

EPSON®

LX-80™ 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

of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference in a residential installation. However, installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on,

the following measures:

- Reorient the receiving antenna
- Relocate the computer with respect to the receiver
-

are on different branch circuits.

If necessary, the user consult the dealer or an experienced radio/television

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WARNING

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Introduction

The Epson LX-80 printer combines low price with the high quality and advanced features formerly available only on more expensive printers.

LX-80 Features

In addition to the high performance and reliability you've come to expect from an Epson printers, the LX-80 offers:

- Draft mode for quick printing of ordinary work
- Near Letter Quality mode for top quality printing
- A variety of print styles, including Roman and 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
- Eleven international character sets
- Easy paper loading
- Ribbon cassette for quick and clean ribbon changing

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 LX-80 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-80, 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-80 easy to use. No matter what your background, if you want to learn about and experiment with all the advanced features of the LX-80, the information you need is here.

For a preview of what your LX-80 can do, look at the following samples of a few of its typestyles.

NEAR LETTER QUALITY

NLQ. standard	ABCDEFGHIJKLMNOPQRSTUVWXYZ
WLQ emphasized	ABCDEFGHIJKLMNOPQRSTUVWXYZ

DRAFT MODE

Pica	ABCDEFGHIJKLMNOPQRSTUVWXYZ
Elite	ABCDEFGHIJKLMNOPQRSTUVWXYZ
Compressed	ABCDEFGHIJKLMNOPQRSTUVWXYZ
<i>Italic</i>	<i>ABCDEFGHIJKLMNOPQRSTUVWXYZ</i>
<u>Underline</u>	<u>ABCDEFGHIJKLMNOPQRSTUVWXYZ</u>
Emphasized expanded	ABCDEFGHIJKLMNOPQRSTUVWXYZ

Chapter 1

Setting Up Your LX-80 Printer

Setting up your LX-80 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.

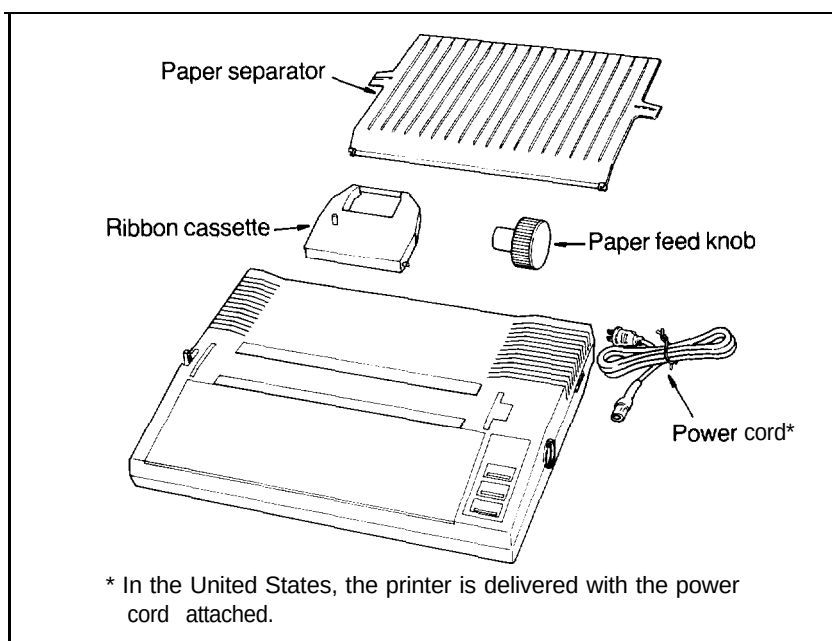


Figure 1-1. Printer parts

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-80'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-80, 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.

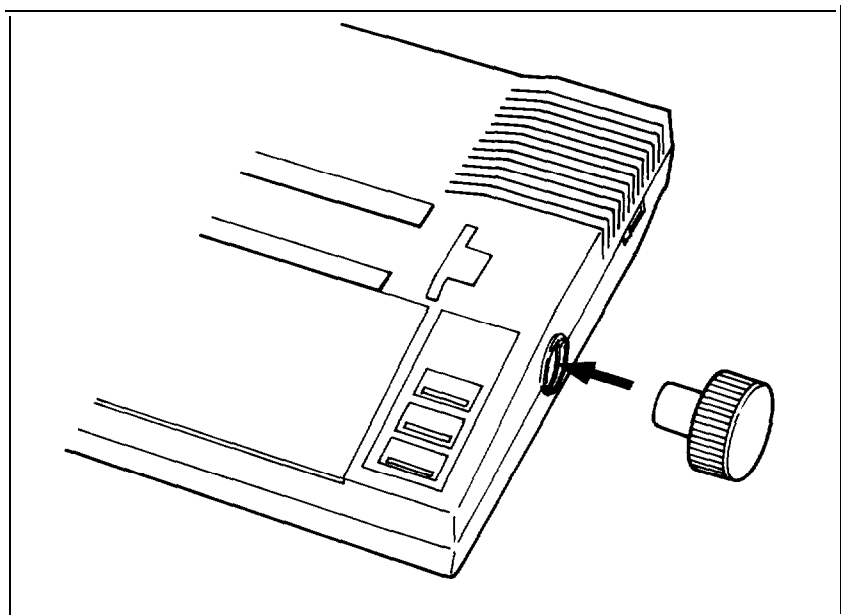


Figure 1-2. Paper feed knob installation

Ribbon Installation

The LX-80 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.

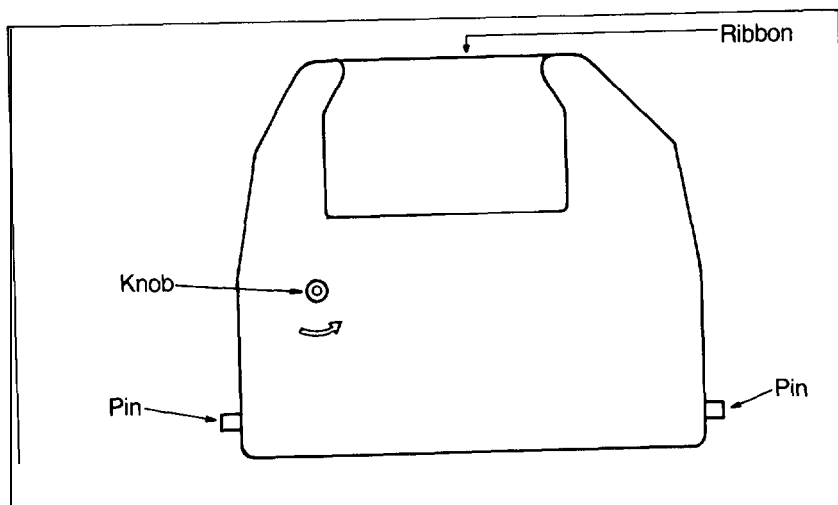


Figure 1-3. Ribbon cassette

To install the ribbon, first open the lid at the front of the LX-80 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.

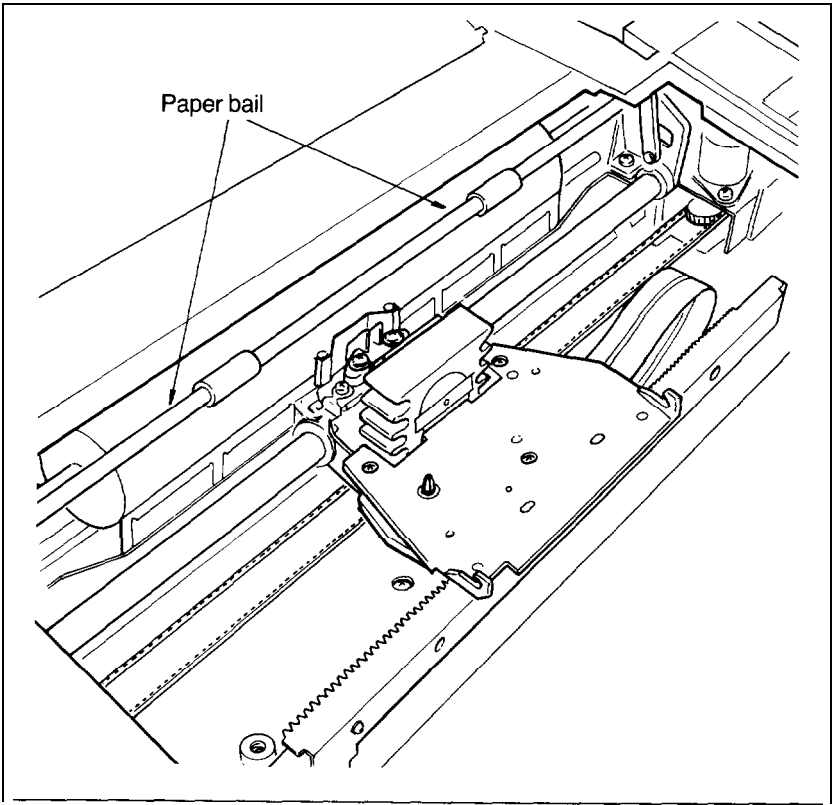


Figure 1-4. Print head assembly

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.

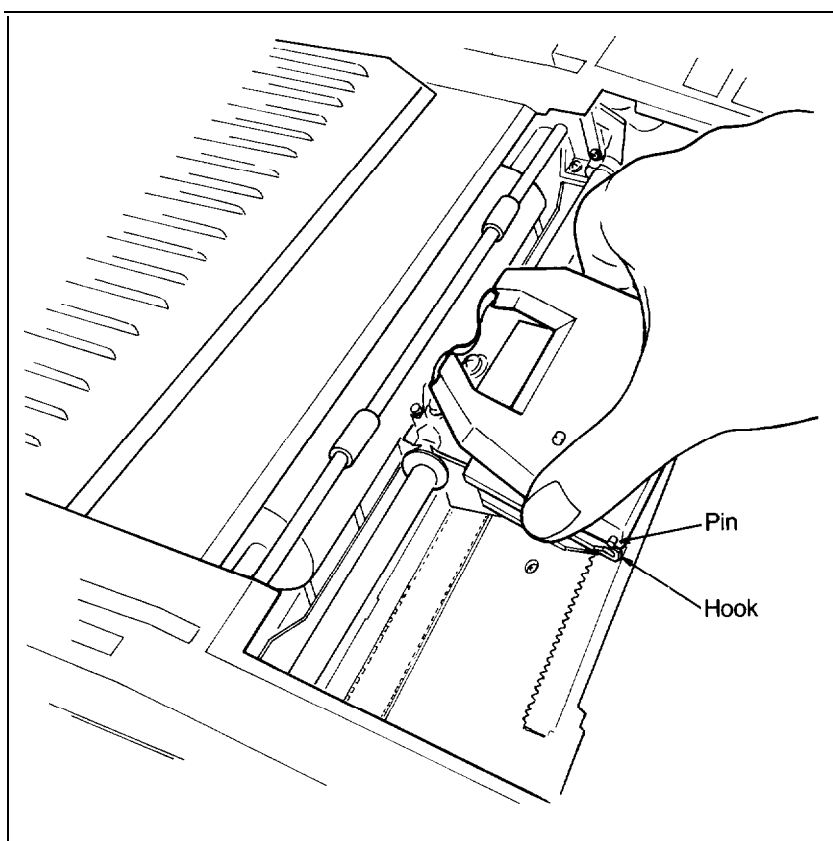


Figure 1-5. Ribbon cassette installation

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 l-6). If it doesn't, guide it with a pen or a pencil.

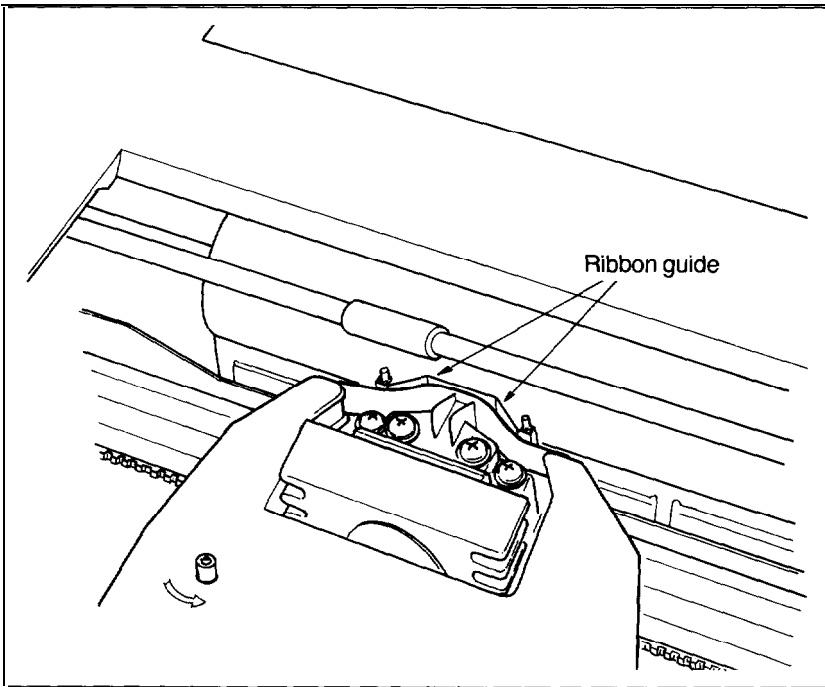


Figure l-6. Ribbon placement

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-80 so you can test it. Figure 1-7 shows the names of the parts that you need to know.

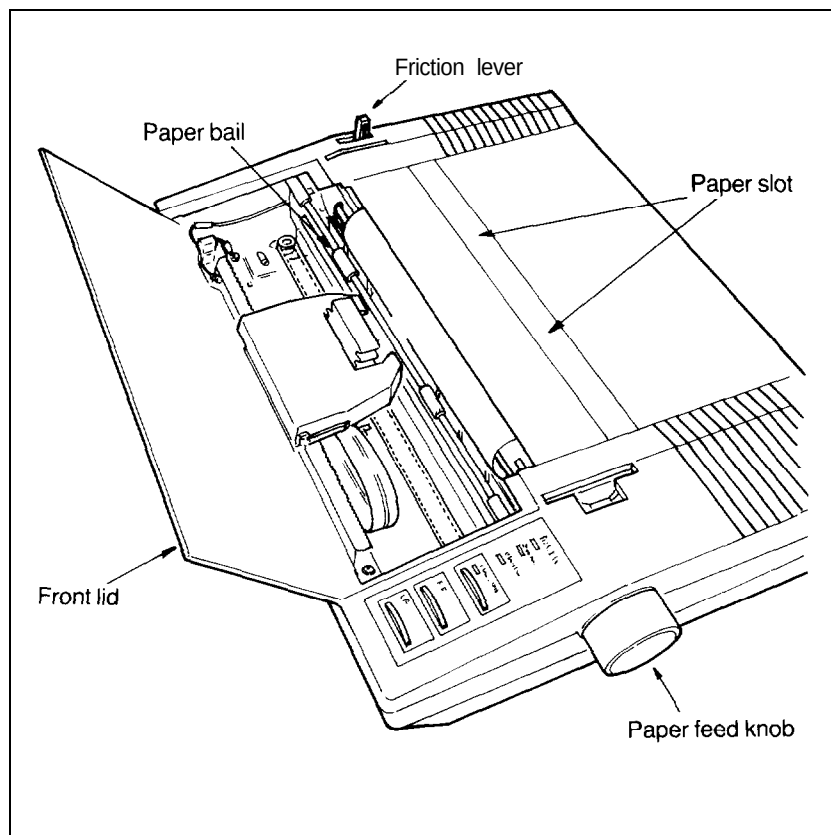


Figure 1-7. LX-80 ready for paper loading

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 on the right side of the top of your LX-80.

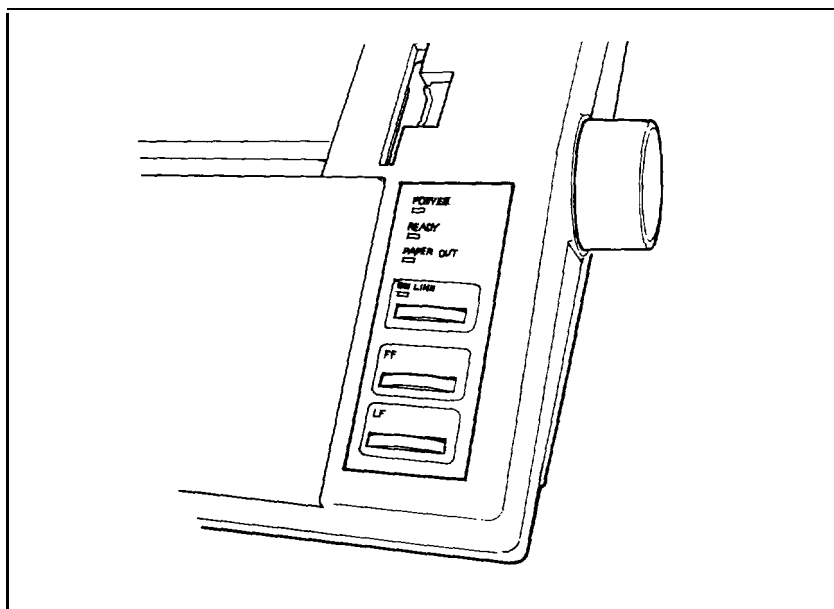


Figure 1-8. Control panel

There are several buttons and indicator lights on the control panel. Their primary functions are described below:

- 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.
- The ON LINE 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.

The following two buttons work only when the printer is off-line. If the ON LINE light is on, press the ON LINE button to put the printer off-line before you use these buttons.

- The FF (Form Feed) button advances the paper to the top of the next page.
- The LF (Line Feed) button advances the paper one line at a time.

The control panel buttons can also be used to turn on several printing functions using a feature called SelecType, which is described in Chapter 2. In addition, you'll find another use for the LF and FF buttons in the next section.

Test Pattern

Now you'll see your LX-80 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 LF button on the control panel while you turn the printer on with the power switch. The LX-80 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 LF 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 FF button. Partial results of both tests are shown in Figure 1-9.

<Draft>

```
123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ
23456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ
3456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ;
456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ;#
56789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ;#^
6789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ;#^_
789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ;#^_`
89:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ;#^_`a
9:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ;#^_`a
:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ;#^_`ab
;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ;#^_`abc
<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ;#^_`abcd
```

<NLQ>

```
123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ
23456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ
3456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZi
456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZin
56789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZin_
6789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZin_^
789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZin_^_
89:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZin_^_`
9:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZin_^_`a
:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZin_^_`ab
;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZin_^_`abc
<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZin_^_`abcd
```

Figure 1-9. Test patterns

Connecting the LX-80 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 1-10. Plug one end of your printer cable into the cable connector of your LX-80 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.

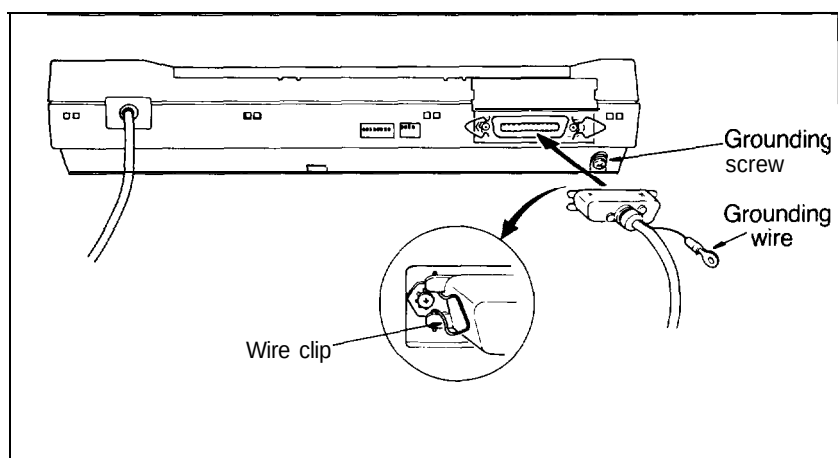


Figure 1-10. Cable connection

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-80 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-80 print. If you plan to use your LX-80 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

SelectType

At the end of the introduction you saw samples of the typestyles available on your LX-80. In this chapter you'll learn how Epson's SelectType feature puts the most-used print modes at your fingertips. With a few taps on the panel buttons of the LX-80, you can change your printing from

standard single-strike pica

to the more detailed

Near Letter Quality (NLQ) mode
or any of several other possibilities.

Choosing Print Modes

The LX-80 printer's many print modes give you a great choice of width, weight, and style of characters. You can activate these modes in several different ways, depending on your needs and the capabilities of your software. The most common ways include placing printing codes in your document, using a programming language such as BASIC, and giving print commands as part of the printing instructions for your software.

Often the SelectType feature is the easiest way to choose print modes on the LX-80. This feature changes the function of the three buttons on top of your printer—ON LINE, FF, and LF. After turning on the SelectType mode, you can use the buttons to choose one or more of six separate functions. The functions include five typestyles and a reset code.

Table 2-1 shows the typestyles you can print with SelecType, and-as you will learn later in this chapter-you can combine some of them.

Table 2-1. *SelecType modes*

Mode	Function	
0	Reset	ABCDEFGHIJKLMNOPQRSTUVWXYZ
1	NLQ	ABCDEFGHIJKLMNOPQRSTUVWXYZ
2	Emphasized	ABCDEFGHIJKLMNOPQRSTUVWXYZ
3	Double-strike	ABCDEFGHIJKLMNOPQRSTUVWXYZ
4	Compressed	ABCDEFGHIJKLMNOPQRSTUVWXYZ
5	Elite	ABCDEFGHIJKLMNOPQRSTUVWXYZ

SelecType lets you use the Epson typestyles in Table 2-1 and combinations of those styles even if your word processing or business program does not support all of them. SelecType also lets you make print style choices when you print rather than when you edit. If you would like a memo or letter to be in the NLQ mode, a few taps on the panel buttons tell your printer what you want, and you don't have to re-edit the document to put in print codes.

SelecType is also handy for selecting narrow pitches to put more characters on a line. If you find that your spreadsheet would be too wide for a single page in pica, with SelecType you can choose compressed to fit over 130 characters on a line or compressed elite for over 150 characters. In addition, you undoubtedly will have your own uses for this feature.

Using SelecType is a simple four-step process:

- 1) Enter SelecType mode.
- 2) Select a print function.
- 3) Set the function.
- 4) Exit SelecType mode.

Turning SelecType Mode On

To turn on SelecType make sure that the printer is turned on (with the POWER, READY, and ON LINE lights all on), and then press the top two buttons on the panel (ON LINE and FF) at the same time, as illustrated in Figure 2-1. The LX-80 will beep to signal that it is in SelecType mode. The READY light also turns off, and the ON LINE light begins flashing. Now that your printer is in SelecType

mode, all the panel buttons have new functions (also shown in Figure 2-1).

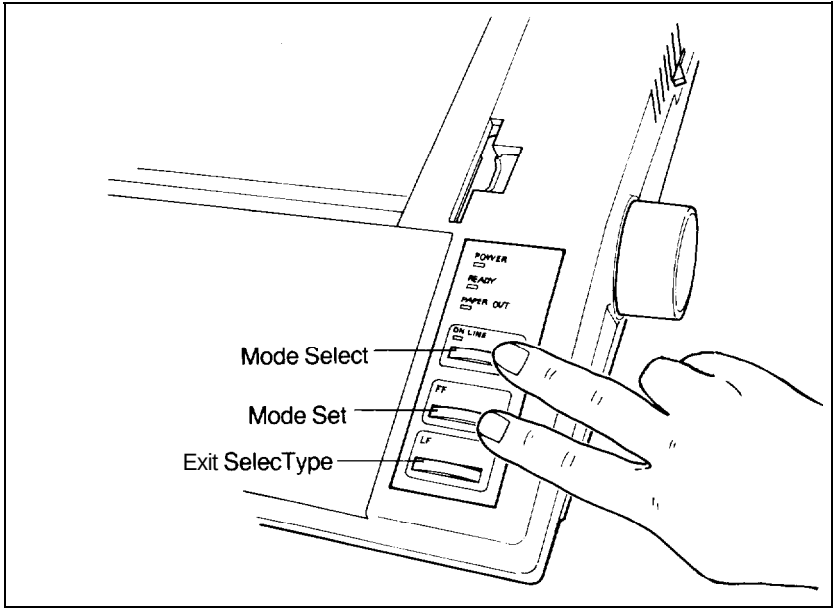


Figure 2-1. SelectType setting and functions

In SelectType mode, the ON LINE button *selects* printing functions, the FF button sets the functions, and the LF button turns SelectType off, returning the panel buttons to their former operation.

Using SelectType

Once you have turned on SelectType, you select the print functions you want according to Table 2-1. The mode number is the number of times you press the ON LINE button to select each function.

After you press the ON LINE button the required number of times, press the FF button to set your selection. Then press the LF button to turn off SelectType and return all the panel buttons to their standard operations.

First SelectType Exercises

For practice in using SelectType, try setting emphasized mode. First turn the printer off and back on with the switch on the right side of the printer. Then press the ON LINE and FF buttons at the same time. The LX-80 beeps to tell you that it is in SelectType mode, the READY light turns off, and the ON LINE light begins blinking. Then press the ON LINE button two times to select emphasized. (The printer beeps each time you press the ON LINE button in SelectType mode.) After that, press the FF button once to set the function.

You have now set emphasized mode. Next, press the LF button once, and your panel buttons return to their normal operation, but your printer is in emphasized mode. Since this is only an exercise, turn the LX-80 off and back on again to cancel all settings and prepare for the next exercise.

You will probably use SelectType with commercial software as well as with BASIC or another programming language, but for now try a simple exercise using BASIC. You don't need to know anything about programming for this exercise. It is merely for practice. If your computer system does not include BASIC or if you would rather not use it, skip to the next section.

Type the short BASIC program listed below:

```
10 LPRINT "This is a sample program."  
20 LPRINT "Notice the size ";  
30 LPRINT "and darkness of the print."
```

Next, print a listing of the program using LLIST or your computer system's print listing command. Your LX-80 prints your program in ordinary single-strike pica, as illustrated below in our sample program.

```
10 LPRINT "This is a sample program."  
20 LPRINT "Notice the size ";  
30 LPRINT "and darkness of the print."
```

Now that you have a sample program to list, follow these simple steps to print your listing in compressed mode:

- 1) See that both the ON LINE light and the READY light are on.
- 2) Press the ON LINE and FF buttons at the same time. You hear a beep to signal that SelectType is on.

- 3) As you can see in Table 2-1, the code for compressed is four. Therefore, press the ON LINE button four times. (Remember that you hear a beep each time you press the ON LINE button when you are in SelecType mode).
- 4) Now that you have selected compressed, push the FF button once to set that mode.
- 5) Push the LF button once to return the panel buttons to their standard functions.

Now you have set the LX-80 to print in compressed mode. Merely push the ON LINE button to put your printer back on-line and list your program once more. It should print in compressed mode just as in our example below:

```
10 LPRINT "This is a sample program."  
20 LPRINT "Notice the size ";  
30 LPRINT "and darkness of the print."
```

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

Testing Your Software for the Reset Code

A few commercial software programs clear all previous modes by resetting the LX-80 before printing each document. Of course, this resetting wipes out whatever you have done with SelecType. But don't worry if your software resets the printer; you can still use SelecType. In Appendix F we tell you ways around the problem.

Since only a few programs reset the LX-80 before printing, you probably won't have this problem. The following test tells you for sure. First, use your word processing or business program in the normal way to create a short file or document of the type you usually print.

After you have created a file or document, print it in the usual way. Save this first copy for comparison with the next versions you print. Your test can be as simple as our example below, a two-line document created with a word processor and printed with its standard print command.

```
This is a short document, but it is long  
enough to check for a resetting code.
```

Now set your LX-80 for elite printing using the following steps.

- 1) See that both the ON LINE and READY lights are on.
- 2) Press the ON LINE and FF buttons at the same time.
- 3) Press the ON LINE button five times (the code for elite). You should hear a beep each time you press the button.
- 4) Press the FF button to set elite.
- 5) Press the LF button to leave SelecType and return the panel buttons to their standard functions.

Now press the ON LINE button and print your file again, using exactly the same command that you used before. If your document comes out in elite as in our example below, you can forget about resetting codes and continue to use SelecType as described above.

```
This is a short document, but it is long
enough to check for a resetting code.
```

If your example is once again printed in pica, turn your printer off and back on. Then try the steps above one more time to be sure that you made no mistakes. If your printout is still in pica after the second test, turn to Appendix F for an explanation of how to solve the problem.

Now that you know the basics of using SelecType, all you need to learn is how to combine modes and how to avoid unexpected results with SelecType.

Mode Combinations

In addition to the five typestyles available with SelecType, there are also many combinations of those five that you can use. Table 2-2 shows which modes can be combined. An X in a box indicates that the two modes can be combined.

Table 2-2. Mode combinations

Mode	NLQ	Emphasized	Double-strike	Compressed	Elite
NLQ		×			
Emphasized	×		×		
Double-strike		×		×	×
Compressed			×		×
Elite			×	×	

To combine modes you simply select and set more than one mode before you press the LF button to leave SelectType. After beginning the procedure in the normal way and pressing the ON LINE button to select a function and the FF button to set it, you do not press the LF button. Instead, you press the ON LINE button the required number of times to select another mode and set that mode with the FF button. When you have selected and set all the modes you want, press the LF button to leave SelectType.

Don't worry about harming your printer if you try to combine two modes that the LX-80 can't mix. Your settings cannot damage the printer because it is prepared for the possibility of receiving codes for conflicting modes. If it receives codes for two modes that it can't combine, it uses only one of the codes.

The essential element in combining modes is keeping a correct count of the number of times you press the ON LINE button. You do not start counting again after you press the FF button the first time. Instead, you continue the count. Therefore, pressing the ON LINE button three times, then the FF button, then the ON LINE button two more times and the FF button again gives you a combination of double-strike and elite. The first pressings of the ON LINE button select double-strike and the next two give a total of five, which is the number for elite. The number of times you press ON LINE is *cumulative*.

For another example, follow these steps to combine NLQ with emphasized for a crisp, bold effect:

- 1) See that the ON LINE and READY lights are on. Then press the ON LINE and FF buttons at the same time.

- 2) Press the ON LINE button once and then the FF button once. Since one is the code for NLQ, you have now set the LX-80 for that mode.
- 3) Press the ON LINE button one more time and then the FF button once. This makes a total of two times, and thus sets the LX-80 for emphasized also.
- 4) Press the LF button to return the panel buttons to their standard functions.

Now press the ON LINE button and print your document. If your printing appears in

emphasized Near Letter Quality

as you see here, you have successfully combined the two modes. If you get any other results, turn your printer off and back on (to reset it) and then try the steps again.

SelecType Cautions and Tips

Once you have learned the simple technique for controlling print styles with the panel buttons, you can use it whenever you wish. You should be aware of two minor restrictions, however.

- SelecType is designed to control the printing of an entire file or document, not an individual line or word. To print a single word in an enhanced mode, use one of the other print control methods listed at the beginning of this chapter.
- If there are print codes in the document or file you are printing, those codes override your SelecType settings. This seldom happens, since most people use SelecType on files that don't have print codes, but remember that if your LX-80 follows the SelecType instructions for only part of a document, you may have print codes in the document that are conflicting with the SelecType modes.

Remember that any mode you turn on with SelecType stays in effect until the printer is turned off or receives a cancelling or reset code. Turning off the printer is the simplest method to cancel the modes you have set, but if you want to learn how to cancel them by using SelecType, turn to the section called Cancelling Functions with SelecType in Appendix F.

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 LX-80 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 $1/72$ 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 $1/60$ th of an inch, fires the top pin again, moves $1/60$ th of an inch, fires the top seven pins, moves $1/60$ th of an inch, fires the top pin, moves another $1/60$ th of an inch, and fires the top pin once more to finish the letter. All this happens in only $1/100$ th of a second.

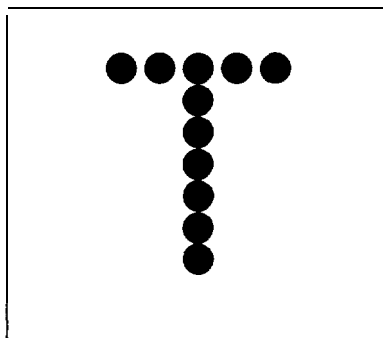


Figure 3-1. A capital T

Bidirectional Printing

In nearly all of our discussions in this manual, we describe the action of the LX-80 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-80 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-80 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-80 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-80 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 slightly more than 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 LX-80 prints letters that are uppercase and lowercase, wide and narrow, and with and without descenders (the bottom part of the y).

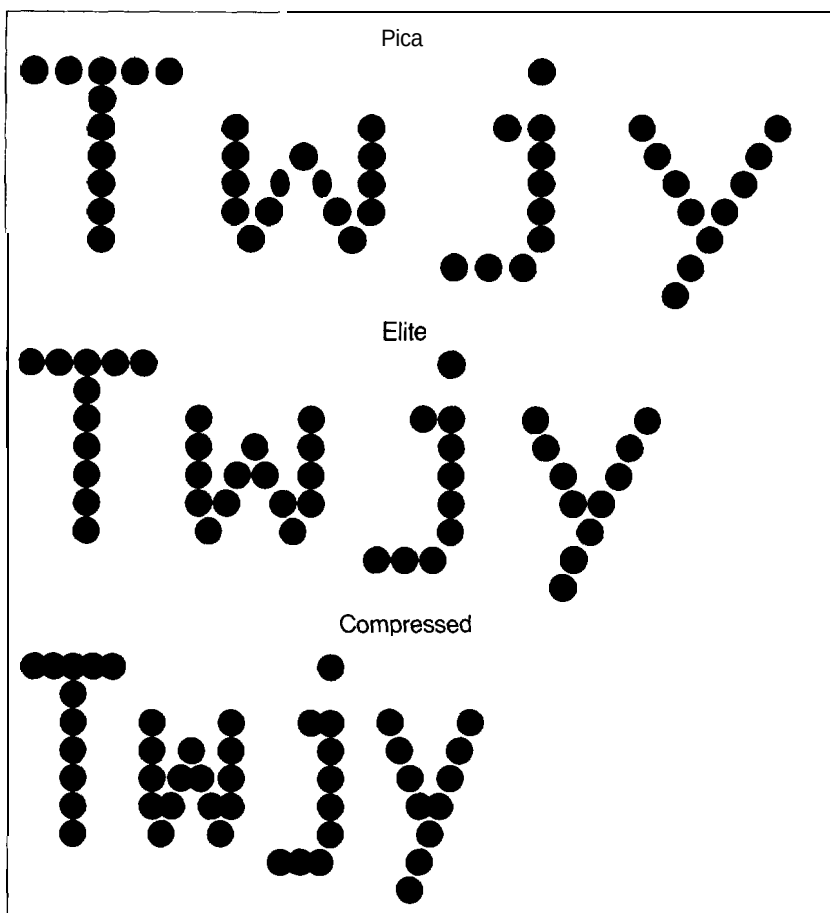


Figure 3-2. The three pitches of the LX-80

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.

SelectType makes it especially easy to change from draft to NLQ, but you can also select and cancel the NLQ mode with a software command or with a special switch in the back of your printer. You can find the software command in Chapter 5 and the operation of the switch (called a DIP switch) in Appendix D.

Chapter 4

Printer Control Codes

The LX-80 printer is easy to use, especially with commercial software that has print control features. This chapter explains some of the

how a computer communicates with your printer. This information should also help you understand the terms used in your software or

If you are an advanced user or a programmer, you may want to turn to Appendix B, which has a full summary of all the LX-80

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 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 LX-80, for example, the codes from 160 through 254 are used for italic 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 Appendix B. There you will see that nearly every code the LX-80 uses is an ESCape code.

Printer Codes

To take advantage of the many print features of the LX-80, 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 LX-80 works with so many different applications programs and computer systems. If we gave precise instructions on how to use your LX-80 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-80 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-80 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-SO 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-80. 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-SO, 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 LX-80, 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 expanded emphasized), you would probably have to use inserted codes. For the program we mentioned above you would type Control-V, then the code for expanded emphasized, Control-V again, and then the text of the heading. The codes for expanded emphasized are in Chapter 6 and Appendix B.

Again, if this sounds terribly complicated, don't worry. Use your LX-80 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.

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-80 printer.

Chapter 5

LX-80 Features

Beginning with this chapter we describe many of the printing fea-

Demonstration Programs

Along with our discussion and examples of the LX-80 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-80 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, such as the Greek character Σ , 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

load paper. Therefore, you shouldn't be intimidated by the information in this manual. In most cases the software that you use for word

cating with the printer for you.

In fact, because of Epson's long-standing popularity, many programs 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 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-80 instead of on programming, but a few instructions are necessary. Because the examples in this manual are in Microsoft BASIC (MBASIC), the most widely used 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-80 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.

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

Changing Pitches

Now you can try other pitches. As we explained in Chapter 3, the

```
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.

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

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

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

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

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

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-80 modes stay on until they are cancelled. It is important to remember this because an LX-80 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 compressed mode; therefore, the memo will be in compressed print. To cancel compressed, 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-80 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, 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 three 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 compressed 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 compressed gives you, you can combine elite and compressed for a mode we call compressed elite. It is not really another pitch, because the size of the characters is the same as in the compressed 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 compressed but doesn't turn off elite, giving you the printout below:

```
ABCDEF GHIJKLMNOPQRSTU VWXYZ[\]^_`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 SelectType, 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 compressed.

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

Table 5-1. Summary of LX-80 pitches

Print sample		CPI	Codes	
← 1inch →			On	Off
Near Letter Quality		10.00	ESC "x" 1	ESC "x" 0
PICAPRINT		10.00		
Elite print		12.00	ESC "M"	ESC "P"
Compressed print		17.16	15	18
Compressed 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 LX-80 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 compressed) that we covered in Chapter 5, the LX-80 offers many other typestyles, including two for bold printing-emphasized and double-strike.

Emphasized mode

In the emphasized mode the LX-80 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.

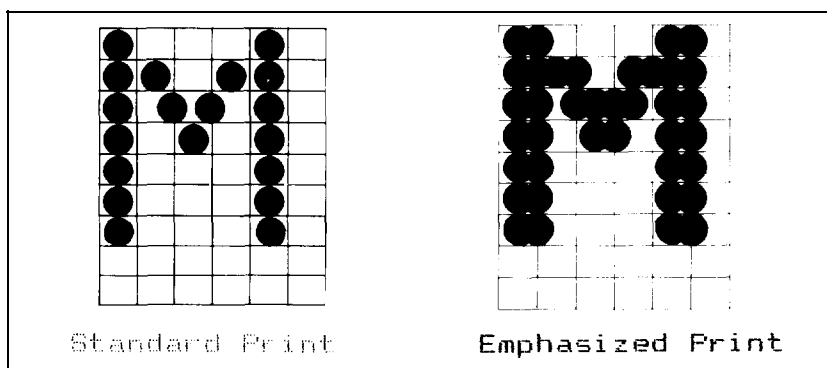


Figure 6-1. Emphasized and single-strike

Emphasized works only in draft pica and NLQ modes. In elite and compressed the dots are already so close together that even with the reduced print speed, the LX-80 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.

```
20PRINT "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-80 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.

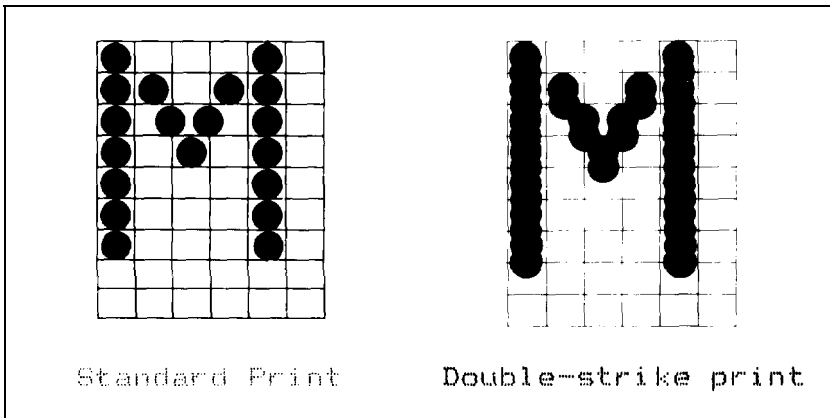


Figure 6-2. Double-strike and single-strike

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”.

Expanded Mode

Perhaps the most dramatic mode on the LX-80 is expanded. 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 expanded pica in Figure 6-3.

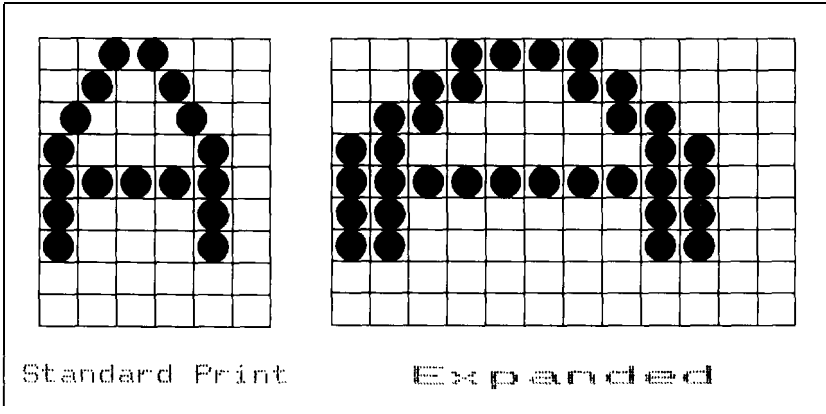


Figure 6-3. Expanded and standard characters

You can try expanded yourself by using the code “W1” in the master program. Notice that expanded 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 expanded. 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 expanded and ESCape “W0” turns it off.

Those of you who are programmers may be interested in another form of expanded. In this alternate form, called one-line expanded, 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 “MO”.

Mode Combinations

If you have read Chapter 2, by now you’re probably wondering how to combine modes using control codes as you did with the SelecType feature. For example, can a title be made especially vivid by combining expanded and emphasized? The answer is that you can combine nearly all of the print modes on the LX-80. Indeed, your

LX-80 printer can print such complicated combinations as double-strike emphasized expanded 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-80 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 expanded."

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.

emphasized expanded

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-80 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-80 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.

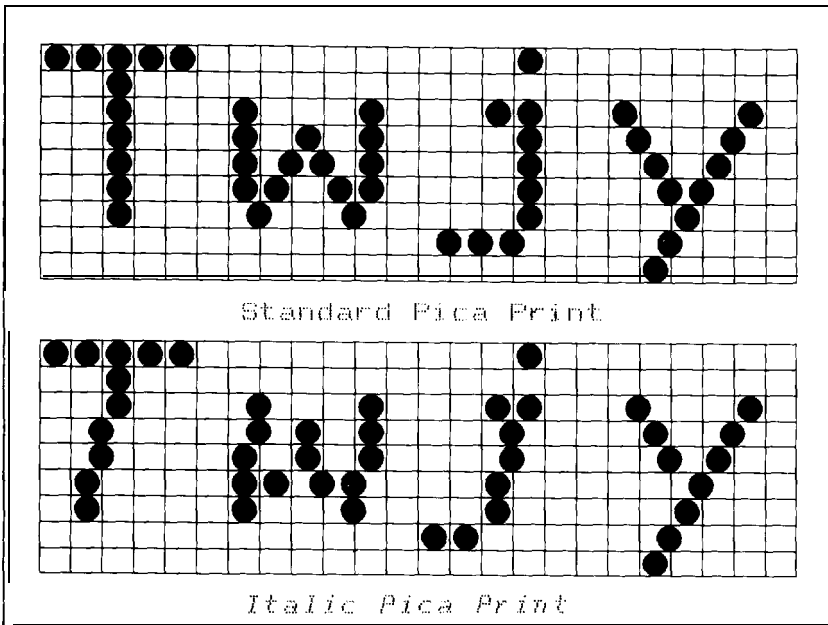


Figure 6-4. Italic and pica

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-80 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.

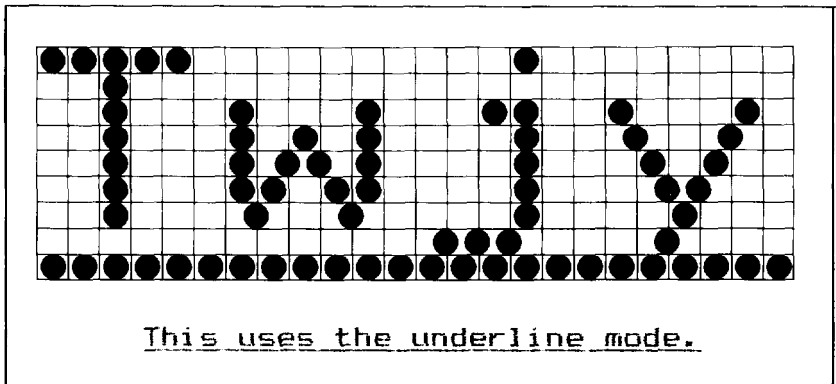


Figure 6-J. The underline mode

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 underline character.

If your software prints this type of underline, it is using the LX-80's underline character (ASCII 95), 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-80 has a special ESCape code called Master Select that allows you to choose any possible combination of eight different modes: pica, elite, compressed, emphasized, double-strike, expanded, 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
expanded	32
double-strike	16
emphasized	8
compressed	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 expanded italic underlined pica, add the following numbers together:

underline	128
italic	64
expanded	32
pica	<u>0</u>
	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 compressed 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 compressed to produce emphasized only, and a combination of all three to produce compressed elite.

Master Select is a powerful code that gives you an easy way to produce multiple combinations 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-80 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-80 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 “S0” 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-80 has two groups of special characters that can add distinction to your printing. The international set gives you characters used in many different languages, and the special graphics set contains symbols, objects, and line characters that you can combine for artistic effects or business uses.

International Characters

As you know, you need a few extra characters for languages other than English. The LX-80 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, 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

	35	36	64	91	92	93	94	96	123	124	125	126
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	#	\$	È	Å	Ö	Å	Ü	é	ä	ö	å	ü
ITALY	#	¤	€	•	\	é	^	ù	ä	ò	à	ì
SPAIN	¤	\$	@	í	ñ	¿	^	`	ñ	ñ	}	~
JAPAN	#	\$	@	[	¥	]	^	`	{		}	~
NORWAY	#	¤	È	Æ	Ø	Å	Ü	é	æ	ø	å	ü
DENMARK II	#	\$	È	Æ	Ø	Å	Ü	é	æ	ø	å	ü

Table 6-2. International characters in draft mode

	35	36	64	91	92	93	94	96	123	124	125	126
USA	#	\$	@	[	\	]	^	`	{		}	~
FRANCE	#	\$	à	°	ç	š	^	`	é	ù	è	..
GERMANY	#	\$	ä	ä	ö	ü	^	`	ä	ö	ü	ß
UK	£	\$	@	[	\	]	^	`	{		}	~
DENMARK I	#	\$	@	Æ	Ø	Å	^	`	æ	ø	å	~
SWEDEN	#	ö	é	Ä	Ö	Å	ü	é	ä	ö	å	ü
ITALY	#	\$	@	°	\	é	^	ù	à	ò	è	ì
SPAIN	ñ	\$	@	í	ñ	¿	^	`	ñ	í	¿	~
JAPAN	#	\$	@	[	¥	]	^	`	{		}	~
NORWAY	#	ö	é	Æ	Ø	Å	ü	é	æ	ø	å	ü
DENMARK II	#	\$	é	Æ	Ø	Å	ü	é	æ	ø	å	ü

Table 6-3. International characters in draft italic

	35	36	64	91	92	93	94	96	123	124	125	126
USA	#	\$	@	[	\	]	^	`	{		}	~
FRANCE	#	\$	à	°	ç	š	^	`	é	ù	è	..
GERMANY	#	\$	ä	ä	ö	ü	^	`	ä	ö	ü	ß
UK	£	\$	@	[	\	]	^	`	{		}	~
DENMARK I	#	\$	@	Æ	Ø	Å	^	`	æ	ø	å	~
SWEDEN	#	ö	é	Ä	Ö	Å	ü	é	ä	ö	å	ü
ITALY	#	\$	@	°	\	é	^	ù	à	ò	è	ì
SPAIN	ñ	\$	@	/	ñ	¿	^	`	ñ	/	¿	~
JAPAN	#	\$	@	[	¥	]	^	`	{		}	~
NORWAY	#	ö	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-80 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-80 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-80. The characters in Figure 6-6 are printed in expanded elite. The printout below shows the characters in pica:

+	┌	┐	└	├	┤	┼	┴	┴	┴	┴
▒	▓	░	▒	▓	░	▒	▓	░	▒	▓
⌘	⌘	⌘	⌘	⌘	⌘	⌘	⌘	⌘	⌘	

The next printout shows the characters in emphasized expanded pica:



The design of all the special graphics characters is shown in enlargements in Appendix A.

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.

Although you can use any print mode with the graphics characters, we suggest that you not use elite or compressed. These modes cause small gaps in horizontal lines that are formed by a combination of line graphics characters.

Chapter 7

Page Formatting

Although the LX-80 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-80 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 LX-80 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-80 printer are 80 in pica, 96 in elite, 137 in compressed, and 160 in compressed 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 the 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-80 prints right over the perforations between pages. The LX-80 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-80 to skip at the bottom of a page. For example, in BASIC the following line will make the LX-80 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-80 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-80.

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-80 characters use nine rows of dots, the 12-dot line spacing leaves three blank rows between the lines of text.

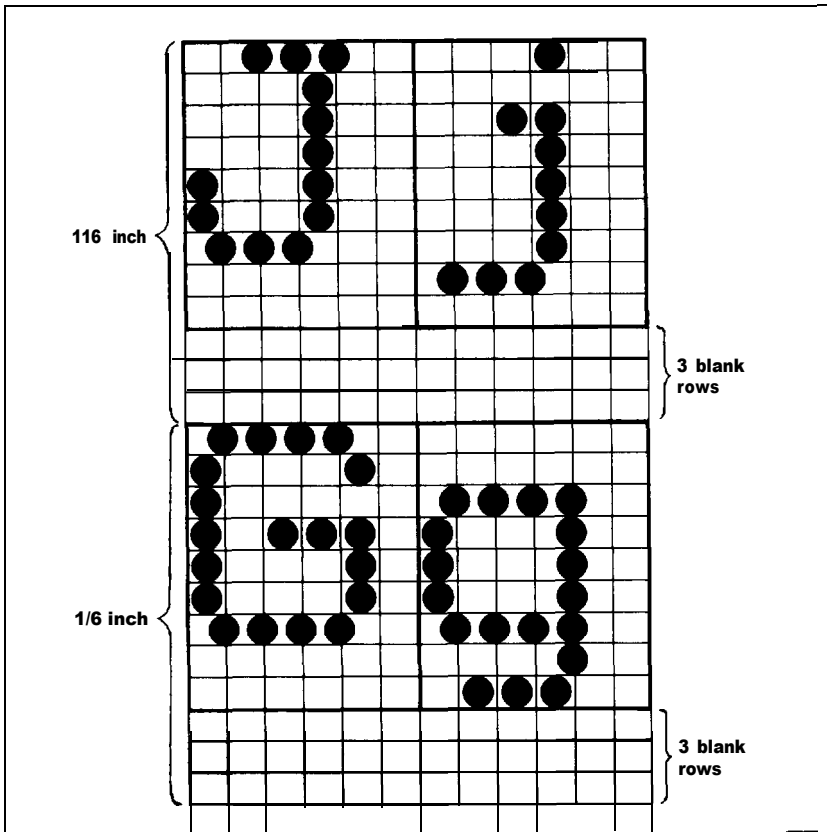


Figure 7-1. Standard line spacing

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-80 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 B 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-80 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 LX-80, 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-80 has 416 different characters stored in its ROM (Read Only Memory). Although this number includes draft, italic, international, 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-80 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.

Σ Ω Ψ ↑ Θ

It may seem that designing a character and telling the LX-80 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 ↑.

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-80. They must fit into an 11x9 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 LX-80 characters are designed.

Designing Process

Suppose that you need the Greek letter sigma (Σ) for your work. Although the LX-80 has a number of special symbols, the sigma 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.

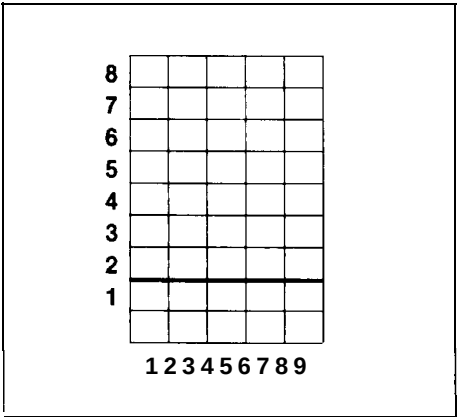


Figure 8-1. Grid for designing draft characters

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 LX-80 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.

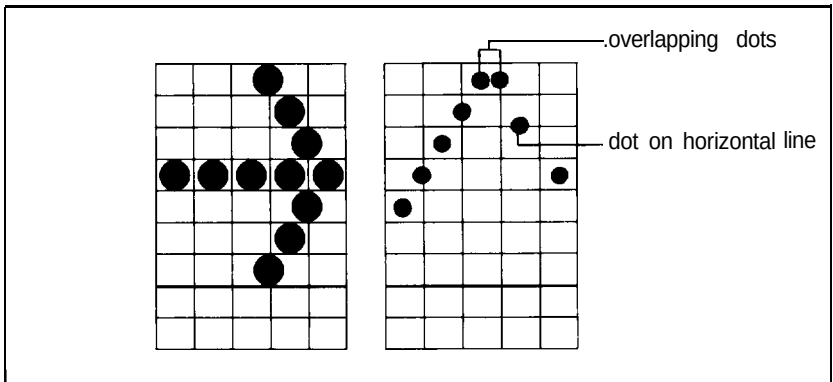


Figure 8-2. Correct and incorrect designs

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$(0)"<<";
190 LPRINT CHR$(128);
200 FOR X=1 TO 9
210 LPRINT CHR$(F(X));: NEXT X
220 LPRINT CHR$(0)CHR$(0);
230 LPRINT "YOUR CHARACTER IN PICA: < < <"
240 LPRINT "IN EXPANDED EMPHASIZED PICA: ";
250 LPRINT CHR$(27)";!*< < <"
260 LPRINT CHR$(27)";!"CHR$(0)"YOUR DATA NUMBERS: "
270 FOR K=1 TO 9: LPRINT F(K);: NEXT K
300 END

```

So that you can see how the program works, we'll present the steps used to create the Greek letter sigma. First is the grid we used to design the character.

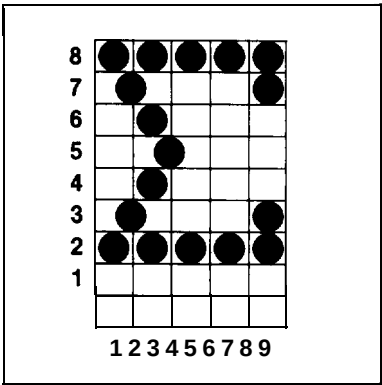


Figure 8-3. Design for sigma

Running the program

For each of the nine columns, the program will ask for the numbers of the rows in which you want dots to appear. Enter the row numbers one at a time, pressing the RETURN key after each one. When you have entered all the numbers for a column or when you want no dots in a column, press RETURN without a number. Remember that the vertical lines in the grid are the even-numbered columns.

In our example, the program first asks what rows have dots in column 1. Respond with 8, RETURN, and 2, RETURN to indicate that you want dots in rows 8 and 2. Then press RETURN alone to indicate that no more dots go in column 1. For column 2 (the vertical line) enter 7, and 3, with a RETURN after each of them. Then enter RETURN to finish with column 2 and go on to column 3.

For column 3 enter 8, 6, 4, and 2. (From now on we assume that you know to press RETURN after each number and one extra time to end the entries for each column.) For column 4 enter 5; for column 5 enter 8 and 2; in column 6 there are no dots, so press RETURN only; for column 7 enter 8 and 2; for column 8 RETURN only; for column 9 enter 8, 7, 3, and 2.

Now wait a moment for your computer to calculate the dot patterns and your LX-80 to print the new character in two different types. 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:  Σ Σ Σ
IN EXPANDED EMPHASIZED PICA:  Σ Σ Σ
YOUR DATA NUMBERS:
130 68 170 16 130 0 130 0 198
```

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.

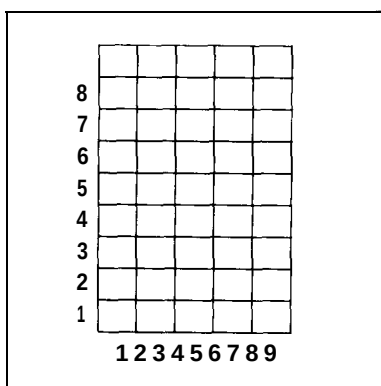


Figure 8-4. Using the bottom eight rows

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 sigma 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$(P);: NEXT P
100 K=1: IF K>3 THEN A=58 ELSE A=60
110 LPRINT CHR$(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 130,68,170,16,130,0,130,0,198
220 FOR P=58 TO 63: LPRINT CHR$(P);: NEXT P
300 SYSTEM

```

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 58,68,2,128,0,128,2,68,58

```

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.

```

# 1 < = > ?
Σ Ω Ψ † @ ?

```

The two lines when printed by your own program provide you with a key to the characters your LX-80 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-80 will print ↑ (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.

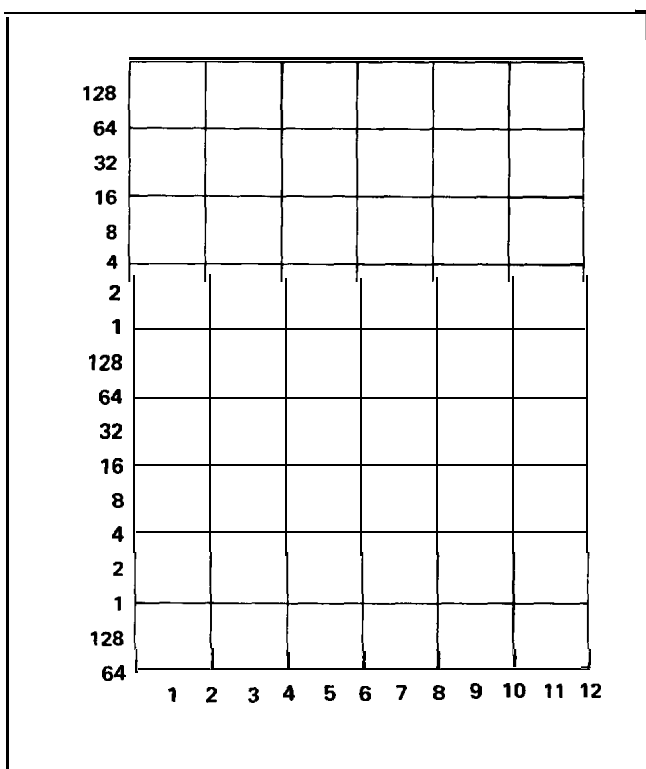


Figure 8-5. Grid for NLQ characters

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.

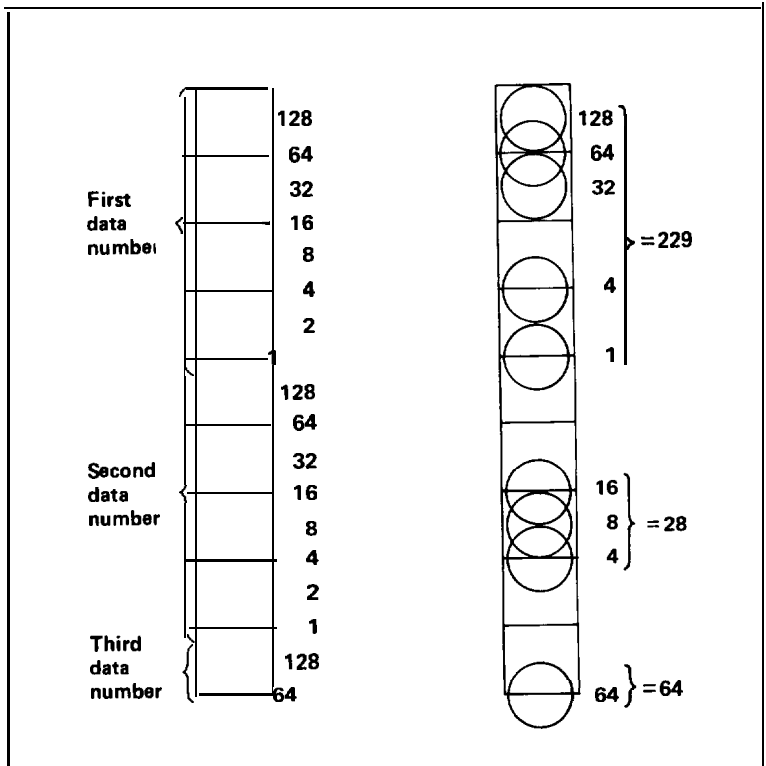


Figure 8-6. Data numbers for one column

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.

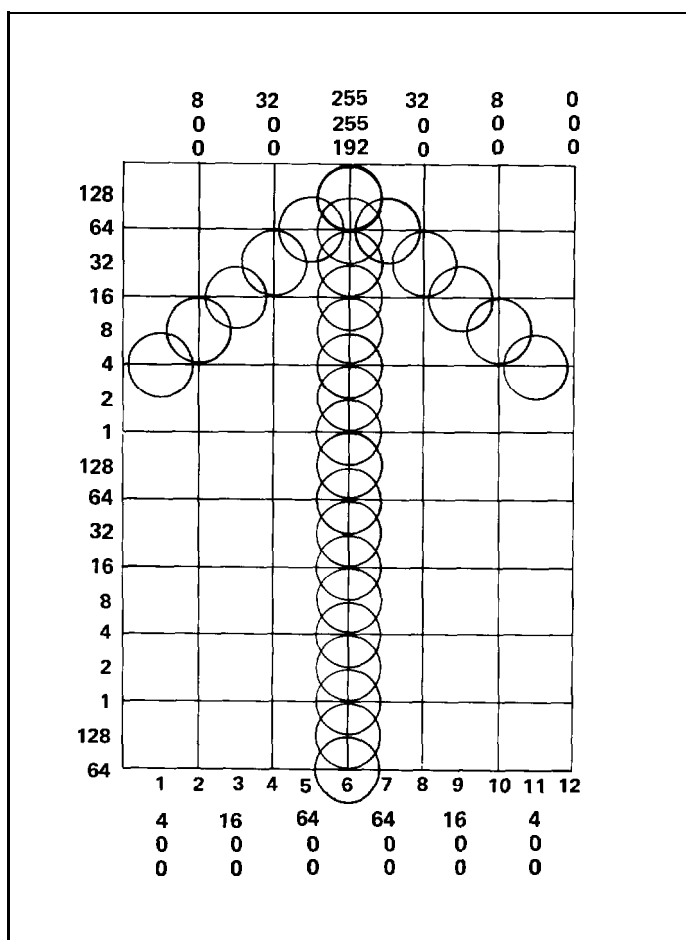


Figure 8-7. Arrow design and data numbers

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$(27) "x"CHR$(1)
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$(C);
80 NEXT X
90 LPRINT "YOUR CHARACTER IN PICA: < < <"
100 LPRINT "IN EXPANDED EMPHASIZED PICA: ";
110 LPRINT CHR$(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

```

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 **LX-80** will print. **You** can use them with an applications program or a program you write yourself.

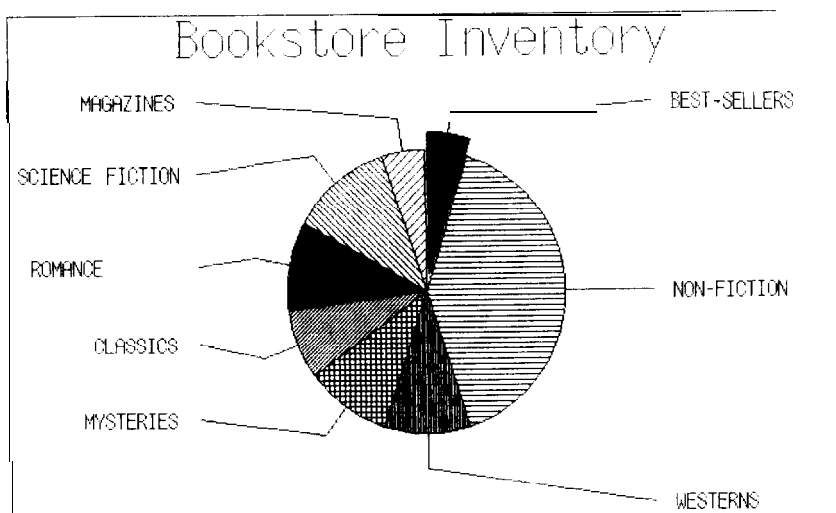
Chapter 9

Introduction to Dot Graphics

The Epson dot graphics mode allows your LX-80 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-80'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-80 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.





Some commercial software programs perform what is called a screen dump, in which whatever is on the computer screen is sent to, and printed by, the printer. This function is sometimes accomplished by a “print screen” command. If you have a program for screen dumps or any other software 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-80 prints graphics, read on.

Dot Patterns

The LX-80 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 LX-80 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-80 graphics mode allows as many as 240 dot positions per inch horizontally and 72 vertically. The images you print on the LX-80 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-80 will print nearly any pattern or figure you can imagine.

Print Head

The graphics mode on the LX-80 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-80 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 wide.

To insure the proper alignment of dots in figures that use more than one pass of the print head, the LX-80 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-80 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-80 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-80 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.

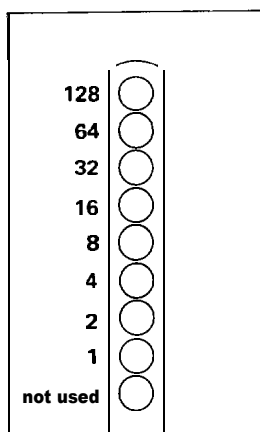


Figure 9-1. Pin labels

To fire any 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.

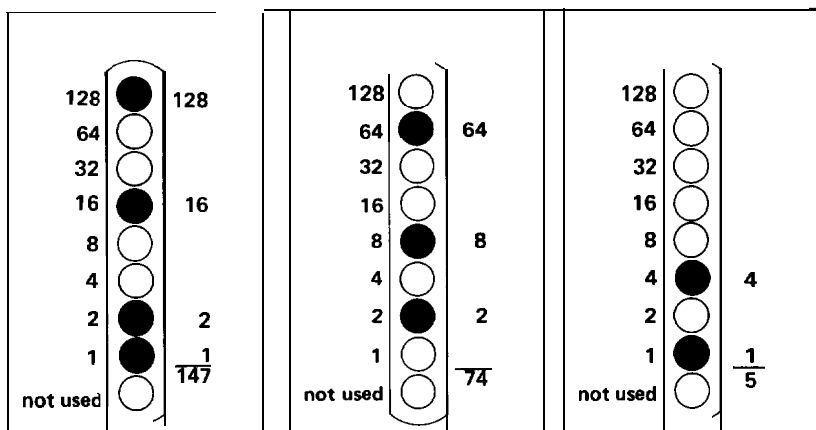


Figure 9-2. Calculating numbers for pin patterns

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-80 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:



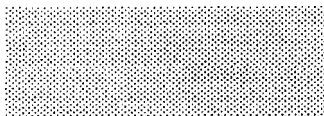
To see how more than one line combines to form a figure, enter and run the following program, which uses two of the lines you have already typed and adds several more.

```

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 7-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 line 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-80 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 B. 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	Epson QX-10™	none	80 dots/inch; 640 dots/8” line Matches the screen density of the QX-10, which makes it easy to do screen dumps.
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-80 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 LX-80 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 S-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 LX-SO, 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-80.

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.

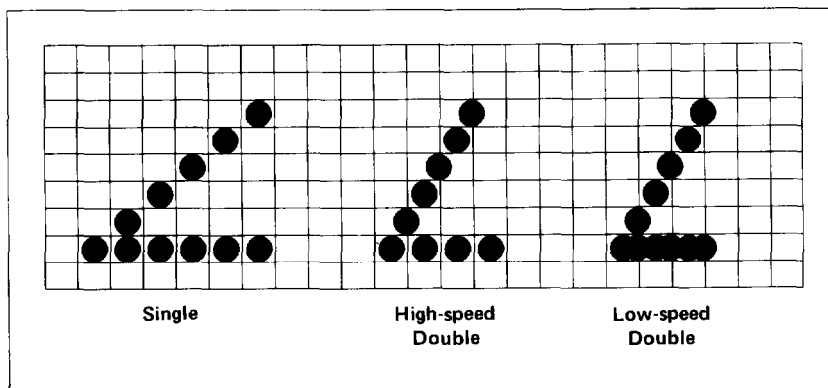


Figure 9-3. Designing in different densities

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.

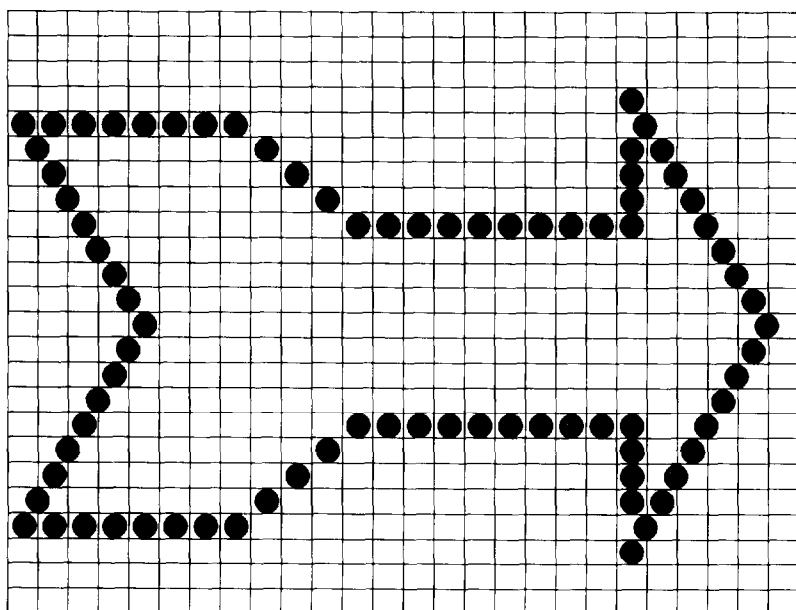


Figure 9-4. Arrow design

After plotting all the dots as in Figure 9-4, you calculate the numbers for each pin pattern by dividing the design grid into separate print lines. For the arrow design the grid was divided into three lines, each seven dots high. Then each column was examined and the sums of the pin values determined. This process for the first line is shown in Figure 9-5. The pin values are on the left side and the sums are at the bottom of each column.

Those of you who have read the previous chapter will see that designing graphics is much like designing user-defined characters.

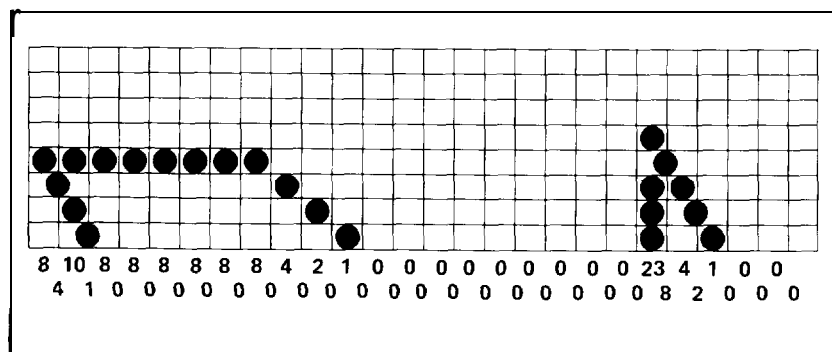


Figure 9-5. First line of arrow figure

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 READN: 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 0,0,0,0,64,32,17,10,4,0,-6,0,0,-10
815 DATA 64,0,0,0,0,64,32,17,10,4,128
820 DATA 2,4,10,16,34,64,-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 LX-80 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 50-column graphics line with the line spacing set to 7-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 7-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.

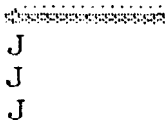
Expected pattern	 Actual result
--------------------------------	---

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.

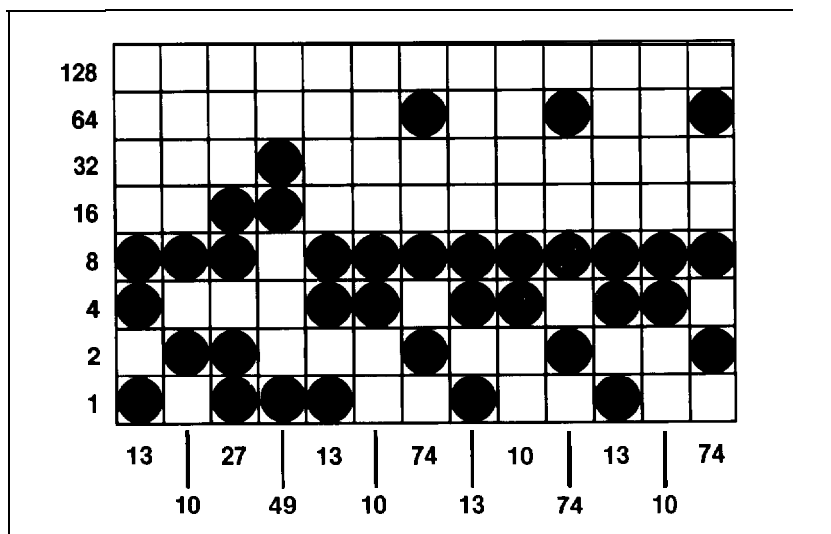


Figure 9-7. Pin patterns of incorrect program

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-80 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 LX-80 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-80 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

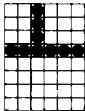
ASCII Codes and Character Fonts

This appendix provides information about the way ASCII codes are used on the LX-80 printer and about the character fonts associated with those codes. The first section summarizes the codes. The second section displays the decimal and hexadecimal numbers, a printout, and an enlarged dot matrix for each of the special graphics characters and the draft international characters. Other dot matrixes are in Chapter 3. The enlarged dot matrix characters are shown in elite to save space.

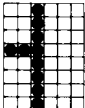
Sending printer codes is discussed in Chapter 4, and the method of printing the special graphics and international characters is discussed in Chapter 6.

Dec	Hex	CHR	Dec	Hex	CHR	Dec	Hex	CHR	Dec	Hex	CHR
0	00	none	64	40	@	128	80	!	192	C0	À
1	01	none	65	41	A	129	81	"	193	C1	Á
2	02	none	66	42	B	130	82	#	194	C2	Â
3	03	none	67	43	C	131	83	\$	195	C3	Ã
4	04	none	68	44	D	132	84	%	196	C4	Ä
5	05	none	69	45	E	133	85	&	197	C5	Å
6	06	none	70	46	F	134	86	'	198	C6	Æ
7	07	BEL	71	47	G	135	87	(	199	C7	Ç
8	09	BS	72	48	H	136	88	)	200	C8	È
9	0A	HT	73	49	I	137	89	*	201	C9	É
10		LF	74	4A	J	138	8A	+	202	CA	Ê
11	0B	VT	75	4B	K	139	8B	=	203	CB	Ë
12	0C	FF	76	4C	L	140	8C	>	204	CC	Ü
13	0D	CR	77	4D	M	141	8D	?	205	CD	Ý
14	0E	SO	78	4E	N	142	8E	@	206	CE	Û
15	0F	SI	79	4F	O	143	8F	A	207	CF	Ü
16	10	none	80	50	P	144	90	B	208	D0	Þ
17	11	none	81	51	Q	145	91	C	209	D1	ÿ
18	12	DC2	82	52	R	146	92	D	210	D2	ÿ
19	13	none	83	53	S	147	93	E	211	D3	ÿ
20	14	DC4	84	54	T	148	94	F	212	D4	ÿ
21	15	none	85	55	U	149	95	G	213	D5	ÿ
22	16	none	86	56	V	150	96	H	214	D6	ÿ
23	17	none	87	57	W	151	97	I	215	D7	ÿ
24	18	CAN	88	58	X	152	98	J	216	D8	ÿ
25	19	EM	89	59	Y	153	99	K	217	D9	ÿ
26	1A	none	90	5A	Z	154	9A	L	218	DA	ÿ
27	1B	ESC	91	5B	[	155	9B	M	219	DB	ÿ
28	1C	none	92	5C	\	156	9C	N	220	DC	ÿ
29	1D	none	93	5D	]	157	9D	O	221	DD	ÿ
30	1E	none	94	5E		158	9E	P	222	DE	ÿ
31	1F	none	95	5F		159	9F	Q	223	DF	ÿ
32	20		96	60		160	A0	R	224	E0	ÿ
33	21	!	97	61	a	161	A1	S	225	E1	a
34	22	"	98	62	b	162	A2	T	226	E2	b
35	23	#	99	63	c	163	A3	U	227	E3	c
36	24	\$	100	64	d	164	A4	V	228	E4	d
37	25	%	101	65	e	165	A5	W	229	E5	e
38	26	&	102	66	f	166	A6	X	230	E6	f
39	27		103	67	g	167	A7	Y	231	E7	g
40	28	(	104	68	h	168	A8	Z	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	!	240	F0	p
49	31	1	113	71	q	177	B1	"	241	F1	q
50	32	2	114	72	r	178	B2	#	242	F2	r
51	33	3	115	73	s	179	B3	\$	243	F3	s
52	34	4	116	74	t	180	B4	%	244	F4	t
53	35	5	117	75	u	181	B5	&	245	F5	u
54	36	6	118	76	v	182	B6	'	246	F6	v
55	37	7	119	77	w	183	B7	(	247	F7	w
56	38	8	120	78	x	184	B8	)	248	F8	x
57	39	9	121	79	y	185	B9	*	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	A	255	FF	

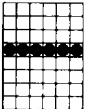
Special Graphics Characters

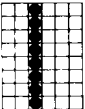
Dec **Hex** **Character**
 129 81  

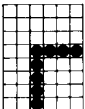
130 82  

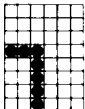
131 83  

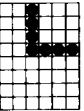
132 84  

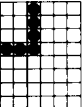
133 85  

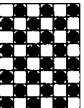
134 86  

135 87  

136 88  

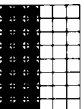
Dec **Hex** **Character**
 137 89  

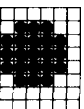
138 8A  

139 8B  

140 8C  

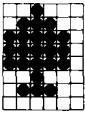
141 8D  

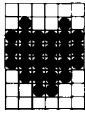
142 8E  

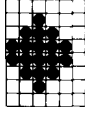
143 8F  

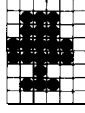
144 90  

Dec Hex Character

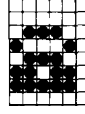
145 91 ☙ 

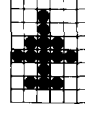
146 92 ☚ 

147 93 ☛ 

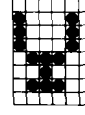
148 94 ☜ 

149 95 ☞ 

150 96 ☛ 

151 97 ☞ 

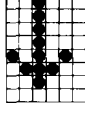
152 98 ☛ 

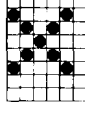
153 9A ☛ 

Dec Hex Character

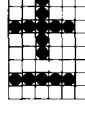
154 9B ☛ 

155 9C ☛ 

156 9C ☛ 

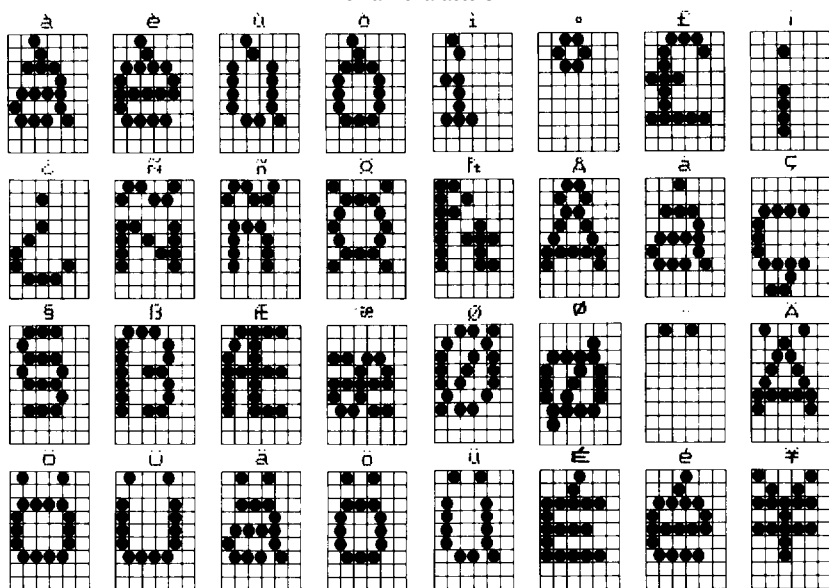
157 9D ☛ 

158 9E ☛ 

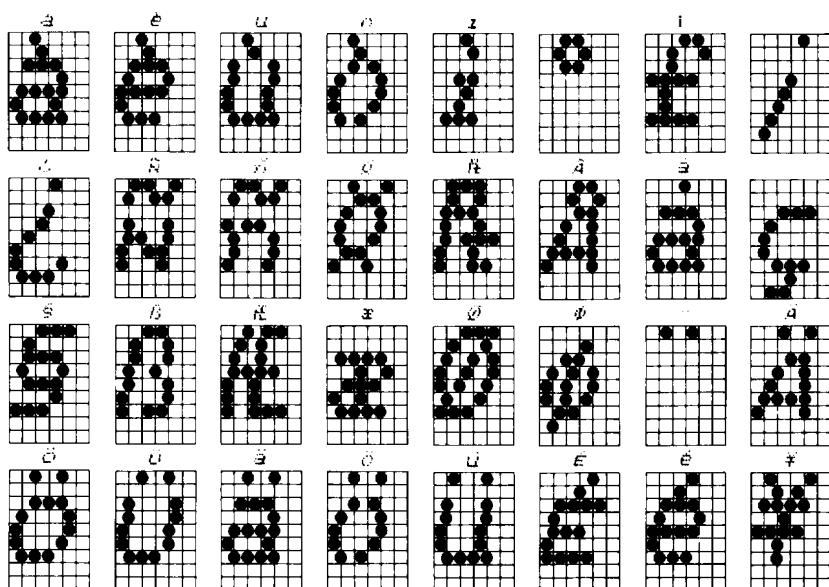
159 9F ☛ 

Draft International Characters

Roman characters



Italic characters



Appendix B

Control Codes in Numeric Order

You can use any of the methods explained in Chapter 4 to send these control codes to your LX-80. If you use MBASIC, you send a control code using `LPRINT CHR$(27)` followed by `CHR$(n)`, where `n` is a number from the decimal (Dec) column below. For a few codes, those with a dash in the ESC column, you omit the ESCape code. For the codes above decimal 27, you can use either the character in the symbol column (in quotation marks) or `CHR$(n)`. For example, the command for turning on emphasized can be entered as:

```
LPRINT CHR$(27)CHR$(69)or LPRINT CHR$(27)"E"
```

See Chapter 4 and your system documentation for other methods of sending codes to the printer.

Some applications programs can use control key codes for decimal codes O-26. See the control key chart at the end of this appendix or the Quick Reference Card for a complete list of control key values.

Abbreviations: cpi = characters per inch
 cps = characters per second

ESC	Dec	Hex	Symbol	Function
	0	00	NUL	Terminates horizontal and vertical tab setting ESCape sequences.
	7	07	BEL	Sounds beeper.
	8	08	BS	Backspace. Empties the printer buffer, then moves the print head left 1 space in the current pitch.
	9	09	HT	Horizontal tab. Empties the printer buffer, then moves the print head to the next tab stop.

ESC	Dec	Hex	Symbol	Function
	10	0A	LF	Line feed. Empties the printer buffer, performs a line feed at the current line spacing, and resets the buffer character count to 0.
	11	0B	VT	Vertical tab. Empties the printer buffer, then advances the paper to the next vertical tab stop.
	12	0C	FF	Form feed. Empties the printer buffer, then advances the paper to the next top of form.
	13	0D	CR	Carriage return. Prints the contents of the buffer and resets the buffer character count to 0.
	14	0E	SO	Shift out. Turns expanded mode ON for the length of the line. Can be cancelled by ASCII 20 or ESC "W0". Works with pica, elite, or compressed mode.
	15	0F	SI	Shift in. Empties buffer and turns compressed (17.16 cpi) ON. Cannot mix with emphasized or pica. Can also use DIP switch 1-1.
	17	11	DC1	When DIP switch 2-2 is OFF, places printer in the active state.
	18	12	DC2	Device control 2. Turns compressed mode OFF.
	19	13	DC3	Device control 3. When DIP switch 2-2 is OFF, places printer in the inactive state until a DC1 code is received.
	20	14	DC4	Device control 4. Turns the expanded mode set by ASCII 14 OFF.
	24	18	CAN	Cancels all text but not control codes in the print buffer.
ESC 25	19	EM		Sets the optional cut-sheet feeder. Format: ESC 25 n where n toggles the cut-sheet feeder: n=0 turns it OFF and n=4 turns it ON. You cannot use "EM" in place of 25. Can also use DIP switch 1-3.

ESC	Dec	Hex	Symbol	Function
	27	1B	ESC	Escape. Prepares the printer to receive control codes.
ESC	33	21	!	Master Select Selects 1 of 64 unique print mode combinations. Format: ESC "!" n where n stands for a number between 0 and 255.
ESC	37	25	%	Activates a character set. ESC "%" 0 0 selects the ROM set, and ESC "%" 1 0 selects the RAM set defined by ESC "&".
ESC	38	26	&	Defines user characters in RAM. Format: ESC "&" 0 c ₁ c ₂ a d ₁ . . . d ₁₁ The 0 is for future use, c ₁ is the starting character, c ₂ is the ending character. Both c ₁ and c ₂ must be between 58 and 63 inclusive. If a ≥ 128, character uses top 8 pins; if a < 128, character uses bottom 8 pins. Each character in the range c ₁ -c ₂ requires an attribute byte (a) and 11 data bytes (d ₁ -d ₁₁). If NLQ mode is selected first, the command requires 3 bytes for a. The first, a ₀ , is ignored, the second, a ₁ , is the printing width and values above 12 are ignored. The third, a ₂ , is the value of the right spacing and is automatically adjusted to 12-a ₁ . In NLQ the command also requires 3 × a ₁ data bytes.

ESC Dec	Hex	Symbol	Function
ESC 42	2A	*	Turns graphics mode ON. Format: ESC “*” m n ₁ n ₂ followed by n data numbers, where n = total number of dot columns, n ₁ = n MOD 256, n ₂ = INT (n/256), m selects mode 0-6. See Chapter 9 for modes.
ESC 45	2D	—	Turns underline mode ON. Format: ESC “—” n where n toggles underline on and off: 0 turns it OFF, 1 turns it ON.
ESC 47	2F		Selects a vertical tab channel. Format: ESC “/” n where n = 0-7.
ESC 48	30	0	Sets line spacing to 1/8-inch (9-dot).
ESC 49	31	1	Sets line spacing to 7/72-inch (7-dot).
ESC 50	32	2	Returns line spacing to the default of 1/6-inch (12-dot).
ESC 51	33	3	Sets line spacing to n/216-inch (1/216-inch is 1/3-dot). Stays on until changed. Format: ESC "3" n where n = 0-255.
ESC 52	34	4	Turns italic mode ON.
ESC 53	35	5	Turns italic mode OFF.
ESC 56	38	8	Disables the paper-out sensor. Can also be disabled with DIP switch 1-5.
ESC 57	39	9	Enables the paper-out sensor. Can also be enabled with DIP switch 1-5.
ESC 58	3A		Copies the ROM character set to RAM. Format: ESC “:” n ₁ n ₂ n ₃ where n ₁ , n ₂ , and n ₃ are all 0. They are included for future expansion. The RAM character set must be acti- vated with ESC “%”.
ESC 60	3C	<	Turns one-line unidirectional mode ON. Prints each line from left to right.

ESC	Dec	Hex	Symbol	Function
ESC	63	3F	?	Redefines one of the four alternate graphics codes--“K”, “L”, “Y”, or “Z”--as one of the seven graphics density numbers used with the ESCape “*” command. Format: ESC “?s” n where s is K, L, Y, or Z and n is 0-6.
ESC	64	40	@	Reset code, which resets the printer to its power-up state, including resetting top of page. Clears all text and control codes from the print buffer.
ESC	65	41	A	Sets line spacing to n/72-inch (n-dot). Format: ESC “A” n where n = 0-255.
ESC	66	42	B	Sets up to 16 vertical tabs in the current line spacing. Tab settings are not affected by subsequent changes in line spacing. Format: ESC “B” n₁n₂ . . . n_k 0 where n_k = 1-255. Terminate this tab sequence with 0 or a number less than the last defined tab (n_k).
ESC	67	43	C	Sets the form length to n lines in the current line spacing. The default is 66 lines. Also resets top of form. Format: ESC “C” n where n = 1-127.
ESC	67	43	C	Sets the form length to n inches, regardless of the current line spacing. The default length is a set by the DIP switches. Also resets top of form. Format: ESC “C” 0 n where n = 1-22.

ESC	Dec	Hex	Symbol	Function
ESC	68	44	D	Resets the current tabs and sets up to 32 horizontal tabs in the current pitch. Tabs may range up to the maximum width for the character and printer size. For example, the maximum tab for pica characters on an 8-inch line is 79. Tab settings are not affected by subsequent changes in pitch. Format: ESC "D" $n_1 n_2 \dots n_k 0$ Terminate this tab sequence with 0 or a number less than the last defined tab (n_k).
ESC	69	45	E	Turns emphasized mode ON. Cannot mix with elite or compressed mode.
ESC	70	46	F	Turns emphasized mode OFF.
ESC	71	47	G	Turns double-strike mode ON. Cannot mix with NLQ mode.
ESC	72	48	H	Turns double-strike mode OFF.
ESC	74	4A	J	Forces an immediate line feed of $n/216$ inches without changing the current line spacing. Prints the contents of the buffer without a carriage return. Format: ESC "J" n where $n = 0-255$.
ESC	75	4B	K	Turns single-density graphics mode ON. Prints 480 dots per 8-inch line. Format: ESC "K" $n_1 n_2$ followed by n data numbers, where n = total number of dot columns, $n_1 = n \text{ MOD } 256$, $n_2 = \text{INT} (n/256)$. For example, to print 480 dots, $n_1 = 244$, $n_2 = 1$.

ESC	Dec	Hex	Symbol	Function
ESC 76		4C	L	Turns low-speed double-density graphics mode ON. Prints 960 dots per 8-inch line. Format: ESC "L" $n_1 n_2$ followed by n data numbers, where n = total number of dot columns, $n_1 = n \text{ MOD } 256$, $n_2 = \text{INT} (n/256)$. For example, to print 960 dots, $n_1 = 192$, $n_2 = 3$.
ESC 77		4D	M	Turns elite mode (12 cpi) ON. Cannot mix with NLQ, pica, or emphasized mode.
ESC 78		4E	N	Sets skip-over-perforation to n lines. Format: ESC "N" n where $n = 1-127$.
ESC 79		4F	O	Turns skip-over-perforation OFF.
ESC 80		50	P	Turns elite mode OFF. Returns to pica unless compressed mode is active.
ESC 81		51	Q	Sets the right margin. Also cancels all text that is in the print buffer. Format: ESC "Q" n where n ranges from: 2-80 in pica 3-96 in elite" 4-137 in compressed') 4-160 in compressed elite:' * You may need a WIDTH statement; consult your system documentation.
ESC 82		52	R	Selects an international character set by its country's number. See Chapter 6. Format: ESC "R" n where $n = 0-10$.

ESC	Dec	Hex	Symbol	Function
ESC	83	53	S	Turns script mode ON. Either type of script is printed in double-strike. Format: ESC "S"CHR\$(n) where n = 0 produces superscript, and 1 produces subscript.
ESC	84	54	T	Turns script mode OFF.
ESC	85	55	U	Turns unidirectional mode ON. Prints each line from left to right. Format: ESC "U" n where n toggles the mode on and off: 0 turns it OFF, 1 turns it ON.
ESC	87	57	W	Turns expanded mode ON; stays ON until turned OFF. Cannot be turned off with ASCII 20. Format: ESC "W" n where n toggles the mode on and off: 0 turns it OFF, 1 turns it ON.
ESC	89	59	Y	Turns high-speed double-density graphics mode ON; gives the same density as ESC "L" but cannot print two adjacent dots in the same row.
ESC	90	5A	Z	Turns quadruple-density graphics mode ON. Allows 1920 dot positions per S-inch line. Format: ESC "Z" n ₁ n ₂ followed by n data numbers, where n = total number of dot columns, n ₁ = n MOD 256 n ₂ = INT (n/256). For example, to print 1920 dots, n ₁ = 128, n ₂ = 7.

ESC	Dec	Hex	Symbol	Function
ESC	94	5E	^	Turns nine-pin graphics ON. Format: ESC “*” d $n_1 n_2$ followed by 2 times n data numbers, where n = total number of dot columns, $n_1 = n \text{ MOD } 256$, $n_2 = \text{INT} (n/256)$. The printer expects two data numbers for each column of print. The d selects the density, where 0 produces single-density and 1 produces double-density.
ESC	97	61	a	Sets justification format in NLQ mode. Format: ESC “a” n where n=0 for left justification; n=1 for centering; n=2 for right justification; and n=3 for full justification.
ESC	98	62	b	Sets up to 16 vertical tabs for channel n. Format: ESC “b” n $n_1 n_2 \dots n_k$ 0 where n = 0-7, and n = 0 is the same as ESC “B”. Terminate this tab sequence with 0 or a number less than the last defined tab (n_k).
ESC	101	65	e	Sets horizontal and vertical tab increments. Horizontal format: ESC “e0” n where n is the number of spaces and equals : 0-21 in pica 0-25 in elite 0-36 in compressed. Vertical format: ESC “e1” n where n is the number of line feeds and equals : INT (255/x) for x/216-inch line spacing, INT (85/x) for x/72-inch line spacing, 7 for 12-dot line spacing.

ESC	Dec	Hex	Symbol	Function
ESC	102	66	f	Prints spaces or line feeds without carriage returns. Horizontal format: ESC “f0” n where n is the number of spaces and equals 0-127. Vertical format: ESC “f1” n where n is the number of line feeds and equals 0-127.
ESC	108	6C	l	Sets the left margin. Format: ESC “l”CHR\$(n) where n ranges from: 0-78 in pica 0-93 in elite 0-133 in compressed 0-156 in compressed elite.
ESC	109	6D	m	Makes available the graphics character set, which is stored behind the control codes at ASCII positions 128 to 159. Format: ESC “m” n where n toggles the character set on and off: 4 turns the graphics characters ON, 0 turns them OFF.
ESC	115	73	s	Selects the print speed. Half-speed mode can be employed to reduce noise. Format: ESC “s” n where n toggles half-speed on and off, so that 1 produces 50 cps, while 0 produces 100 cps.
ESC	120	78	x	Selects draft or NLQ mode. ESC “x” 0 selects draft. ESC “x” 1 selects NLQ. ESC “x0” and ESC “x1” will also work.
	127	7F	DEL	Deletes the last text character in the print buffer but does not affect control codes.

The printer's high-order control codes from 128 to 155 mirror their low-order counterparts (O-27). In some cases it is necessary or more convenient to use the high-order codes instead of the low-order ones. For example, if your system will not send a 9 for a horizontal tab, use 137 instead. For ready reference, both sets are listed here:

Low Dec	High Dec	High Hex	Symbol	Function
0	128	80	NUL	Terminates horizontal and vertical tab setting ESCape sequence
7	135	87	BEL	Sounds beeper
8	136	88	BS	Backspace
9	137	89	HT	Horizontal tab
10	138	8A	LF	Line feed
11	139	8B	VT	Vertical tab
12	140	8C	FF	Form feed
13	141	8D	CR	Carriage return
14	142	8E	SO	Shift out; turns expanded mode ON
15	143	8F	SI	Shift in; turns compressed mode ON
18	146	92	DC2	Device control 2; turns compressed mode OFF
20	148	93	DC4	Device control 4; turns expanded mode set by ASCII 14 OFF
24	152	97	CAN	Cancels all text in print buffer
25	153	98	EM	Used with ESCape code to enable/disable cut-sheet feeder
27	155	9B	ESC	ESCape code

Note: The high-order control codes cannot be used if the special graphics characters are activated.

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

Control Codes by Function

This appendix shows most of the control codes in Appendix B, but this time they are arranged by categories. If your computer cannot generate lowercase letters, use the equivalent decimal ASCII values.

This appendix enables you to find a particular code quickly but does not give all the details on the format and use of each code. See Appendix B or the appropriate chapter for further information.

Near Letter Quality Mode

ESC "x" 1	Turns NLQ mode ON.
ESC "x" 0	Turns draft mode ON.
ESC "a"	Activates NLQ justification modes,

Character Width (Pitch)

ASCII 15	Turns compressed mode ON.
ASCII 18	Turns compressed mode OFF.
ASCII 14	Turns one-line expanded mode ON.
ASCII 20	Turns one-line expanded mode OFF.
ESC "M"	Turns elite mode ON.
ESC "P"	Turns elite mode OFF.
ESC W0"	Turns either expanded mode OFF.
ESC W1	Turns continuous expanded mode ON.

Character Weight

ESC "E"	Turns emphasized mode ON.
ESC "F"	Turns emphasized mode OFF.
ESC "G"	Turns double-strike mode ON.
ESC "H"	Turns double-strike mode OFF.

Print Enhancement

ESC “SO”	Turns superscript mode ON.
ESC “S1”	Turns subscript mode ON.
ESC “T”	Turns either script mode OFF.
ESC “-0”	Turns underline mode OFF.
ESC “-1”	Turns underline mode ON.

Mode and Character-Set Selection

ESC “!”	Master select.
ESC “4”	Turns italic mode ON.
ESC “5”	Turns italic mode OFF.
ESC “@”	Reset code.
ESC R	Selects an international character set.
ESC “m”	Selects and cancels special graphics characters.

Special Printer Features

ASCII 8	Backspaces.
ESC 25	Enables and disables the optional cut-sheet feeder.
ESC <	Turns one-line unidirectional mode ON.
ESC U0	Turns continuous unidirectional mode OFF.
ESC U1	Turns continuous unidirectional mode ON.
ESC s0	Returns to normal speed.
ESC s1	Turns half-speed mode ON.

Line Spacing

ESC 0	Sets line spacing to 1/8-inch.
ESC 1	Sets line spacing to 7/72-inch.
ESC 2	Sets line spacing to 1/6-inch (default).
ESC A n	Sets line spacing to n/72-inch.
ESC 3 n	Sets line spacing to n/216-inch.
ESC “J” n	Produces an immediate one-time line feed of n/216-inch without a carriage return.

Forms Control

ESC 8	Turns the paper-out sensor OFF.
ESC 9	Turns the paper-out sensor ON.
ESC C 0	Sets the form length in inches.
ESC C	Sets the form length in lines.
ESC N	Turns variable skip-over-perforation ON.
ESC O	Turns skip-over-perforation OFF.

Page Format

ASCII 9 or 137	Activates a horizontal tab .
ASCII 11	Activates a vertical tab.
ESC D	Sets horizontal tab stops.
ESC Q	Sets the right margin.
ESC "1"	Sets the left margin.

User-defined Characters

ESC &	Defines characters in user RAM.
ESC :	Copies the character set from ROM to RAM.
ESC %	Activates ROM or RAM character set.

Dot Graphics

ESC "⋆"	Selects one of seven graphics densities.
ESC ?	Reassigns a graphics density.
ESC K	Turns single-density graphics mode ON.
ESC L	Turns double-density graphics mode ON.
ESC Y	Turns high-speed double-density graphics mode ON.
ESC Z	Turns quadruple-density graphics mode ON.
ESC "	Turns nine-pin graphics mode ON.

Appendix D

The DIP Switches

Several tiny switches called DIP (for Dual In-Line Package) switches are in the back of your LX-80 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-80 gives you easy access to the switches. You can see them in the back of the printer as indicated in Figure D-1.

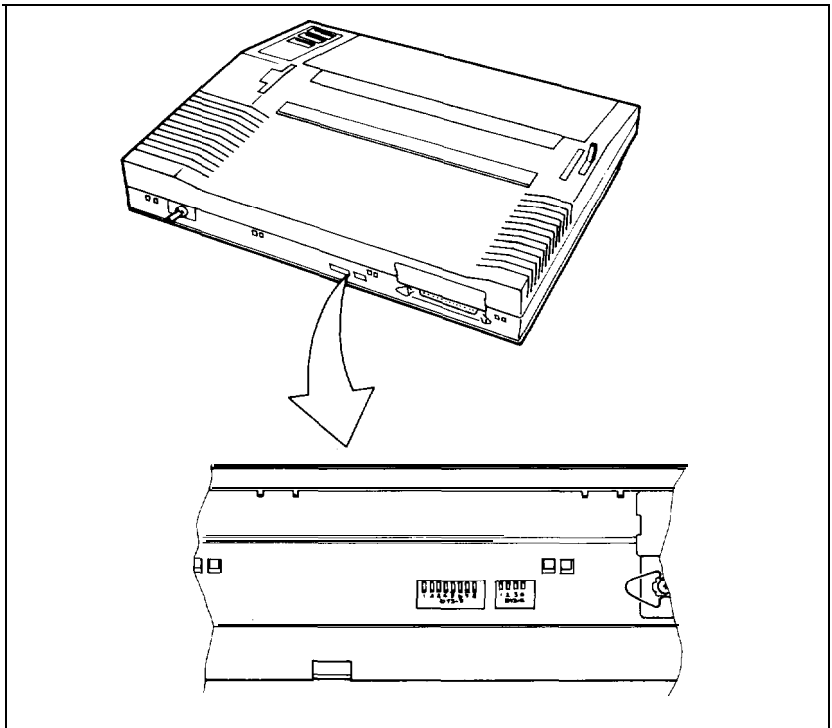


Figure D-1. DIP switch location

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	NLQ	NLQ/draft	Draft
1-1	Compressed	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	Ø	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	Off
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 draft or Near Letter Quality. When it is ON, the printer prints in the NLQ mode. When it is OFF, it prints in the draft mode. If the switch is off, you can still use the NLQ mode by using `SelecType` or an `ESCape` code.

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-80 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-80 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 (ϕ); when it is OFF, they are not.

Appendix E

Using the Optional Tractor Unit

The optional tractor unit 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.

Printer Location

When you use the tractor and continuous paper, you must put your LX-80 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.

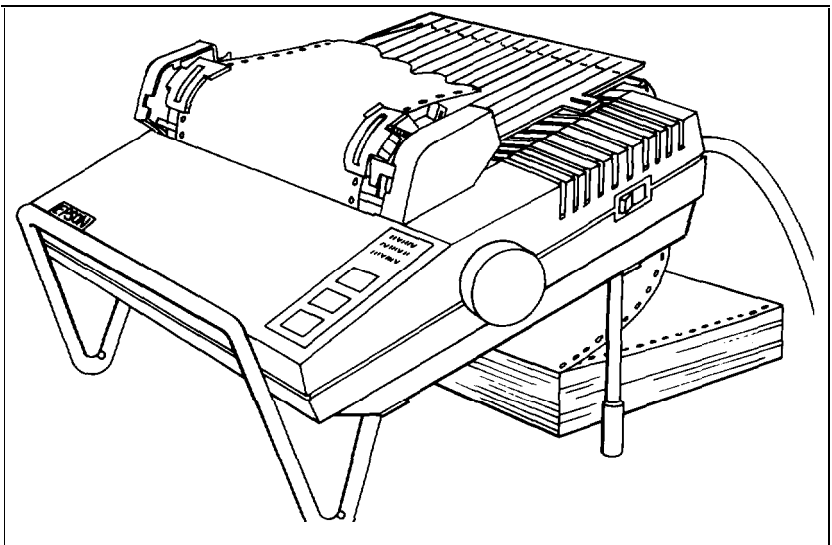


Figure E-1. Continuous paper with printer stand

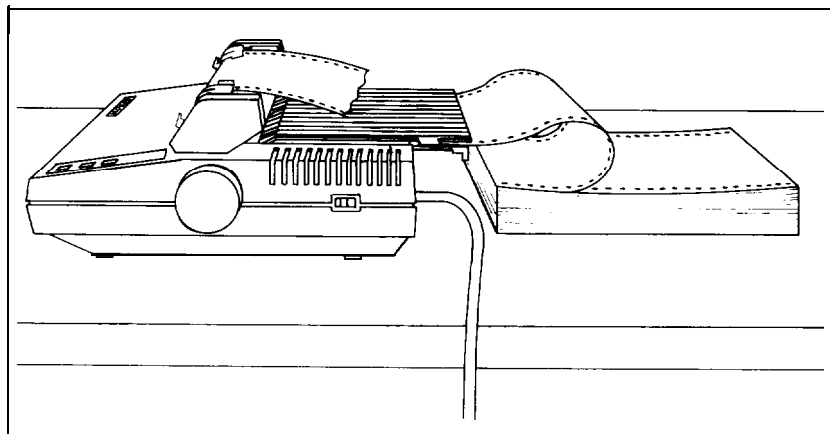


Figure E-2. Continuous paper without stand

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.

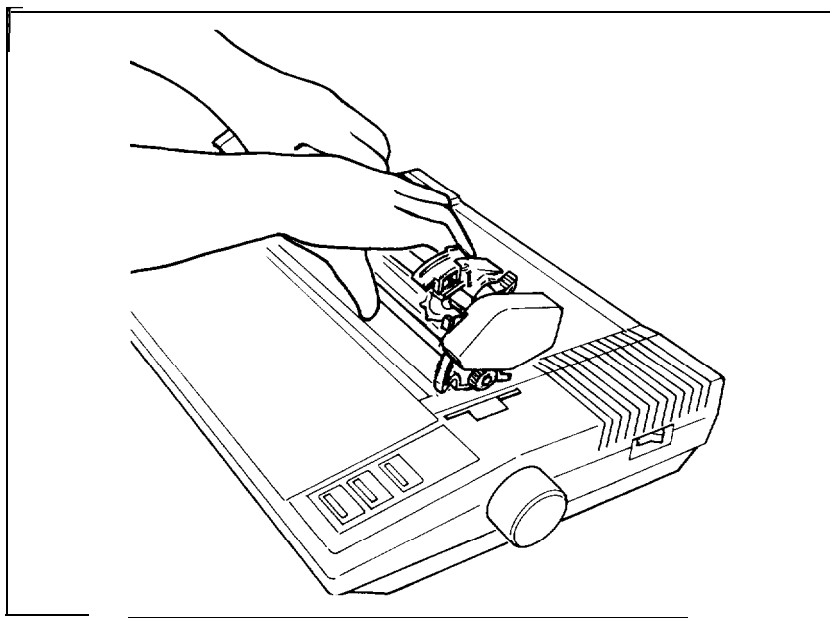
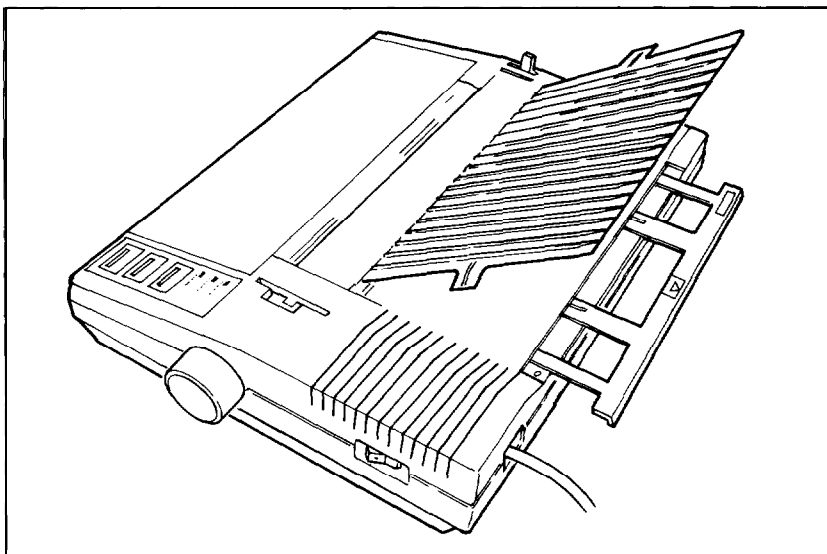


Figure E-3. Tractor placement

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-80, 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.

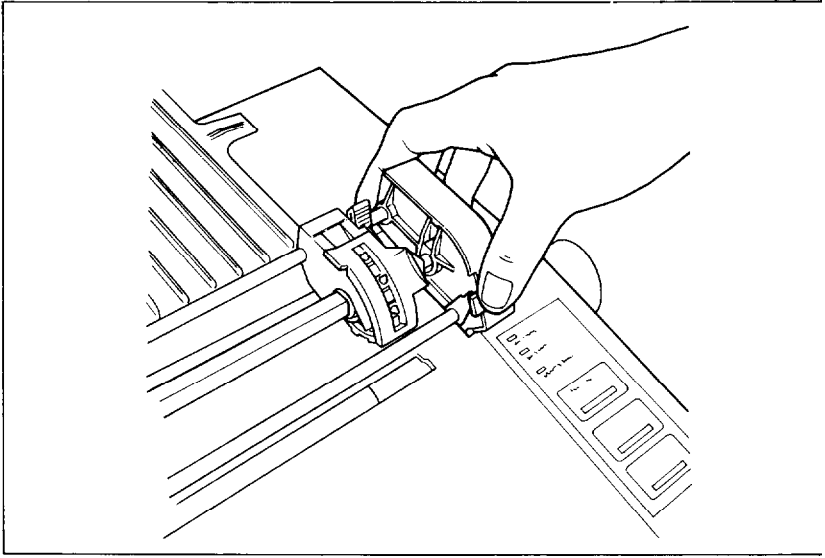


Figure E-5. Tractor release levers

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.

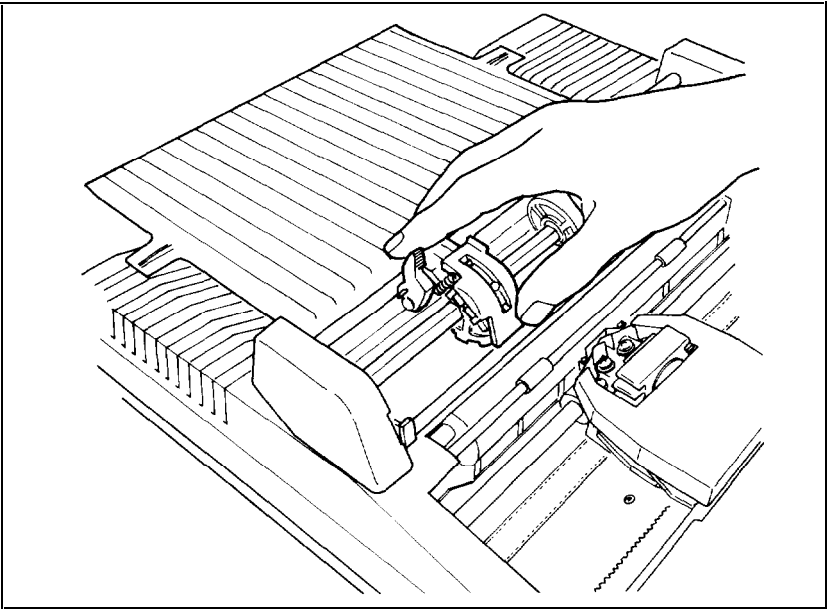


Figure E-6. Pin feed bolder adjustment

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.

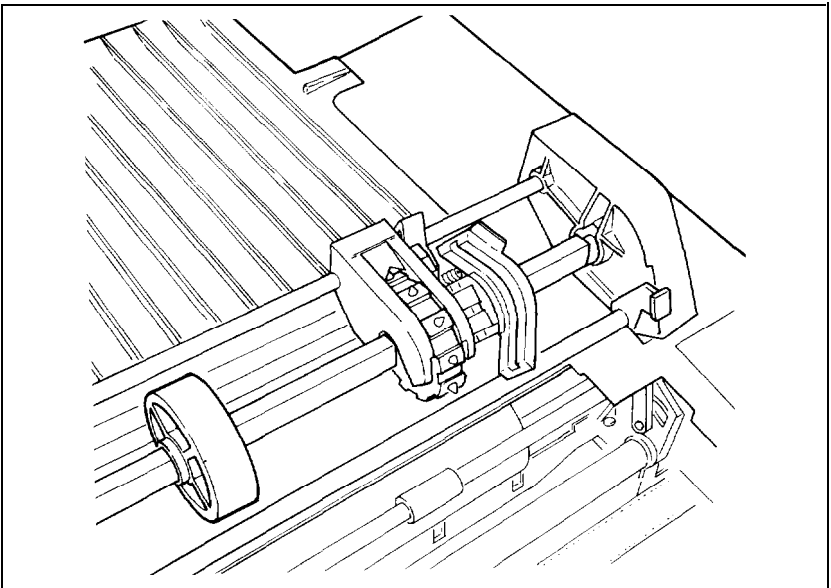


Figure E-7. Open pin feed cover

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.

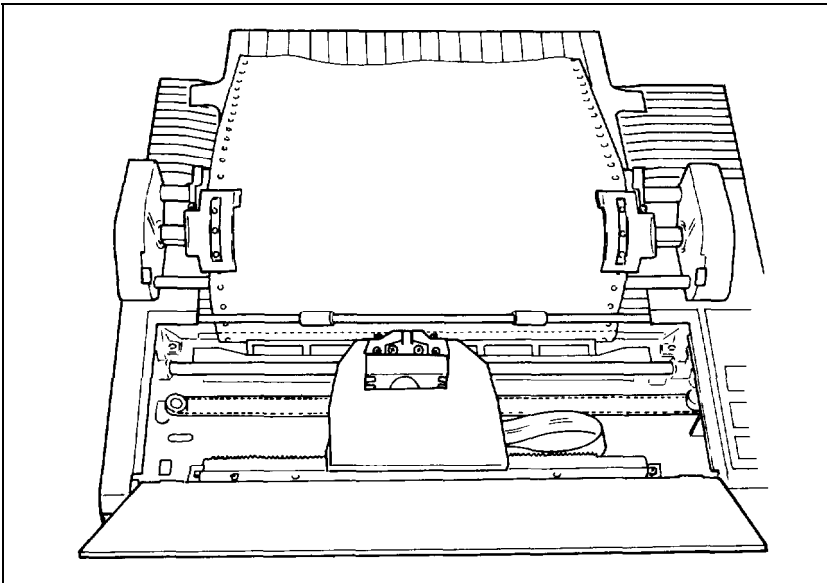


Figure E-8. *Top of page position*

When you turn on your LX-80, 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 pages 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

Solution

Setting print styles

Can't get compressed print.

Cancel emphasized; it has priority over compressed.

Tabbing

Horizontal tabs don't work.

Set margins before tabs, not after.

Horizontal tabs are incorrect when changing pitch.

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

Graphics

Strange things print.

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 (128). If you have a seven-bit computer and any of your graphics data numbers are larger than 127, change the numbers.

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

Seven-bit computers are limited to widths of 0-127, 256-383, 512-639, etc. See seven-bit graphics subsection.

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-80 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 tape a business card over the switch. Be sure to remove the card if you use a cut-sheet feeder, however.

SelecType Solutions

If you have found that your software sends a resetting code and wipes out your SelecType settings, one of the following methods should help you find a way around the problem.

Method 1

Use the installation program for your software to remove the initialization code. See your software manual for details.

Method 2

Without using SelecType, give your program the command to print your document. Then, before the printing actually starts, give the command to stop printing. Now use SelecType to select compressed mode using the following steps:

- 1) Be sure that both the ON LINE and READY lights are on.
- 2) Press the ON LINE and FF buttons at the same time.
- 3) Press the ON LINE button four times (the code for compressed).
- 4) Press the FF button to set compressed.
- 5) Press the LF button to exit SelecType.
- 6) Press the ON LINE button.

Now give your printer the command to resume printing. If your example is now in compressed, you can use this same sequence each time you want to use SelecType. The procedure is not complicated; once you practice it a few times, it gives you fingertip control of your printing.

Method 3

Another method that may work with your software is to give the print command with the printer turned OFF. If at this point your screen gives you a message that your printer is off-line and tells you to press a certain key to re-try the printing after the printer is on, you may be able to turn on the printer and use SelecType before you press the key to signal that you want to re-try printing. Try turning on the printer and using SelecType as outlined above. Once you have selected your print function and put the printer back on-line by pressing the ON LINE button once, give your computer system the signal to resume printing.

Method 4

This is a variation of Method 3. Try giving the print command for your program and then pressing the ON LINE button to take the LX-80 off-line before printing actually starts. Then follow the procedure in Method 3.

Other software

For some software you may have to consult its manuals or your dealer to find out at what point the printer is reset. You will probably find some stage in the printing process after the resetting where you can use SelecType.

Some of these tests may seem to take too much time and trouble, but you need to do them only once. Then you will know exactly what you need to do each time you use SelecType. After you have done the procedure two or three times, it will become quick and easy.

Cancelling Functions with SelecType

If you want to cancel the modes you have set with SelecType, you can turn your printer off and back on with the power switch on the right side of the printer. This cancels all SelecType settings, returns your LX-80 to its defaults, resets the top of page, and empties the contents of the buffer, any including user-defined characters that you may have put there.

Occasionally you may wish to cancel one or more modes with SelecType instead of resetting the printer with power switch. To cancel all modes controlled by SelecType, simply enter SelecType mode and then press the FF button without pressing the ON LINE button. (This is the zero code from Table 2-1.) This is useful when you make a mistake while setting codes and want to start over again, and it does not interfere with top of page, user-defined characters, or other items that are not controlled by SelecType.

If you do make a mistake while using SelecType, just press the LF button to turn off SelecType and then turn it on again and press the FF button before you press the ON LINE button.

In fact, some users like to use the FF button to cancel any previous SelecType setting each time they use SelecType. If you want to be absolutely certain that no previous settings interfere with your use of SelecType, always press the FF button once immediately after you enter SelecType mode. For this procedure, after you press the ON LINE and FF buttons to turn on SelecType, press the FF button once, and then make and set your selection or selections as outlined at the beginning of this chapter.

You can also cancel individual modes with SelecType if you wish. You do this with the same procedure that sets them. When a mode is already set, selecting it again cancels it, as demonstrated in the example below.

Suppose that you have set emphasized and NLQ modes and then you decide that you don't want emphasized. You can either cancel all the modes and reset NLQ, or you can use the following steps to cancel emphasized and leave NLQ.

- 1) See that the ON LINE and READY lights are on. (Be sure that you do not touch the power switch and cancel all the modes.)
- 2) Press the ON LINE and FF buttons to enter SelecType.
- 3) Press the ON LINE button twice. (This is the code for emphasized.) Notice that the ON LINE light is blinking and that it is on more than it is off. This tells you that the emphasized mode is set.
- 4) Press the FF button once. Now the ON LINE light is still blinking, but it is off more than it is on. This tells you that the emphasized mode is not set.
- 5) Press the LF button once to leave SelecType mode.

6) Press the ON LINE button to put the printer on-line.

Now you have cancelled emphasized without affecting any other modes.

Some users think that this procedure is too complicated and prefer to cancel all the SelecType settings and then reset the ones they want. Use whichever method you prefer. If you want to cancel modes individually, remember to watch the ON LINE light. It blinks mainly on when a mode is set and mainly off when it is not.

Beeper Error Warnings

When the LX-80'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-80 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 FF and LF 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-80 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 LX-SO 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.K.L.
0001 73 5C 5D 70 5C 65 20 70 65 73 74 0D 0A 1B 40 0D  Sample text...@
0002 00
```

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 LX-80 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-80 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 print-out of the test program run on a QX-10, you can see that in this case MBASIC 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).

```
00000 00 01 02 03 04 05 06 07 08 20 20 20 20 20 20 20  . . . . .
```

The data dumping capability can help you debug a program 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-80, 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. We'll give the procedure for a couple of systems here; if your system is neither of them, use the procedure as a model. 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.

We show a sample printer driver below (following the examples of POKEing codes). The idea is to pass the codes issued by a BASIC program directly to the printer.

POKEing codes

The TRS-80™ Model I version of the CHR\$ function does not correctly pass on the values of 0, 10, 11, and 12. Zero is a particular problem as it is very important to the ESCape codes of the LX-80 printer.

These codes can be sent directly to the printer by POKEing them to a special memory location where they are immediately forwarded to the printer. The format is:

POKE 14312, N

where N is the decimal value of the code you wish to send to the printer. This works fine as long as the printer is ready to receive the data when you are ready to send it. On the Model I, the printer's readiness is assured if location 14312 contains a decimal 63.

It is best to first test to see if the printer is ready with:

```
100 IF PEEK( 14312.) <> 63 THEN 100
```

This puts the program into a continuous loop until the printer is ready to receive data. If data is sent while the printer is "out to lunch," it will be lost.

To show how similar these commands can be from system to system, here is the same concept implemented on the Apple® II Plus:

```
100 IF PEEK(49601) > 127 THEN 100  
200 POKE 49296, N
```

The printer's status is stored in location 49601 and the outgoing values are sent to 49296.

Special printer drivers

An even better (but more difficult) way to overcome these problems is to modify the printer driver so that the codes are passed correctly to the printer without any **PEEKs** or **POKEs**. If you do not want to write such a driver yourself, your computer dealer may be able to help you. Or you may find aid in the pages of a trade journal.

The following printer driver, for instance, was written for the TRS-80 Model I by Bob Boothe and reprinted with the kind permission of 80 Micro (Wayne Green Publishers). The program **POKEs** a machine-language printer driver program (stored in line 10) into memory, then tells the system where its new driver is located. Once you **RUN** the program, all codes sent by any BASIC program are sent directly to the printer-including 0s, 10s, and 12s.

```
10 DATA 21E837CB7E20FC211100397E32E837C9
20 READ B$: A=16571
30 FOR P=1 TO LEN(B$) STEP 2
40 B=ASC(MID$(B$, P, 1)) - 48
50 IF B>9 THEN B=B - 7
60 T=ASC(MID$(B$, P + 1, 1)) - 48
70 IF T>9 THEN T=T - 7
80 POKE A, B*16 + T
90 A=A + 1
100 NEXT P
110 POKE 16422, 187
120 POKE 16423, 64
```

This driver will also work on the TRS-80 Model III-with one change in line 10: change 32E837 to D3FB. That's all there is to it.

Solutions for Seven-Bit Systems

The BASIC language on some computers can only send seven bits to the printer at one time, even though the machine language may be able to send eight. (The Apple II Plus is a case in point). On such computers, the **CHR\$** function cannot send the entire range of ASCII codes (0-255) to the printer; it can send only the lower half (0-127).

To find out whether your system is an 8-bit system, capable of generating all 256 ASCII codes, enter this simple test:

```
10 FOR X=160 TO 254
20 LPRINT CHR$( X );
30 NEXT X
```

If you get italic characters when you RUN this, you are using an 8-bit system.

If you have a 7-bit system, you need to understand what happens to the control codes you send. The LX-80 automatically interprets these codes the way your system sends them-as the lower half of the range. There is something you can do when you want to send the upper half (128-255): have your program convert all codes outside of the active range to their equivalent in the upper half by adding 128 to them.

The problems that are associated with 7-bit systems include:

- Limitations on width in graphics mode
- Inability to use the top pin for graphics mode

User-defined characters can't be printed with the top eight pins (the standard position for most characters). Eight pins can't be used in defining characters.

Remember that the best solution usually is to use an interface that can send eight bits to the printer.

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-80, 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.

You can POKE codes to memory as discussed above, you can write your own printer driver, or you can avoid the types of programs that require eight bits. A routine to POKE codes to the memory of an Apple II Plus is given in the POKEing codes subsection.

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-80 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)
```

TRS-80™ solutions

A routine to POKE codes to the memory of a Model I is given in the POKEing codes subsection. A special printer driver for either the Model I or the Model III is shown in the Special printer drivers subsection. One of those methods should solve any problems with the programs in this manual.

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
```

The 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, "Now 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 # 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 (DOS 1.05); 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.

QX-10™ solutions

There are two types of computer-printer interface problems that you owners of Epson QX-10s may need to address. The first is making a width statement when a line is to be more than 80 characters wide. The second is changing any occurrence of the number nine to some other number.

Any time you want to print more than 80 characters (or more than 130 dot columns in graphics) on one line, you need to reserve the extra room by putting the WIDTH statement:

WIDTH LPRINT 255

in one of the first lines of the program.

The only problem code for the QX-10 is 9. One way to get around this is to use the ASCII high-order equivalent (137) whenever you would normally use 9.

Sometimes it may be easier to use another low-order value. For example:

```
FOR X=1 TO 10 : IF X=9 THEN X=10 : NEXT X
```

When DATA numbers include 9, you can change each 9 to 8 or 11. The best number to substitute for 9 in pin patterns is usually 11.

Appendix G

Printer Maintenance

Always

Always keep your printer in a safe and clean location. Keep it away from :

Dust and grease

Heaters and furnaces. Safe temperature range is 41°F (5°C) to 95°F (35°C)

Now and Then

Clean particles and dust from the printer every so often with a soft cloth or brush. Use a mild cleanser for the outside framework and, after removing the ribbon cassette, denatured alcohol for the inside.

See your Epson dealer for replacement ribbon cassettes.

Rarely

Once in a great while your printer should be lubricated. Epson recommends two lubricants: O-2 (Epson Part No. B710200001) and G-2 (Epson Part No. B70020001). Every 6 months or one million lines, use O-2 lubricant on the shafts and platen bearings, wiping off excess with cloth. Use G-2 sparingly on ribbon feed, line feed, and carriage return drive gears every five million lines.

Note: Using too much lubricant can cause problems with your printer. Apply the lubricant sparingly.

Appendix H

Technical Specifications

Printing

Printing method	Impact dot matrix
Printing speed	100 characters per second per line in
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 set	96 Roman characters 96 italic characters 32 international characters 32 italic international characters 32 graphic characters 96 NLQ characters 32 NLQ international characters

Character size

Mode	Width inches	Height inches
Pica	.083 in	.122 in
Pica expanded	.166 in	.122 in
Elite	.059 in	.122 in
Elite expanded	.118 in	.122 in
Compressed	.041 in	.122 in
Compressed expanded	.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 expanded	40
Elite	96
Elite expanded	48
Compressed	132*
Compressed expanded	66*
Compressed 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 $\pm$ 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	No trouble when 1 kilovolt (R.M.S.) 50 or 60 Hz is applied for more than 1 minute between AC power line and chassis

Interface

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

Appendix I

The Parallel Interface

The LX-80 printer uses a parallel interface to communicate with the computer; this appendix describes it.

Connector pin assignments and a description of respective interface signals are shown in Table I-1.

Table I-1. Pins and signals

Signal Pin	Return Pin	Signal	Direction	Description
1	19	STROBE	IN	STROBE pulse to read data in. Pulse width must be more than 0.5 microseconds at the receiving terminal.
2	20	DATA1	IN	These signal represent information of the 1st to 8th bits of parallel data, respectively. Each signal is at HIGH level when data is logical 1 and LOW when it is logical 0.
3	21	DATA2	IN	
4	22	DATA3	IN	
5	23	DATA4	IN	
6	24	DATA5	IN	
7	25	DATA6	IN	
8	26	DATA7	IN	
9	27	DATA8	IN	
10	28	ACKNLG	OUT	Approximately 12-microsecond pulse LOW indicates that data has been received and that the printer is ready to accept more data.
11	29	BUSY	OUT	A HIGH signal indicates that the printer cannot receive data. The signal goes HIGH in the following cases: 1) During data entry. 2) During printing. 3) When off-line. 4) During printer-error state.
12	30	PE	OUT	A HIGH signal indicates that the printer is out of paper.

Table I-1, continued

Signal Pin	Return Pin	Signal	Direction	Description
13	—	—	—	Pulled up to +5 volts through 3.3K ohm resistance.
14	—	AUTO FEED XT	IN	When this signal is LOW, the paper is automatically fed 1 line after printing. (The signal level can be fixed to this by setting DIP switch 2-3 to ON.)
15	—	NC	—	Unused.
16	—	0V	—	Logic ground level.
17	—	CHASSIS GND	—	Printer's chassis ground, which is isolated from the logic ground.
18	—	NC	—	Unused.
19-30	—	GND	—	Twisted-pair return signal ground level.
31	—	INIT	IN	When this level becomes LOW, the printer controller is reset to its power-up state and the print buffer is cleared. This level is usually HIGH; its pulse width must be more than 50 microseconds at the receiving terminal.
32	—	ERROR	OUT	This level becomes LOW when the printer is in: 1) Paper-end state. 2) Off-line. 3) Error state.
33	—	GND	—	Same as for pins 19-30.
34	—	NC	—	Unused.
35	—	—	—	Pulled up to +5V through 3.3K ohm resistance.
36	—	SLCT IN	IN	Data entry to the printer is possible only when this level is LOW; DIP switch 2-2 is set for this at the factory.

Notes:

1. The column heading "Direction" refers to the direction of signal flow as viewed from the printer.
2. "Return" denotes the twisted-pair return, to be connected at signal ground level. For the interface wiring, be sure to use a twisted-pair cable for each signal and to complete the connection on the return side. To prevent noise, these cables should be shielded and connected to the chassis of the host computer or the printer.
3. All interface conditions are based on TTL level. Both the rise and the fall times of each signal must be less than 0.2 microsecond.

4. Data transfer must be carried out by observing the ACKNLG or **BUSY** signal. (Data transfer to this printer can be carried out only after receipt of the ACKNLG signal or when the level of the **BUSY** signal is LOW.)
5. Under normal conditions, printer cable pins 11, 12, and 32 are activated when the paper-end condition is detected. The ESCape "8" code disables pins 11 and 32, but not pin 12. Those computers that monitor pin 12 halt printing when the paper is out, making ESCape "8" ineffective.

Data Transfer Sequence

Interface timing

Figure I-1 shows the timing for the parallel interface.

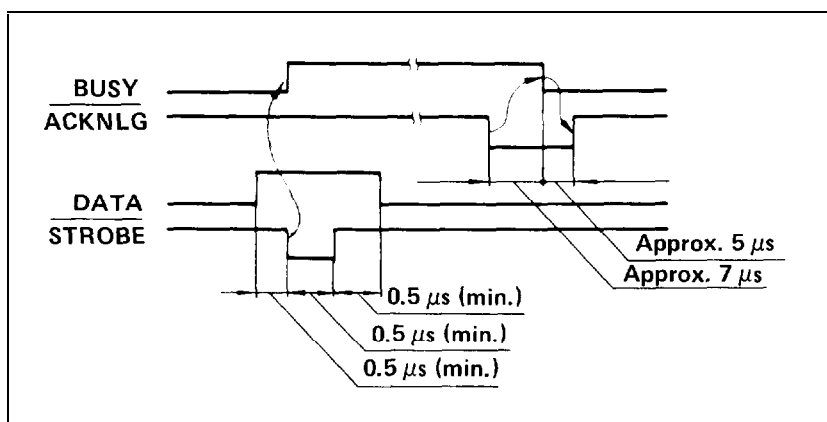


Figure I-1. Parallel interface timing

Signal relationships

Table I-2 shows the way data entry is handled in the on-line and off-line states by showing the relationships between seven signal sets.

Table I-2. Signal interrelations

On-Line	SLCT IN	ERROR	BUSY	ACKNLG	DATA ENTRY
OFF	HIGH/LOW	LOW	HIGH	Not generated	Disabled
ON	HIGH	HIGH	LOW/HIGH	Generated after data entry	Enabled
ON	LOW	HIGH	Same	Same	Enabled (normal entry)

*When SLCT IN is at high level, data entry is enabled, but the input data will be disregarded until SLCT IN is at low level.

Note: ERROR status is assumed to rest only in off-line state, and the ERROR status does not always mean SLCT IN.

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Quick Reference

Spectrum LX-80® Printer

Near Letter Quality Mode

ESC “x” 1	Turns NLQ mode ON.
ESC “x” 0	Turns draft mode ON.
ESC “a”	Activates NLQ justification modes.

Character Width (Pitch)

ASCII 15	Turns compressed mode ON.
ASCII 18	Turns compressed mode OFF.
ASCII 14	Turns one-line expanded mode ON.
ASCII 20	Turns one-line expanded mode OFF.
ESC “M”	Turns elite mode ON.
ESC “I”	Turns elite mode OFF.
ESC “W0”	Turns either expanded mode OFF.
ESC “W1”	Turns continuous expanded mode ON.

Character Weight

ESC “E”	Turns emphasized mode ON.
ESC “F”	Turns emphasized mode OFF.
ESC “G”	Turns double-strike mode ON.
ESC “H”	Turns double-strike mode OFF.

Print Enhancement

ESC “S0”	Turns superscript mode ON.
ESC “S1”	Turns subscript mode ON.
ESC “T”	Turns either script mode OFF.
ESC -0”	Turns underline mode OFF.
ESC “-1”	Turns underline mode ON.

Mode and Character-Set Selection

ESC !	Master select.
ESC “4”	Turns italic mode ON.
ESC “5”	Turns italic mode OFF.
ESC “@”	Reset code.
ESC “R”	Selects an international character set.
ESC “m”	Selects and cancels special graphics characters.

Special Printer Features

ASCII 8	Backspaces.
ESC 25	Enables and disables the optional cut-sheet feeder.
ESC "<"	Turns one-line unidirectional mode ON.
ESC "U0"	Turns continuous unidirectional mode OFF.
ESC "U1"	Turns continuous unidirectional mode ON.
ESC "s0"	Returns to normal speed.
ESC "s1"	Turns half-speed mode ON.

Line Spacing

ESC "0"	Sets line spacing to 1/8-inch.
ESC "1"	Sets line spacing to 7/72-inch.
ESC "2"	Sets line spacing to 1/6-inch (default).
ESC "A" n	Sets line spacing to n/72-inch.
ESC "3" n	Sets line spacing to n/216-inch.
ESC "J" n	Produces an immediate one-time line feed of n/216-inch without a carriage return.

Forms Control

ESC "8"	Turns the paper-out sensor OFF.
ESC "9"	Turns the paper-out sensor ON.
ESC "C" 0	Sets the form length in inches.
ESC "C"	Sets the form length in lines.
ESC "N"	Turns variable skip-over-perforation ON.
ESC "O"	Turns skip-over-perforation OFF.

Page Format

ASCII 9 or 137	Activates a horizontal tab.
ASCII 11	Activates a vertical tab.
ESC "D"	Sets horizontal tab stops.
ESC "Q"	Sets the right margin.
ESC "1"	Sets the left margin.

User-defined Characters

- ESC “&” Defines characters in user RAM.
- ESC “:” Copies the character set from ROM to RAM.
- ESC “%” Activates ROM or RAM character set.

Dot Graphics

- ESC “*” Selects one of seven graphics densities.
- ESC “?” Reassigns a graphics density.
- ESC “K” Turns single-density graphics mode ON.
- ESC “L” Turns double-density graphics mode ON.
- ESC “Y” Turns high-speed double-density graphics mode ON.
- ESC “Z” Turns quadruple-density graphics mode ON.
- ESC “^” Turns nine-pin graphics mode ON.

SelectType Feature

Code	Function	
0	Reset	ABCDEFGHIJKLMNopqrstuvwxyz
1	NLQ	ABCDEFGHIJKLMNopqrstuvwxyz
2	Emphasized	ABCDEFGHIJKLMNopqrstuvwxyz
3	Double-strike	ABCDEFGHIJKLMNopqrstuvwxyz
4	Compressed	ABCDEFGHIJKLMNopqrstuvwxyz
5	Elite	ABCDEFGHIJKLMNopqrstuvwxyz

ASCII Codes

Dec	Hex	CHR	Dec	Hex	CHR	Dec	Hex	CHR	Dec	Hex	CHR
0	00	none	64	40	@	128	80	†	192	C0	ø
1	01	none	65	41	A	129	81	‡	193	C1	á
2	02	none	66	42	B	130	82	£	194	C2	â
	03	none	67	43	C	131	83	†	195	C3	ç
4	04	none	68	44	D	132	84	†	196	C4	ð
5	05	none	69	45	E	133	85	—	197	C5	é
6	06	none	70	46	F	134	86	†	198	C6	ƒ
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	í
10	0A	LF	74	4A	J	138	8A	†	202	CA	j
11	0B	VT	75	4B	ƒ	139	8B	☼	203	CB	ƒ
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	148	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		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	º
35	23	#	99	63	c	163	A3	#	227	E3	»
36	24	\$	100	64	d	164	A4	\$	228	E4	¼
37	25	%	101	65	e	165	A5	%	229	E5	½
38	26	&	102	66	f	166	A6	&	230	E6	¾
39	27		103	67	g	167	A7	'	231	E7	g
40	28	(	104	68	h	168	A8	(	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	»
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	248	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	

Control Keys

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

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