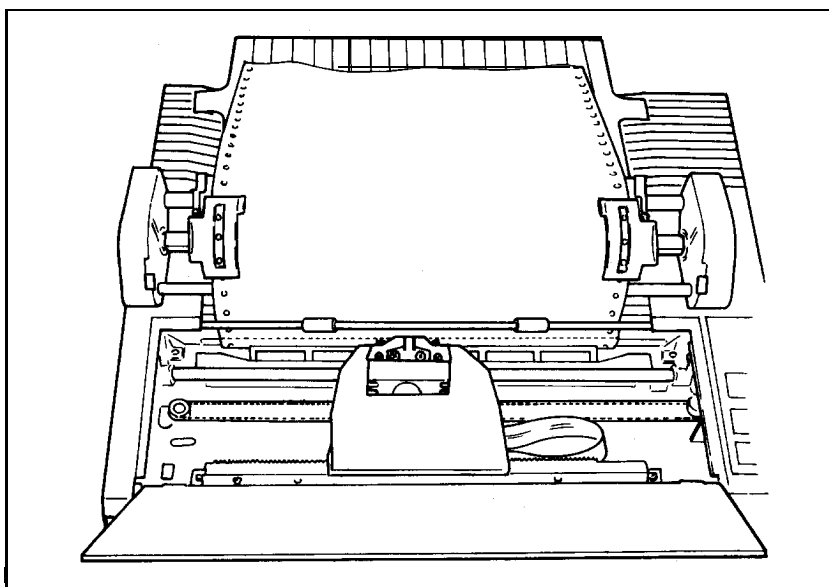


Figure E-8. Top of page position

When you turn on your LX-86, it will remember this top of page setting and will use it when any program tells it to move to the top of the next page. If you later find that your word processing or other applications program is putting your printing too high or too low on the page or is printing on the perforations, check to see that your top of page setting is correct.

Once you have set the top of page, each time you finish printing a document, push the ON LINE button to put the printer off-line and then push the FF button once to advance the paper so that you can tear off your just-printed page and the paper will be in the right position to begin the next document.

Appendix F

Troubleshooting and Advanced Features

This appendix approaches troubleshooting from several directions. The first section uses a columnar format to match solutions with problems. Other sections cover beeper error warnings, hexadecimal data dumping, coding and seven-bit solutions, and specific solutions for several popular personal computer systems.

Problem/Solution Summary

Possible problems are listed on the left and solutions on the right.

Problem

Setting print styles

Can't get condensed print.

Tabbing

Horizontal tabs don't work.

Horizontal tabs are incorrect when changing pitch.

Graphics

Strange things print.

Solution

Cancel emphasized; it has priority over condensed.

Set margins before tabs, not after.

Tabs are set according to current print pitch. Changes in pitch do not affect the position of the tabs on the page.

Some systems require a WIDTH statement. See your system documentation.

Many computers have problems sending one or more of the codes between 0 and 13. Avoid any that

affect your system if possible. You can also POKE the problem codes directly to the printer port.

Seven-bit computers cannot use the eighth pin (**12 8**). If you have a seven-bit computer and any of your graphics data numbers are larger than 127, change the design so that all numbers are less than **128**.

Be sure that no other commands or carriage returns come between the graphics command and its data. See Chapter 9.

Printer “freezes” in graphics mode. The printer expects a certain number of pin patterns, determined by n_1 and n_2 . It will wait patiently until the quota is full.

Note that 9-pin graphics mode requires two bytes for each column of graphics.

Can’t get a full page in width. Some systems require a WIDTH statement. See your system documentation.

Problems with paper feeding or irregular darkness of printing. If a self-adhesive label comes off of the backing, it may stick behind the platen and cause problems with paper feeding and printing. If this happens, take your LX-86 to a qualified service person; do not attempt to remove the label yourself.

Paper-out sensor

Can't deactivate paper-out sensor with DIP switch 1-5 or ESCape "8".

Computer systems that monitor printer cable pin 12 will ignore both ESCape "8" and the setting of switch 1-5. These systems will stop the printing when no paper is in contact with the paper-end detector (a small switch located beneath the platen). Certain printer cables are designed to overcome this problem, or you can use a longer page as a backing sheet.

Beeper Error Warnings

When the LX-86's beeper sounds, it usually indicates that the printer is out of paper. The beeper can also be sounded by any program that sends the ASCII 7 code and by certain error conditions in the printer itself.

If the printer beeps and stops printing when it is not out of paper, turn the printer off and check to see if the paper is loaded correctly. If the paper is loaded correctly, turn the printer back on and try to print again. If the printer beeps and does not print again, take it to a qualified service person.

Data Dump Mode

The LX-86 has a special feature that makes it easy for experienced printer users to find the causes of problems. Called the data dump mode, it gives a printout of exactly what codes reach the printer.

Turn on this mode by turning on the printer while holding down the FORM FEED and LINE FEED buttons at the same time. The printer responds by printing the words "Data Dump Mode." Then, when you run a program, either an applications program or one you have written in any programming language, the LX-86 prints one or more lines. Each line has three parts: the line number (four digits), the hexadecimal codes (up to **16** numbers), and the guide section (16 characters at the end of each line except the last).

The hexadecimal numbers are the codes received by the printer, and the guide section helps you find a certain place in the list of codes. Each character in the guide section corresponds to one of the codes. If the code is for a printable character, that character is printed. If the code is for a non-printable character, such as the ESCape code or the code for a line feed or carriage return, a dot is printed.

Therefore, if you ran the following BASIC program while your IX-86 was in the data dump mode, you would get the printout below it. The printer will print all but this last line and then stop. Press the ON LINE button to make the printer print the last line.

```
10 FOR X=70 TO 73
20 LPRINT CHR$(X): NEXT X
30 LPRINT CHR$( 27) "E"
40 LPRINT "Sample text"
50 LPRINT CHR$( 27) "@"
```

Data Dump Mode

```
0000 46 0D 0A 47 0D 0A 48 0D 0A 49 0D 0A 1B 45 0D 0A   F . G . H . I . J . E . .
0001 53 61 6D 70 6C 65 20 74 65 78 74 0D 0A 1B 40 0D   Sample text . . @ .
0002 0A
```

You can consult Appendix A or the Quick Reference Card to see the meaning of the hexadecimal codes. We will explain the first line to put you on the right track for using the data dump mode.

The first code in line 0000 is hex 46, which is the same as decimal 70, which is the code for “F”; therefore “F” is printed in the first position in the guide section. Then, because there is no semicolon in line 20, MBASIC sends a carriage return and a line feed, hex codes 0D and 0A. Each of these is represented by a dot in the guide section. The program then sends the hex codes 47, 48, and 49, with each followed by a carriage return and line feed.

When the program gets to line 30, it sends ESCape “E” and a carriage return and line feed. These are hex codes 1B, 45, 0D, and 0A, which are represented in the guide section by a dot, an “E”, and two more dots. Now you can follow a data dump printout on your own.

Some computer systems change one or more codes when sending them from BASIC to the printer. The ability of the Ix-86 to dump in hexadecimal lets you determine which codes are creating problems for your system.

A hex printout of a program shows you exactly what the printer is receiving, regardless of what the computer is sending. The following test program lets you check to see what codes, if any, are problems for your computer system.

```
10 FOR X=0 TO 255
20 LPRINT CHR$(X) ;
30 NEXT X
```

Put the printer in data dump mode and then RUN the program. Remember to press the ON LINE button to make the Lx-86 print the final line. Then compare your printout with the list of hex codes in order in the middle columns of page A-2 in Appendix A. If any are skipped or repeated, you will know that your BASIC language changes some codes before it sends them to the printer.

For example, in the line below, which is the first line of the printout of the test program run on a system that changes hex 09, which is the code for horizontal tabbing, to several 20s, the code for a space. Therefore, you know that if you use this system, you must be careful about sending a decimal 9 (hex 09) .

```
0000 00 01 02 03 04 05 06 07 08 20 20 20 20 20 20 20 20  ....
```

The data dumping capability can help you solve problems quickly. Appendix A will help you translate the hex codes to ASCII equivalents.

Coding Solutions

Once you've determined that a code creates problems for your printing, either by trial and error or by using the data dumping capability of the LX-86, you can start overcoming them.

Because each computer system deals with ASCII codes differently, it is impossible to provide solutions for all potential problems in one appendix. We can, however, point out generic problems and suggest ways to handle them.

There are four common approaches. First, you may be able to buy an alternative printer interface card for your system. This is the best solution for 7-bit system problems. See your computer dealer for advice about this.

The second approach is to use commercially available software that is specifically designed to overcome these coding problems. Consult your computer dealer or computer publications to see if a program for your computer system is available.

The third approach consists of avoiding the software that is changing the codes. On most computers you can send each code directly to the printer port. This bypasses the BASIC interpreter and avoids the interface.

Unfortunately, this process is also different for each computer system. Consult your computer's manual to determine if you can do the same on your system.

A fourth approach is to change the printer driver program in your system. This requires a knowledge of machine language and of the way your computer works. If you don't have this knowledge, your computer dealer may be able to help you or suggest someone who can.

Solutions for Specific Systems

The next four subsections illustrate dealing with interface puzzles on four types of computers.

Applesoft BASIC solutions

Applesoft BASIC does not use PRINT to send data to the screen and LPRINT to send data to the printer as MBASIC does. Therefore, put an **PR#1** at the beginning of a program and change all instances of LPRINT to PRINT.

If one of our programs contains an INPUT statement or a PRINT statement, there will be a message that should go to the screen before anything is sent to the printer. In these programs, leave the first lines as they are and after the INPUT and/or PRINT statements, add a line that states **PR#1** ; then change all the instances of LPRINT to PRINT and put a line that states **PR#0** at the end of the program.

Apple® II solutions

There are two types of problems that you who own Apple II computers will need to address. The first is that the Apple II is an 8-bit computer, but its printer interface only handles seven bits. The second is that there is one problem code number: nine.

The printer interface card furnished with the Apple II computer only passes seven bits to the LX-86, which means that you have a 7-bit system. Should you need an 8-bit system, the simplest solution is to purchase a new printer interface card from your computer dealer. Such a card is available for the Apple II.

The Apple II uses CHR\$(9) to “initialize” the printer. This code and the following character or characters are intercepted by the printer interface card and used to change modes. You can divert all output to the printer instead of to the screen by sending the following line to the printer:

```
PR#1
PRINT CHR$(9)"80N"
```

Then type anything, followed by RETURN.

The CHR\$(9)“80N” code directs all subsequent output to the printer, up to 80 characters per row. You can cancel this by typing:

```
PRINT CHR$(9)"I" or PR#0
```

The problem is that the LX-86 uses CHR\$(9) to activate horizontal tabulation and can also use it in graphics programs. When you send this code, however, your system will interpret it as a printer initialization code and the program will not work properly. In these cases use the following method to change your printer initialization code to a number that is not used in the program. For example, you can change your initialization code to one by typing:

```
PR#1
PRINT CHR$(9); CHR$(1)
```

IBM-PC solutions

There are two problems in using the IBM Personal Computer BASIC to drive a printer. First, the IBM-PC BASIC inserts a carriage-return/line-feed (CR-LF) after each 80 characters you send it. Second, it adds an LF to each CR in an LPRINT statement.

Here is the way to adjust the width when it is the only problem. Tell the computer that the print line is wider than 80 characters with this WIDTH statement:

```
WIDTH "LPT1:", 255
```

he 255 is a special number that prevents the computer system from inserting a CR-LF into the line. Unless, of course, there's one in your program.

The extra line feed-CHR\$(10)--that accompanies each carriage return--CHR\$(13)-- is no problem except when you need to use CHR\$(13) in a graphics program. Getting rid of the extra CHR\$(10) is rather complicated. First you open the printer as a random file:

```
OPEN "LPT1 : " AS #1
```

Although this allows you to send any code to the printer, you can no longer use the LPRINT command. Instead, you must use a PRINT # 1 command :

```
PRINT #1, " N o w I can print, anything"
```

This does allow you to print anything, but it ignores any previous WIDTH statements.

If you want to print more than 80 characters per line in a graphics program, you must therefore change your opening statement to include the appropriate WIDTH statement:

```
OPEN "LPT1: " AS #1 : WIDTH $1, 255
```

And for the programs in this manual, don't forget to use PRINT #1 wherever we use LPRINT.

This won't work for those of you who have the original release of the Disk Operating System (DOS 1.0). It can't run a printer like a file. IBM has, however, issued a free update; take a disk to your dealer to get your copy.

Another printer problem with **DOS 1.0** is that it doesn't send CHR\$(7) to the printer; it just rings the computer's bell. This has also been corrected in subsequent versions.

Appendix H

Technical Specifications

Printing

Printing method	Impact dot matrix
Printing speed	120 characters per second in draft pica
Paper feed speed	Approximately 150 ms/line (at 1/6 inch/line) Approximately 100 ms/line (during continuous line feed)
Printing direction	Bidirectional, logic seeking Unidirectional (left to right) in graphics mode

Character size

Mode	Width inches	Height inches
Pica	.083 in	.122 in
Pica double-width	.166 in	.122 in
Elite	.059 in	.122 in
Elite double-width	.118 in	.122 in
Condensed	.041 in	.122 in
Condensed double-width	.083 in	.122 in
Super/Subscript		.063 in

Line spacing	Default is 1/6 inch. Programmable in increments of 1/72 inch and 1/216 inch
--------------------	--

Characters per line:

	Maximum characters per line
Pica	80
Pica double-width	40
Elite	96
Elite double-width	48
Condensed	132*
Condensed double-width	66*
Condensed elite	160

*137 if right margin is changed.

*68 if right margin is changed.

Paper

	Paper width	Paper feed
Pin-feed	4" to 10"	Tractor feed with optional tractor
Single sheet	up to 8.5"	Friction feed
Number of copies	One original plus one copy; total thickness not to exceed 0.005"	

Printer

Ribbon	Cassette ribbon, black
MTBF	3 million lines (excluding print-head life)
Print head life	100 million characters

Dimensions and Weight

Height	3.3 in
Width	16.6 in
Depth (without paper separator)	12.4 in
Weight	11.5 lbs
Power	120 VAC + 10% (US models) 220/240 VAC $\pm$ 10% (European models)
Power usage	70 volt-amperes maximum
Frequency	49.5 to 60.5 Hz

Environment

Temperature	Operating 41°F to 95°F (5°C to 35°C) Storage -- 22°F to 149°F (-30°C to 65°C)
Humidity	Operating 10% to 80% (no condensation) Storage 5% to 85% (no condensation)
Shock	Operating 1 G (less than 1 millisecond) Storage 2 G (less than 1 millisecond)
Vibration	Operating 0.25 G, 55Hz (maximum) Storage 0.50 G, 55Hz (maximum)
Insulation resistance	10 megaohms between AC power line and chassis
Dielectric strength	100 VAC at 50 / 60Hz for 1 minute between AC line and chassis

Interface

Interface	Centronics compatible, <u>8-bit parallel</u>
Synchronization	By externally supplied <u>STROBE</u> <u>pulses</u>
Handshaking	By ACKNLG and BUSY signals
Logic level	Input data and all interface control signals are compatible with TTL levels

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For information on specific commands, see Appendix B or Appendix C.

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