

EPSON[®]

Printer Interface Cartridge

for the IBM[®] PCjr[™]

Operation Manual

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Introduction

The Epson LX-90 printer combines low price with the high quality and advanced capabilities formerly available only on more expensive printers.

The LX-90 User's Manual tells you how to set up your printer. This Printer Interface Cartridge Operation Manual gives you the specific information you need to use the LX-90 with your PCjr computer.

This manual won't waste your time with unnecessary information, but it also won't neglect anything you need to know about the LX-90 and its features.

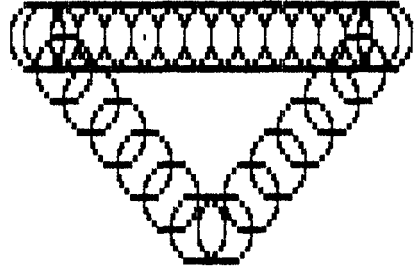
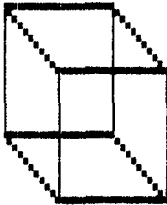
You can read as much or as little of this manual as you wish. The first chapter tells how to test the printer and connect it to your computer. The second chapter explains SelecType, a feature that offers you five special typefaces. The other chapters explain the main features of the LX-90, and the appendixes give technical information on the printer.

Note

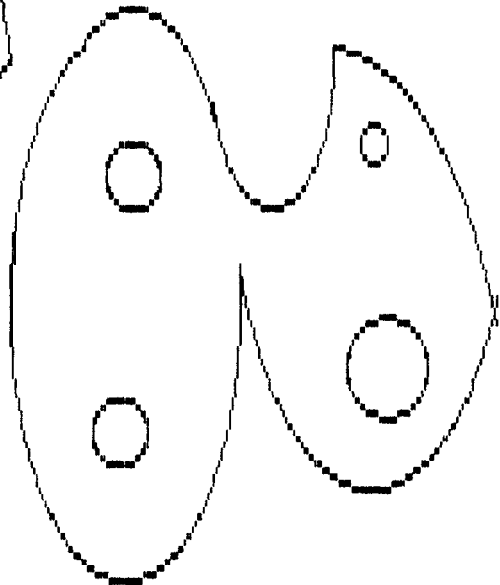
Although all references in this manual are to the Epson LX-90 printer, this PIC can also be used with the Epson HomeWriter™-10.

The samples of typestyles and graphics on the next page are a preview of what your LX-90 can do.

E x p a n d e d e m p h a s i z e d
Typewriter-style Near Letter Quality
Emphasized bold printing
Double-strike bold printing
Compressed narrow printing
Elite printing



TEXT



Chapter 1

Installation and Operation

After you have set up your printer and loaded the paper (following the directions in the LX-90 User's Manual), you are ready to plug in your Printer Interface Cartridge (PIP™) and begin printing.

Inserting the Printer Interface Cartridge

Inserting the PIC is easy. The cartridge slides into the rectangular opening, as shown in the LX-90 manual. Be sure the printer is OFF when you insert the PIC. Once the PIC is installed, you are ready to test your printer.

Printing the Test Patterns

It's time to see the LX-90 in action. You'll start with a test pattern. Don't connect the printer to your computer yet—just follow these steps:

1. Make sure that your printer has paper in it and that the power switch (on the right side of the printer) is off.
2. Press the **LF** button on the control panel, and at the same time, turn the printer on with the power switch.

The LX-90 begins printing letters, numbers, and symbols in the draft mode. It won't stop until you turn it off or until it gets near the end of the paper.

To see the same test in the NLQ (Near Letter Quality) mode, turn the printer on while pressing the FF button. Figure 1-1 shows what both test patterns look like.


```

Draft
/0123456789::<=>? @ABCDEFGHIJKLMN OPQRSTUVWXYZ
0123456789::;<=>? @ABCDEFGHIJKLMN OPQRSTUVWXYZ
123456789::;<=>? @ABCDEFGHIJKLMN OPQRSTUVWXYZ[
23456789::;<=>? @ABCDEFGHIJKLMN OPQRSTUVWXYZ[\
.3456789::;<=>? @ABCDEFGHIJKLMN OPQRSTUUVWXYZ[\]
456789::;<=>? @ABCDEFGHIJKLMN OPQRSTUVWXYZ[\]'

NLQ
3456789:;<=>?@ABCDEFGHIJKLMN OPQRSTUVWXYZ[\]
456789:;<=>?@ABCDEFGHIJKLMN OPQRSTUVWXYZ[\]^
56789:;<=>?@ABCDEFGHIJKLMN OPQRSTUVWXYZ[\]^ -
6789:;<=>?@ABCDEFGHIJKLMN OPQRSTUVWXYZ[\]^ - '
789:;<=>?@ABCDEFGHIJKLMN OPQRSTUVWXYZ[\I^ - 'a
89:;<=>?@ABCDEFGHIJKLMN OPQRSTUVWXYZ[\l ^ - 'ab

```

Figure I-1. Test patterns

Connecting the Printer to Your PCjr

Before connecting the LX-90, be sure that all your computer equipment is turned off.

Plug the PIC cable into the socket marked S in the back of your PCjr. Now the printer can communicate with your computer.

Control Panel

After connecting your LX-90 to your computer system, turn on the printer and look at the control panel on the top.

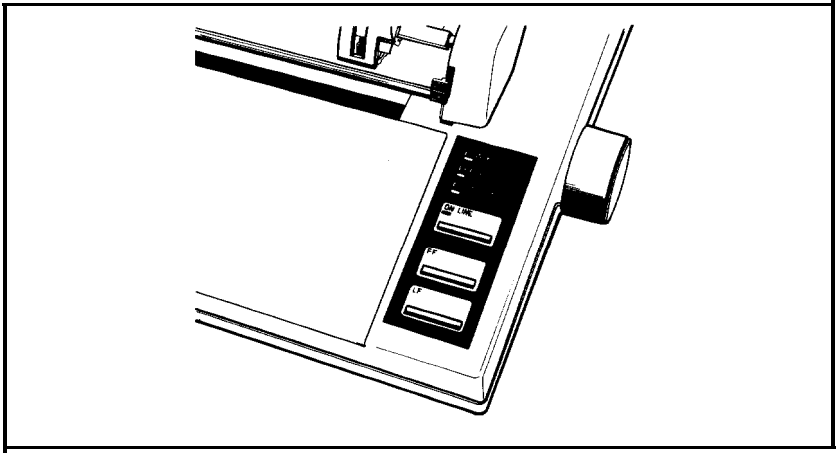


Figure 1-2. Control panel

You have already used the control panel for a special purpose, printing the test patterns. Here are the main functions of the lights and buttons on this panel:

- The POWER light glows green when the power is on.
- The READY light glows green when the printer is ready to accept data. Don't worry if this light flickers somewhat during printing; this flickering is normal.
- The PAPER OUT light glows red when the printer is out of paper or the paper is loaded incorrectly.
- The ON LINE light glows green when the printer can receive data. In addition to the lights, the control panel has three buttons.
- **ON LINE-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 other two buttons, **FF** and **LF**, work only when **the** printer is off-line (when the ON LINE light is off). If the ON LINE light is on, press the **ON LINE** button before you use these.

- **FF (Form Feed)**-advances continuous paper to the top of the next page or ejects a single sheet of paper.
- **LF (Line Feed)**-advances the paper one line at a time.

The control panel can also be used to turn on several printing functions using SelecType, a feature which is described in the next chapter.

Using Your Printer

If you have a word processing or other commercial software program, just load the program into your computer, follow the printing instructions, and watch your LX-90 print.

If your software program requires you to specify which printer you are using, see Appendix E for instructions.

If you plan to use your LX-90 for printing program listings, load a program and use the appropriate listing command for the programming language you are using.

For example, if you are using the BASIC that is built into your PCjr computer, type NEW and then enter the following simple program:

```
10 FOR X=1 TO 5
20 PRINT X/3
30 NEXT X
```

Then make sure your printer is turned on and type the following:

```
LLIST
```

Then press **ENTER** and your LX-90 will list the program.

You can now begin using the LX-90 with your software, or you can find out about the special features of the printer in the next chapters. You may be especially interested in SelecType, the feature described in Chapter 2, which you can use with nearly all software.

Chapter 2

SelecType

The LX-90 enables you to use a feature called SelecType to produce five special typesstyles:

Typewriter-style Near Letter Quality,
Emphasized bold printing,
Double-strike bald printing ,
Compressed narrow printing,
or Elite printing.

Choosing typesstyles with SelecType is simple. A few taps on the printer's control panel tell the printer which style you want, and SelecType lets you choose the typesstyle each time you print. For example, you can print the first draft of a letter or report in the standard mode and the final version in the NLQ mode.

SelecType Operation

Using SelecType is simple. You turn on SelecType and select a typesstyle, then turn off SelecType and print.

Turning SelecType On

1. Make sure that the printer is on and that the POWER, READY, and ON LINE lights are all on.
2. Press both the **ON LINE** and **FF** buttons at the same time, as illustrated in Figure 2-1.

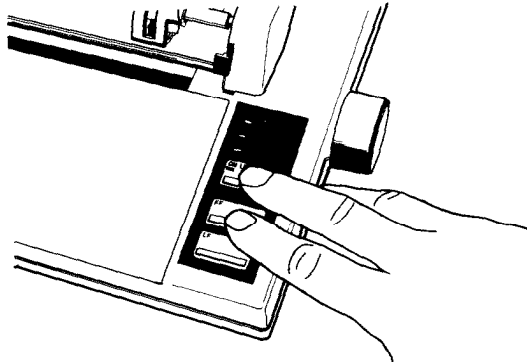


Figure 2-1. Turning SelecType on

When you press the **ON LINE** and **FF** buttons, the LX-90 signals in three ways that SelecType is on.

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

Selecting tpestyles

In SelecType, each button has a function:

- **ON LINE** selects tpestyles.
- **FF** sets the styles.
- **LF** turns SelecType off.

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

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

Table 2-1. SelectType modes

Mode	Typestyle	
1	NLQ	ABCDEFGHIJKLMnopqrstuvwxyz
2	Emphasized	ABCDEFGHIJKLMnopqrstuvwxyz
3	Double-strike	ABCDEFGHIJKLMnopqrstuvwxyz
4	Compressed	ABCDEFGHIJKLMnopqrstuvwxyz
5	Elite	ABCDEFGHIJKLMnopqrstuvwxyz

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

SelectType exercise

You will probably use SelectType mainly with commercial software, but since there are so many different commercial software programs, the sample exercises are in BASIC because it is built into the PCjr.

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

If you do want to use BASIC for this exercise, simply turn on your computer and printer. Then type the short program listed below. Only the words inside the quotation marks are printed. You can put anything you want there.

```
10 LPRINT "This is an example of"
20 LPRINT "LX-90 printing."
```

Now, run the program by typing RUN and pressing **ENTER**, or print your file or document by following the printing instructions of your software. The LX-90 will print your example in standard single-strike printing, as shown below:

This is an example of
LX-90 printing.

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

1. **See that** both the ON LINE and READY lights are on.
2. Press the **ON LINE** and **FF** buttons at the **same** time. You hear a beep to signal that SelecType is on.
3. As shown in Table 2-1, the code for emphasized is two. Therefore, press the **ON LINE** button two times. (Remember to make sure you hear a beep each time you press the **ON LINE** button when you are in SelecType mode.)
4. Now that you have selected the emphasized mode, push the **FF** button once to set it.
5. Push the **LF** button once to return the panel to its standard operation.
6. Press the **ON LINE** button so the LX-90 is ready to print.

Now you have set the LX-90 to print in emphasized mode. Print your sample **once** more. It should appear in emphasized mode just as you see below:

This is an example of
LX-90 printing.

Turn off your printer to cancel the emphasized setting, and-if you wish-try this exercise with other modes. If you are using commercial software and SelecType will not change **the** typestyle, see “SelecType Features” in Appendix E.

Mode combination

Two of the SelecType modes (NLQ and emphasized) can be combined to create an impressive **effect**. If you **want to see** this combination, turn your printer off and back on and follow the instructions below :

1. See that 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 once and then the **FF** button once.

Since one is **the** code for NLQ, you have now set the LX-90 for NLQ.

4. Press the **ON LINE** button one more time and then the **FF** button once again.

This makes a total of two times, and thus sets **the** LX-90 for emphasized also.

5. Press the **LF** button to return the panel to its standard operation.
6. Press the **ON LINE** button to put the LX-90 on-line.

Now print your sample document or run your sample program. 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 and then try the steps again.

You can combine other modes using the same technique, but some modes will not mix with others. Table 2-2 shows which modes can be combined. A dot 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			•	•	

Don't worry about harming your printer if you try to combine two modes that the LX-90 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.

SelecType Tips

After you turn on a mode with SelecType, it usually stays in effect until the printer is turned off. If, for example, you use SelecType to print a document in emphasized, anything you print after that will be emphasized unless you first turn the printer off and back on.

If you like NLQ or compressed well enough to use it most of the time, you can turn it on and keep it on with a special switch in the back of your printer. See Appendix D for instructions.

For more information on the SelecType typestyles, see Chapters 3, 4, and 5.

Chapter 3

Elements of Dot Matrix Printing and Computer/Printer Communications

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, particularly the ones on user-defined characters and graphics.

The Print Head

The LX-90 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 pin and the six below it at the same time, 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.

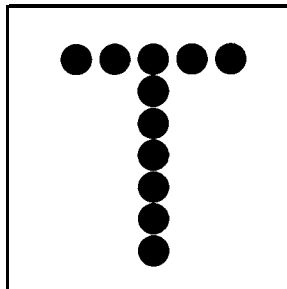


Figure 3-7. A capital T

Changing Pitches

In addition to pica, in which there are 10 characters per inch, the LX-90 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.

Figure 3-2 shows enlargements of four sample letters in each of the three pitches. These letters are chosen to show how the LX-90 prints letters that are uppercase and lowercase, wide and narrow, and with and without descenders (the bottom dots of the j and y).

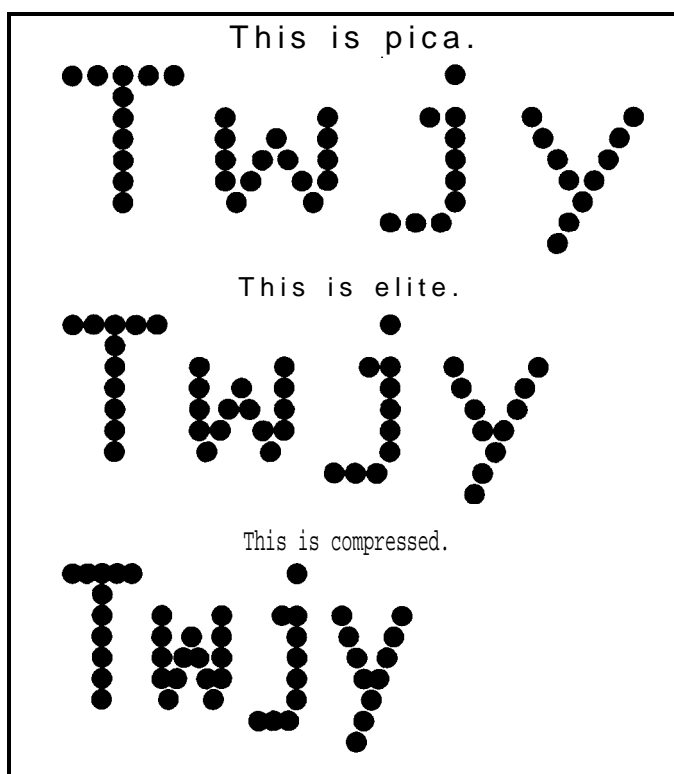


Figure 3-2. The three pitches of the LX-90

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

NLQ Mode

The preceding examples are in the LX-90's draft mode, but the LX-90 also has the high-quality NLQ (Near Letter Quality) mode that you have seen in previous chapters.

The NLQ letters are more fully-formed than the draft letters because they are made up of many more dots as you can see below. Figure 3-3 shows enlargements of two letters in draft mode compared with the same two in the NLQ mode.

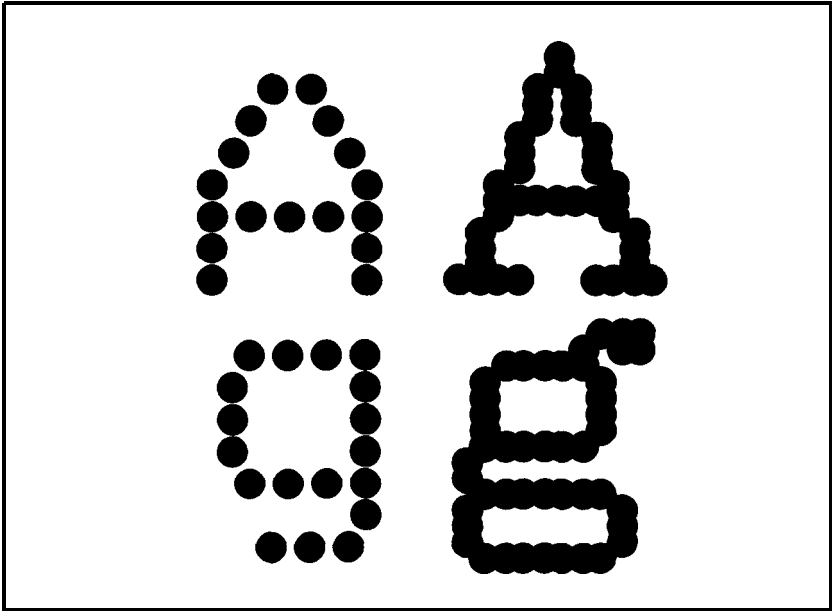


Figure 3-3. Near Letter Quality and draft characters compared

With the two modes, draft and NLQ, the LX-90 lets you choose high speed or high quality each time you print. You can print your ordinary work or preliminary drafts quickly in the draft mode and use the NLQ mode for final copies or special purposes.

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 4 and the operation of the switch (called a DIP switch) in Appendix D.

ESCAPE and ASCII

The details of printer-computer communication are complex, but for most purposes all you need to know is that the computer sends a series of codes (each consisting of one or more numbers) to the printer, and the printer interprets them.

Some codes tell the printer to print a character, and other codes tell it to turn on or off certain printer functions, such as emphasized or Near Letter Quality. Because the codes between 0 and 127 are basically standardized by the American Standard Code for Information Interchange (ASCII) they are referred to as ASCII numbers in this manual.

Nearly all of the codes for printer functions require more than one number and begin with a special code, called the escape code. This code signals that the next number is a code for a printer function and its name is usually printed with the first three letters capitalized (Escape) or it is abbreviated ESC or (ESC) .

In the demonstration programs in this manual, you'll see how ASCII and ESCAPE codes are used in the BASIC programming language.

- LPRINT signals that information is to be sent to the printer.
- The CHR\$(character string) function is used for numerical codes.
- CHR\$(27) is the ESCAPE code.
- Quotation marks are used for printable characters, such as letters of the alphabet.

Your word processing or business program may use other methods to send those codes, such as pressing the **ESC** key for the ESCAPE code. See your software manual for further information and use Appendixes A and B of this manual to find the proper codes. Appendix E also has some suggestions on using LX-90 features with applications software.

Chapter 4

LX-90 Features

The next four chapters describe many of the printing features of the LX-90. You can read these chapters if you wish, but you may not need to. Whether or not you use the rest of this manual depends upon your expertise, your interest, and the software you plan to use.

Demonstration Programs

Along with discussion and examples of the LX-90 features, these chapters include demonstrations in the BASIC programming language **so that** you can see these features in action. Although you will probably not do much of your printing using BASIC, the demonstrations are in BASIC because it is built into your PCjr, so the examples are ones that every one of you can try.

You don't need to know anything about BASIC to type in and run these programs. All the instructions you need are on the next page.

As you run the programs (or even as you read the explanations and look at the printed examples), you learn how the LX-90 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 scientific symbol for one of the planets, 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. In most cases the software that you use for word processing, business, or graphics does the calculating and communicating with the

printer for you and all you have to know about the printer is how to turn it on and how to load paper. If you need help with the installation program for your software, see Appendix E.

How to Run BASIC Programs

If you want to know just enough about BASIC to run the demonstration programs in this manual, here's all you need. For more information, see the manuals for the PCjr.

Even if you don't have a BASIC cartridge, you can still use the version of BASIC that's built into the PCjr's memory. Simply turn on your PCjr with no cartridges or disks in it. When the BASIC copyright notice and the message **Ok** appear on your screen, you can begin entering and running programs.

If you do have a BASIC cartridge, plug in the cartridge, insert a disk containing DOS in the disk drive (if you have one), and turn on the PCjr. Then enter the new date and time as requested by the onscreen messages (or press **ENTER** twice). The screen then displays the prompt **A)**. Type **BASICA** and press **ENTER**. When the BASIC copyright notice and the message **Ok** appear, you can begin entering and running programs. If you want to save programs, replace your DOS disk with a blank formatted disk.

With either type of BASIC, simply type the programs in this manual exactly as you see them. Be sure to include all spaces and punctuation marks, especially semicolons. Press **ENTER** at the end of each line. Since the PCjr uses a 40-column display in the standard mode, it breaks some lines into two parts on the screen, but that does not affect the operation of the program. If you make a typing mistake, retype the whole line; the new line will replace the old one.

When you have typed all the lines, press the **Fn** key and then the **F2** key to run the program.

If you have made changes to a program and want to see all of it on the screen, press **Fn, F1**, and then **ENTER** to list the program. When you are completely through with one program and want to start another, type **NEW** and press **ENTER**.

In Chapter 3 you saw the enlargements of the three LX-90 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. Enter this program:

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

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

```
ABCDEFGHIJKLMN OPQRSTUVWXYZ[\]^-'abcdefghi
```

Changing Pitches

Now you can try other pitches. As explained in Chapter 3, the LX-90 uses the same pattern of dots for pica, elite, and compressed characters, but it changes the horizontal spaces between the dots to produce the three different widths.

In elite mode there are 12 characters per inch, and in compressed there are 17.16. The LX-90 prints in elite when it receives the ESCape "M" command and prints in compressed when it receives the ASCII 15 command. Print a sample line of elite characters by adding the line below to your previous program. (Simply type this line and press **ENTER**; you do not need to retype the other lines.)

```
20 LPRINT CHR$(27)"M";
```

This line uses the command for elite, ESCape "M", to turn on that mode. When you run the program, your printout should look like the one below.

```
ABCDEFGHIJKLMN OPQRSTUVWXYZ[\]^-'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.

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

Cancelling Codes

As you saw in the third version of the print pitch program, you must cancel a code when you don't want it any more. With very few exceptions, the LX-90 modes stay on until they are cancelled. It is important to remember this because an LX-90 mode can stay on even if you change from BASIC to another type of software. For example, if you run the program above and print a memo with a word processing program afterward, the memo is printed in compressed because the printer is still in compressed mode. To cancel compressed, use ASCII 18. In BASIC, you use this format:

```
LPRINT CHR$(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" used above to cancel elite and the ASCII 18 to cancel compressed. 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 or compressed.
- By resetting the printer, a method explained in the **next** section.

Resetting the Printer

Resetting your LX-90 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 the demonstration programs end with a reset code (Escape "@") 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 called 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 to produce the following program:

```
20 LPRINT CHR$(27)"M";
30 LPRINT CHR$(15);
40 FOR X=65 TO 105
50 LPRINT CHR$(X);
60 NEXT X: LPRINT
```

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

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

Near Letter Quality Mode

The examples so far in this chapter are in the draft mode, but you can also use a software command to turn on the NLQ mode, which you turned on with SelecType in Chapter 2.

Enter and run the following program to see how the NLQ mode is turned on by an ESCape sequence:

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

ABCDEFGHIJKLMN~~OP~~QRSTUVWXYZ[\]^_`'abcdefghijklmnopghi

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 4-1.

Table 4-1. Summary **of** LX-90 pitches

Print sample	CPI	Codes	
		On	Off
←1 inch→		ESC "x" 1	ESC "x" 0
Near Letter Quality	10.00		
Pica print	10.00		
Elite print	12.00	ESC "M"	ESC "P"
Compressed print	17.16	1 5	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 or software that sends the proper codes to the printer.

Chapter 5

Print Enhancements and Special Characters

Besides the pitches (pica, elite, and compressed) covered in Chapters 3 and 4, the LX-90 offers many other typestyles.

Bold Modes

Two of the typestyles (emphasized and double-strike) are bolder than standard printing.

Emphasized Mode

In the emphasized mode the LX-90 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. This method produces better-looking, more fully-formed characters **that** are darker than single-strike characters.

To see an example of emphasized, type and run the following program. (See “How to Run BASIC Programs” in Chapter 4 if necessary.)

```
NEW
10 LPRINT "This is standard printing."
20 LPRINT CHR$(27)"E";
30 LPRINT "This is emphasized printing."
100 LPRINT CHR$(27)"@"
```

```
    This is standard printing.
    This is emphasized printing
```

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-90 cannot fire, retract, and again fire the pins quickly enough to print overlapping dots.

You do sacrifice some print speed 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. The code to turn off emphasized is ESCape "F".

Double-Strike

The other bold mode is double-strike. For this mode the LX-90 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 if you run this program, which uses ESCape "G" to turn on double-strike.

```
10 LPRINT "This is standard printing."  
20 LPRINT CHR$(27)"G";  
30 LPRINT "This is double-strike printing."  
100 LPRINT CHR$(27)"@"
```

```
    This is standard printing.  
    This is double-strike printing.
```

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 to turn off double-strike is ESCape "H".

Some users prefer the effect of emphasized, and others prefer double-strike. You can look at the printout below and decide for yourself.

```
    This is standard printing ;  
    this is emphasized printing; and  
    this is double-strike printing.
```

Expanded Mode

Perhaps the most dramatic mode on the LX-90 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 twice as many dots are printed. You can see the difference between pica and expanded pica if you enter and run this program:

```
10 LPRINT "This is standard printing."  
20 LPRINT CHR$(27)"W1";  
30 LPRINT "This is expanded."  
100 LPRINT CHR$(27)"@"
```

```
  T h i s   i s   s t a n d a r d   p r i n t i n g  
  T h i s   i s   e x p a n d e d   .
```

For this mode the letter W and the numeral one together turn the mode on and the letter W 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 the example but it is turned on by ASCII 14 and is turned off by a line feed, ASCII 20, or ESCape "W0".

Mode Combinations

You can also combine modes using control codes. For example, you can make a title especially vivid by combining emphasized and expanded. In fact, you can combine nearly all of the print modes on the LX-90; your LX-90 printer can print such complicated combinations as double-strike emphasized expanded underlined subscript, although you may never want such a combination. The point is, however, that the LX-90 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 emphasized combined with expanded, change two lines in your previous program:

```
20 LPRINT CHR$(27)"W1"CHR$(27)"E";  
30 LPRINT "Emphasized expanded"
```

When you run the program, your printout should match the one below, showing that the two modes combine with no ‘trouble.

```
This is standard printing.  
E m p h a s i z e d   e x p a n d e d .
```

A later section in this chapter explains a special ESCape code, Master Select, which allows you to control seven features with one ESCape sequence.

Underline Mode

The LX-90 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. You can see it in action with the following program:

```
NEW  
10 LPRINT "This text is not underlined."  
20 LPRINT CHR$(27)"-1";  
30 LPRINT "This text is underlined."
```

```
T h i s   i s   n o t   u n d e r l i n e d .  
T h i s   t e x t   i s   u n d e r l i n e d .
```

As shown in the printout above, the underline mode is continuous, but some word processing and other applications programs produce an underline that leaves small gaps in the line as demonstrated in the printout below.

```
T h i s   u s e s   t h e   u n d e r l i n e   c h a r a c t e r .
```

If your software prints this type of underline, it is using the LX-90'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.

Master Select

The LX-90 has a special ESCape code called Master Select **that** allows you to choose any possible combination of seven different modes: pica, elite, compressed, emphasized, double-strike, expanded, 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
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 underlined pica, add **the** following numbers together:

underline	128
expanded	32
pica	0
	160

To print this combination, therefore, you use ESCape "!" followed by the number 160. In the BASIC programming language the command is `CHR$(27)!"CHR$(160)`.

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.

```
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 by using 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.

The printer's 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. Also remember that elite or compressed will cancel pica.

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 underlined 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 seven different modes, a Master Select code will cancel any of those seven that are not selected. For example, suppose that you have a page in elite and want part of it underlined. If you use ESCape "!" 128 to turn on underlining, your LX-90 will begin printing in underlined pica instead of underlined elite because the 128 code does not include elite. Use 129 for underlined elite.

Superscript and Subscript

Your LX-90 can also print superscripts and subscripts, which you can use for mathematical formulas, footnotes, and other items that require numbers or letters above or below the usual print line. ESCape "SO" turns on superscript and ESCape "S1" turns on subscript. ESCape "T" turns off either one. You can see them in action with the program below:

```
10 LPRINT "The formula for water is H";
20 LPRINT CHR$(27)"S1";"2"CHR$(27)"T";
30 LPRINT "0."
40 LPRINT CHR$(27)"@"
```

The formula or water is H₂O .

Now that you see how to use the ESCape sequences for superscript and subscript, you can devise your own examples.

Chapter 6

Page Formatting

Although the LX-90 printer has many sophisticated commands to set margins, line spacing, and horizontal and vertical tabs, this chapter won't take up your time with extensive discussions of these because most are taken care of by applications programs. Instead, this chapter describes a few commands that the average user might need. For more information, see Appendixes B and C, where all the commands are listed and described.

Margins

The LX-90 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-90 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.

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

A program like this also allows 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. If your program resets the printer, use its installation program to remove all codes from the initialization sequence. See Appendix E.

The maximum right margins on the LX-90 printer are 80 in pica, 96 in elite, 132 in compressed, and 160 in compressed elite. For further information on this command see Appendix B.

Skip Over Perforation

If you are using continuous paper for printing program listings or other material not controlled by an applications program, you may find that the LX-90 prints right over the perforations between pages. The LX-90 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-90 to skip at the bottom of a page. For example, in BASIC the following line will make the LX-90 skip 6 lines after each 60 lines if your printer is set for 11-inch paper:

```
10 LPRINT CHR$(27)"N"CHR$(6);
```

Since an 11-inch 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 the section on paper loading in the LX-90 manual 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-90 takes care of this without any special instructions. The line spacing on the LX-90, however, can be changed with an ESCape code.

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. The standard spacing is the same as 12 rows of dots. Since the LX-90 characters use 9 rows of dots, the 12-dot line spacing leaves 3 blank rows between the lines of text.

The standard line spacing 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-90 has several commands to do this. ESCape “0” or ESCape “1” decreases the line spacing to 1/9-inch, and ESCape “2” returns it to 1/6-inch.

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 changes in line spacing can be.

Paper Out Sensor

Under the platen (the black roller) of your LX-90 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 triggers 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-90, you can't print on the last two inches of each page without an adjustment.

If you need to print on the last two inches of single sheet paper, there are two solutions: send the printer an ESCape “8” or change one of the switches described in Appendix D. Then the printer will ignore the paper-out signal. This will allow you to print on the last part of each page, but be careful not to allow the LX-90 to print when there is no paper in it.

Justification with NLQ

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

- 0 Left justify
- 1 Center
- 2 Right justify
- 3 Auto justify

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.

Auto 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 need a WIDTH statement at the beginning of your program. The following line shows the proper format.

```
10 LPRINT WIDTH "LPT1:",255
```

When you are using auto justification use carriage returns at the end of paragraphs only, not at the end of each line of text. Also keep in mind that changing the right margin may make justified text look better. The next paragraph is printed with this feature.

```
Since most word processing programs have  
their own justification commands, use this  
ESCape code only with BASIC or another  
programming language, not with a word  
processingprogram.
```

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

Chapter 7

User-Defined Characters

The LX-90 has several hundred different characters stored in its Read Only Memory. Although this number includes draft, Near Letter Quality, international, and graphics 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-90 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 you can create whatever you need or want.



It may seem that designing a character and telling the LX-90 how to print it would be extremely complicated, but in this chapter the task is reduced 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 Random Access Memory (RAM) 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, you can re-program seldom-used keys to generate the user-defined characters. For example, you will be able to type < to print R.

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-90. In Figure 7-1 are four pica letters with a grid of lines behind them so that you can see how they are designed.

As you look at these characters, notice the three rules that govern their design: the column on the right side is always left blank so that there will be spaces between the characters on a line; a character can use the top row or the bottom row, but no character uses both the top and the bottom row; and a dot can be placed on a vertical line only when the columns next to that line are not used.

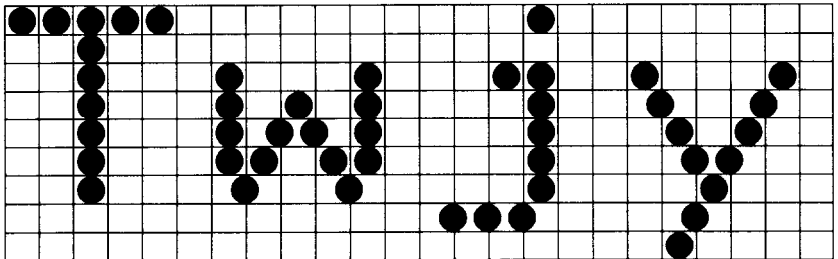


Figure 7-1. LX-90 dot matrix characters

Designing Process

Suppose that you want to print the scientific symbol for the planet Mercury. Although the LX-90 has a number of special symbols, Mercury's symbol 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 7-2 to plan where to place the dots.

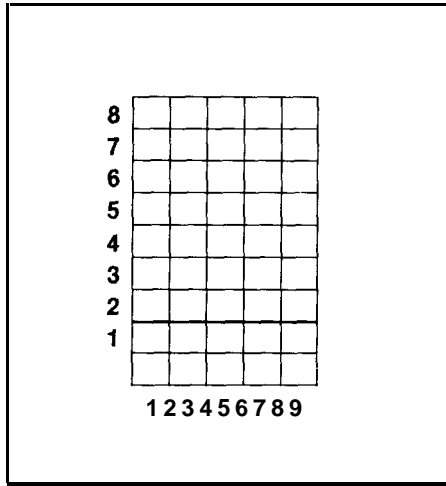


Figure 7-2. Grid for designing draft characters

Because the last two columns are reserved for the space between characters, they are not included in the grid. And since most characters do not use the bottom two rows, a heavy line indicates the usual lower limit for an LX-90 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 7-3. If you draw them smaller, you may have overlapping dots without realizing it.

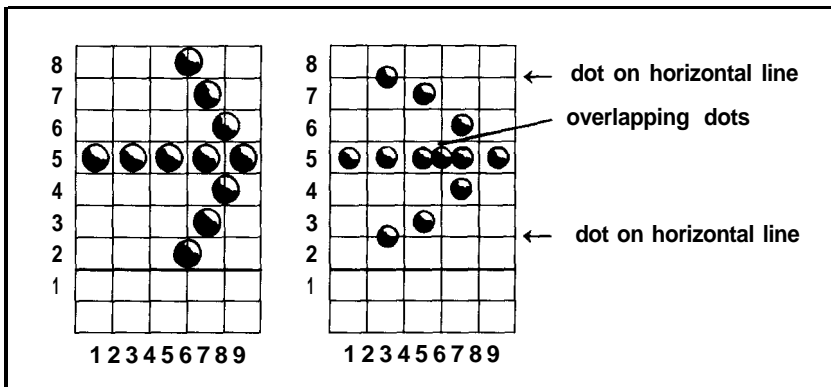


Figure 7-3, Correct and incorrect designs

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.

Definition program 1

The BASIC program below will help you translate your design into a character your LX-90 can print. Type it in now so that you can run it soon.

```
NEW
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)+2A(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 LPRINT: END
```

So that you can see how the program works, the next paragraphs present the steps used to create the symbol for Mercury. First is the grid used to design the character.

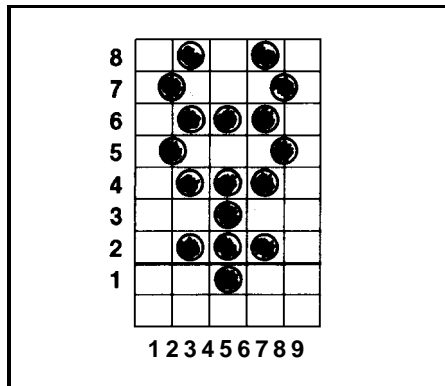


Figure 7-4. Design *for* character

Running the program

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

To see Program 1 produce the character in Figure 7-4 run the program and follow these instructions: When the screen message asks what rows have dots in the column 1, respond with **ENTER** to indicate that no dots go in that column. For column 2 (the vertical line), press 7, **ENTER**, 5, and **ENTER** again to indicate that you want dots in rows 7 and 5. Then press **ENTER** alone to indicate that no more dots go in column 2. For column 3 press 8, 6, 4, and 2, with an **ENTER** after each of them. Then press **ENTER** to finish with column 3 and go on to column 4.

For column 4 press **ENTER** only. (The rest of the directions assume that you **know** to press **ENTER** after each number and one extra time to end the entries for each column.) For column 5, enter 6, 4, 3, 2, and 1. For column 6, press **ENTER** only; for column 7 enter 8, 6, 4, and 2; for column 8 enter 7 and 5; and for column 9 press **ENTER** only.

Now wait a moment for your computer to calculate the dot patterns and your LX-90 to print the new character in two different type-styles. Your printout also gives you nine numbers, which you will use in the next program. You should get the printout you see below:

```
YOUR CHARACTER IN PICA:  $$$
IN EXPANDED EMPHASIZED PICA:  $$$
YOUR DATA NUMBERS:
  0  80  170  0  47  0  170  80  0
```

When you get to this point with a character of your own, you see how it looks and whether or not you like it. If you want to make any changes, move the dots on the grid 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 7-5.

8									
7									
6									
5									
4									
3									
2									
1									
	1	2	3	4	5	6	7	8	9

Figure 7-5. Using the bottom eight rows

Definition program 2

Once the character looks right, type in the next program. The program as listed creates the symbol for Mercury, but you can use it for any characters you create if you make one or two changes explained after the program listing.

```

NEW
90 FOR P=58 TO 63: LPRINT CHR$(P);: NEXT P
95 LPRINT
100 K=1: IF K>3 THEN A=58 ELSE A=60
110 LPRINT CHR$(27) ":"CHR$(0)CHR$(0)CHR$(0);
120 LPRINT CHR$(27) "% "CHR$(1)CHR$(0);
130 LPRINT CHR$(27) "&"CHR$(0)CHR$(A)CHR$(A-1+K);
140 FOR Z=1 TO K
150 LPRINT CHR$(139);
160 FOR X=1 TO 9
170 READ R
180 LPRINT CHR$(R);: NEXT X
190 LPRINT CHR$(0)CHR$(0);
200 NEXT Z
210 DATA 0,80,170,0,47,0,170,80,0
290 FOR P=58 TO 63: LPRINT CHR$(P);: NEXT P
300 LPRINT: END

```

To use program 2 for your own character or characters, change the DATA numbers in line 210 by substituting the numbers generated by program 1. If you have created more than one character, put the DATA numbers for each character on separate lines as you see in the example on the next page.

```
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 DATA 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 program 1 several times and enter all the DATA numbers in program 2.)

Running the program

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

```
## < > ?
## € = > ?
```

When printed by your own program, the two lines provide you with a key to the characters your LX-90 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 press < your LX-90 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 characters 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 program 2 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 program 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 for draft characters.

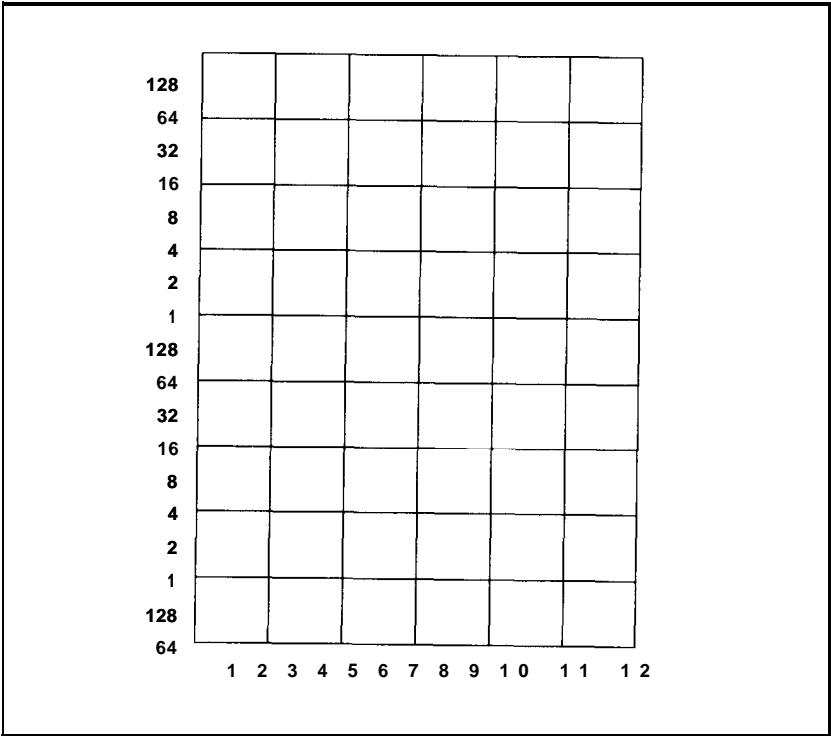


Figure 7-6 . Grid for NLQ characters

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 7-7 shows a single column to make clear how the data numbers are calculated. Notice that using circles instead of dots in designing NLQ characters makes it easier to keep track of overlapping dots.

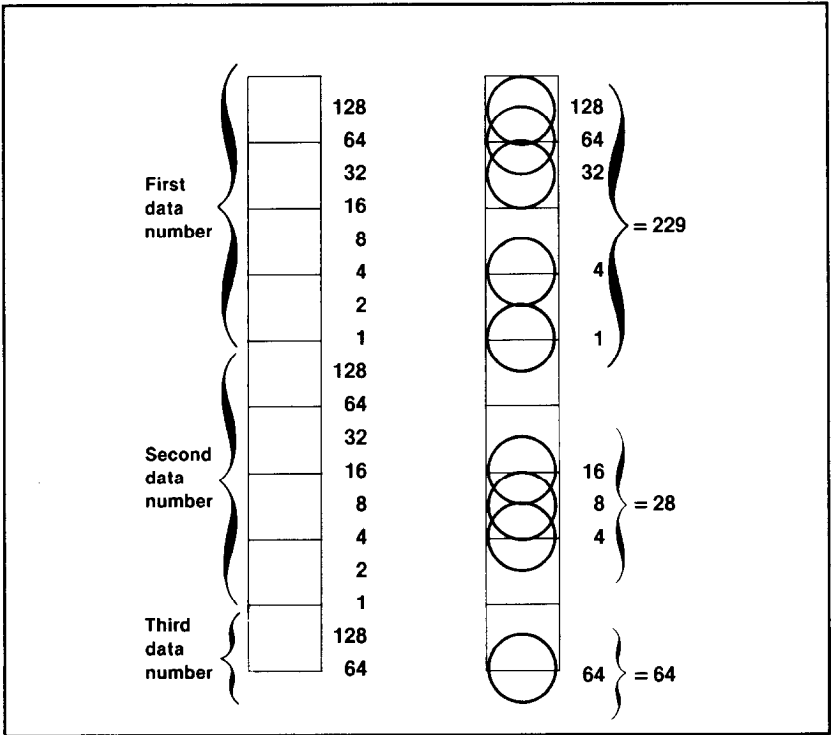


Figure 7-7. Data numbers for one column

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

Figure 7-8 shows you how to use the NLQ character definition with a musical design. The figure shows the design drawn on a grid and the data numbers printed at the top or bottom of each column.

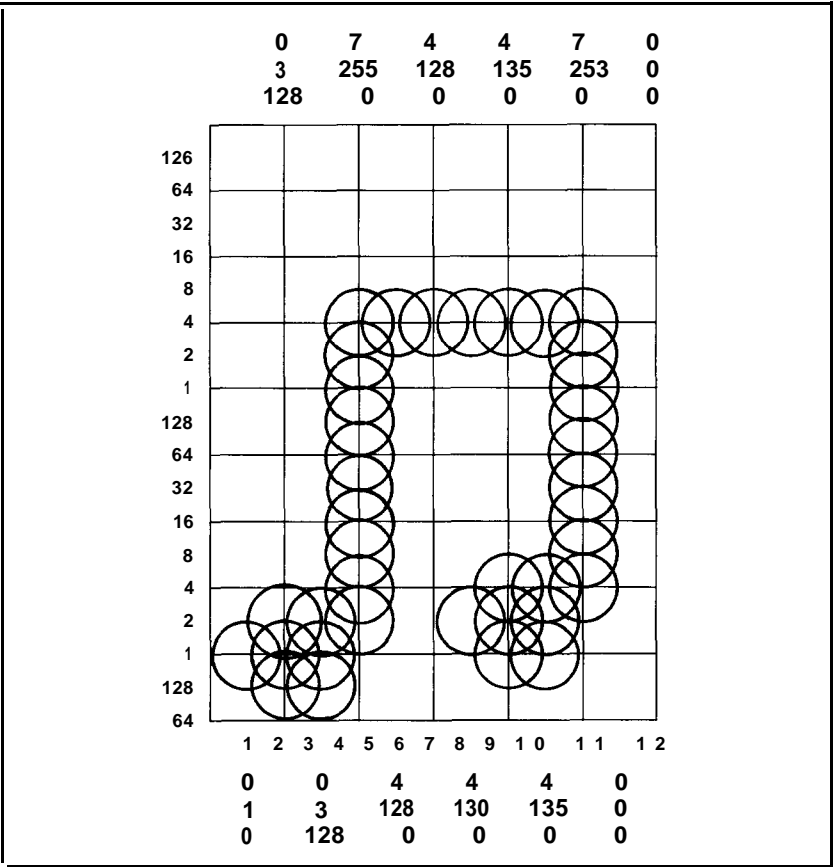


Figure 7-8. Musical design and data numbers

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

NLQ definition program 1

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

```

NEW
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$(~)~((";
50 LPRINT CHR$(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 0, 1, 0, 0, 3, 0, 128, 0, 3, 128, 7, 255, 0
140 DATA 4, 128, 0, 4, 128, 0, 4, 130, 0, 4, 135, 0
150 DATA 4, 135, 0, 7, 253, 0, 0, 0, 0, 0, 0

```

```

YOUR CHARACTER IN PICA: AAA
IN EXPANDED EMPHASIZED PICA: AAA

```

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

NLQ definition program 2

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).


```

NEW
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$(X) " ";: NEXT X
40 LPRINT CHR$(27) ":"CHR$(0)CHR$(0)CHR$(0)
50 LPRINT CHR$(27) "%"CHR$(1)CHR$(0);
60 LPRINT CHR$(27) "&"CHR$(0)CHR$(A)CHR$(A-1+J);
70 FOR Y=1 TO J
80 LPRINT CHR$(0)CHR$(12)CHR$(0);
90 FOR X=1 TO 36: READ C: LPRINT CHR$(C);
100 NEXT X: NEXT Y
110 FOR X=58 TO 63: LPRINT CHR$(X) " ";: NEXT X
120 LPRINT: END
130 DATA 0, 1, 0, 0, 3, 128, 0, 3, 128, 7, 255, 0
140 DATA 4, 128, 0, 4, 128, 0, 4, 130, 0, 4, 135, 0
150 DATA 7, 135, 0, 7, 253, 0, 0, 0, 0, 0, 0, 0

```

```

: ; < = > ?
: ; я = > ?

```

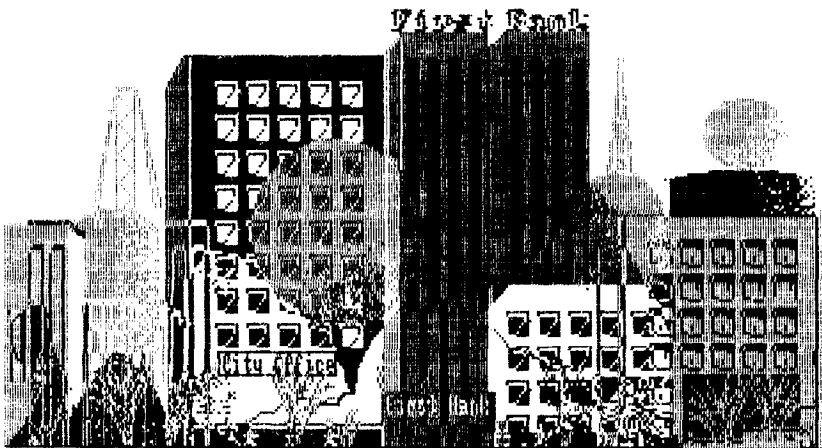
When you run program 2, it prints six characters, then redefines one or more of them and prints them again. As with the draft characters, you use this two-line printout as a guide to the new characters your LX-90 will print. You can use them with an applications program or a program you write yourself.

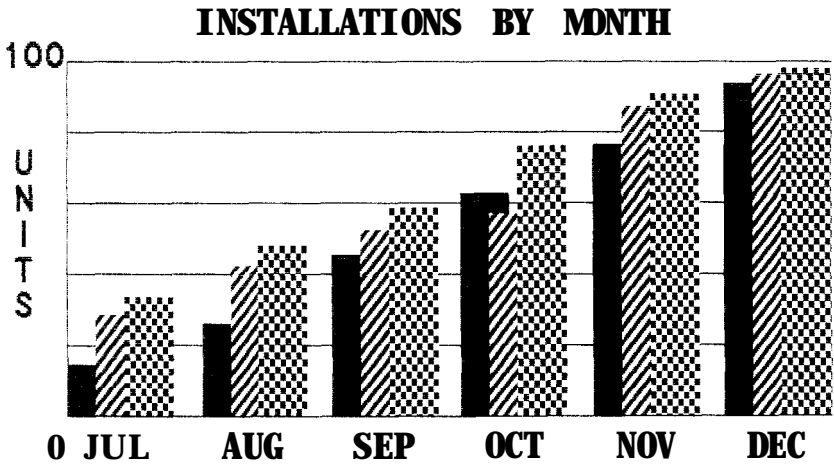
Chapter 8

Introduction to Dot Graphics

The dot graphics mode allows your LX-90 to produce pictures, graphs, charts, or almost any other pictorial material you can devise. Instead of using the standard letters and numbers, 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-90 where to put them.

Because many software programs use dot graphics, you may be able to print pictures and graphs like the ones on this page and the next by simply giving your software a few instructions. A chart like the one on the next page can be created and printed in less than 20 minutes.





The quickest and easiest way to print graphics on your LX-90 is to use a commercial graphics program. With such programs you usually create an image on your monitor or TV screen and then give a command to send the image to the printer.

If you use commercial software that produces graphics, all you need to know about 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-90 prints graphics, read on.

Dot Patterns

Graphic images are formed on the LX-90 about 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-90 also forms its images with patterns of dots, as many as 240 dot positions per inch horizontally and 72 dots per inch vertically. The images you print on the LX-90 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-90 will print almost any picture you can imagine.

The Print Head and Graphics

Chapter 3 told you a little about how the print head on the LX-90 prints letters: it receives a code for a letter and then fires a pattern of pins to form that letter.

In the main graphics mode, however, the LX-90 prints only one column of pins for each code it receives, and it uses only the top eight of the nine pins.

Therefore, your graphics program must send codes for dot patterns, one number for each column in a line. For each of those columns the print head prints the pattern of dots you have specified.

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 changed to eliminate the space between lines. With a change in line spacing, the LX-90 can print finely detailed graphic images that give no indication that they are made up of separate lines, each no more than 8/72nd of an inch tall.

Each pass of the print head prints 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-90 modes, such as emphasized and expanded, 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. After the LX-90 receives this code, it interprets the next numbers as pin patterns and prints them on the paper.

The LX-90 has several different graphics densities, but the first exercises keep things simple by using only one. The code for entering single-density graphics mode is ESCape "K" n1 n2. In 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 (n1 and n2) 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-90 doesn't use decimal numbers larger than 255, the graphics mode command uses two numbers for reserving columns.

To figure the number of columns reserved, multiply the second number by 256 and add it to the first 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 n1 the number of columns you are reserving and make n2 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 8-1.

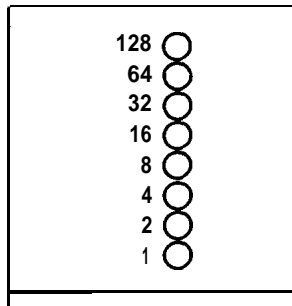


Figure 8-1. Pin labels

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. Figure 8-2 shows three examples of how to calculate the number that will fire a particular pattern of pins.

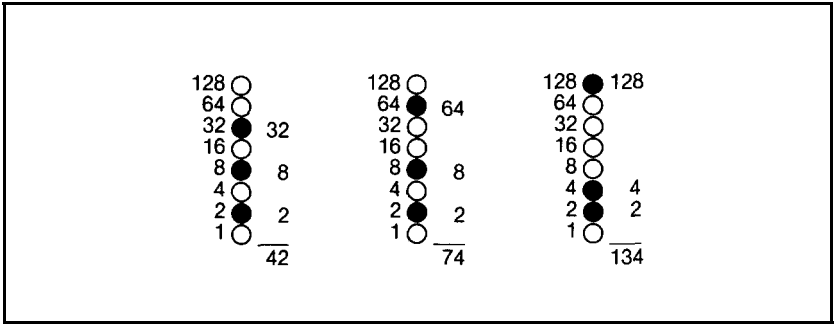


Figure 8-2. Calculating numbers for pin patterns

With this numbering system, any combination of the eight pins adds up to a decimal number between 0 and 255, and no numbers are duplicated.

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

First Graphics Program

Your first graphics exercise could be a program that prints a single column of dots, but it is difficult to see the pattern in 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, the example is in BASIC, but you can adapt it to the programming language you prefer.

```
NEW
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.

WIDTH Statements

Some software (including IBM Personal Computer BASIC) automatically inserts the control codes for a carriage return and a line feed after every 80 - 130 characters. This insertion is usually no problem with text, but it can spoil your graphics. In the graphics mode it may insert the control codes in the middle of a line.

You can usually prevent these unwanted control codes with a WIDTH statement. The format in BASIC is shown below:

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

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 of your programs than to examine each one to see whether or not such a statement is necessary.

Multiple-Line Exercise

Now that you've entered and run a simple graphics program, you can go on to an exercise that shows you how the LX-90 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.

```
NEW
10 WIDTH "LPT1:",255
40 LPRINT CHR$(27)"K"CHR$(100)CHR$(0);
50 FOR X=1 TO 50: LPRINT CHR$(85)CHR$(42);
60 NEXT X: LPRINT
100 LPRINT CHR$(27)"@"
```

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

```
.....
```

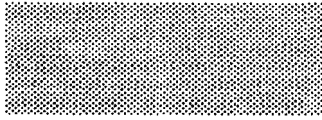
To see how more than one line combines to form a figure, enter and run the following program, which uses the lines you have already typed and adds several more.

```

10 WIDTH "LPT1:",255
20 LPRINT CHR$(27)"A"CHR$(7)
30 FOR R=1 TO 3
40 LPRINT CHR$(27)"K"CHR$(100)CHR$(0);
50 FOR X=1 TO 50: LPRINT CHR$(85)CHR$(42);
60 NEXT X: LPRINT
70 LPRINT CHR$(27)"K"CHR$(100)CHR$(0);
80 FOR X=1 TO 50: LPRINT CHR$(42)CHR$(85);
90 NEXT X: LPRINT: NEXT R
100 LPRINT CHR$(27)"@"

```

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



Because the short and simple program that produced the pattern demonstrates many elements of graphics programming, each line is explained below.

Line 10 changes the line spacing to $7/72$ of an inch, 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 explained previously. Lines 60 and 70 are similar to 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. To print more than one line of graphics, the graphics command must be issued before each line.

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-90 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 "A") in Appendix B. All the eight-pin densities and their commands are described in Table 8-1.

Table 8-1. Graphics modes

Mode	Density	Alternate code	Description
0	Single	ESC "K"	60 dots per inch; 480 dots per 8" line
1	Low-Speed Double	ESC "L"	120 dots per inch; 960 dots per 8" line
2	High-Speed Double	ESC "Y"	Same density as Mode 1, but faster; does not print consecutive dots in a row.
3	Quadruple	ESC "Z"	240 dot positions per inch; 1920 dots per 8" line; does not print consecutive dots in a row.
4	CRT graphics	none	80 dots per inch; 640 dots per 8" line
5	One-to-one (plotter)	none	72 dots per inch; 576 dots per 8" line; produces the same density horizontally as vertically.
6	CRT graphics II	none	90 dots per inch; 720 dots per 8" line

You are familiar with the command format that uses the ESCAPE code and a letter, but LX-90 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 8-1. As usual, n1 and n2 reserve the number of columns for graphics. The seven modes include six densities, with two speeds for double-density.

Reassigning Code

The LX-90 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 BASIC, 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 you've seen the rest of the 8-pin graphics densities and the reassigning code, this section explains in more detail the part of the graphics command that reserves the number of columns for graphics (the numbers n1 and n2 in the examples).

If you need fewer than 255 columns of graphics, n1 is the number of columns you want and n2 is zero. As you can see in Table 8-1, however, a single line will hold as many as 1920 columns in quadruple-density. Specifying more than 255 is where the second number slot (n2) fits in. The first number that you send (n1) indicates a number of columns, but the second does not represent a number of columns; it is multiplied by 256 and added to n1. The command for the maximum number of dots you can reserve on the LX-90, 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 n1, and the INT (integer) function calculates the value for n2. 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.

Designing Your Own Graphics

This section takes 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-90.

You should plan your figure with dots on graph paper, but before beginning to place the dots, you must decide which graphics density you want. Figure 8-3 **shows** the differences between the three most-used graphics modes so that you can choose the one you want.

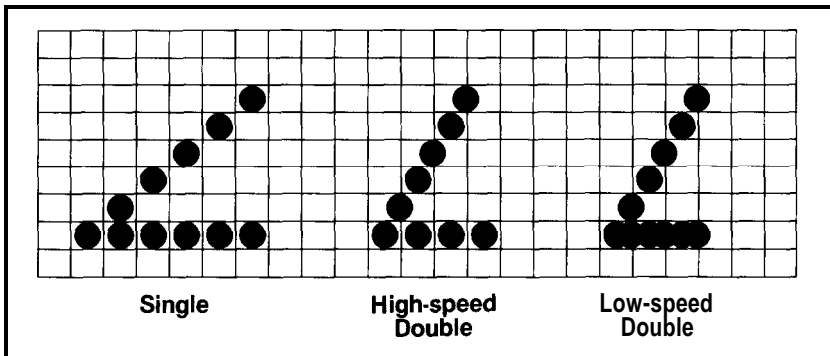


Figure 8-3. Designing in different densities

In this figure you can see the main rules for graphic 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 the figure designed for high-speed double density. It should point you in the right direction for your own designs.

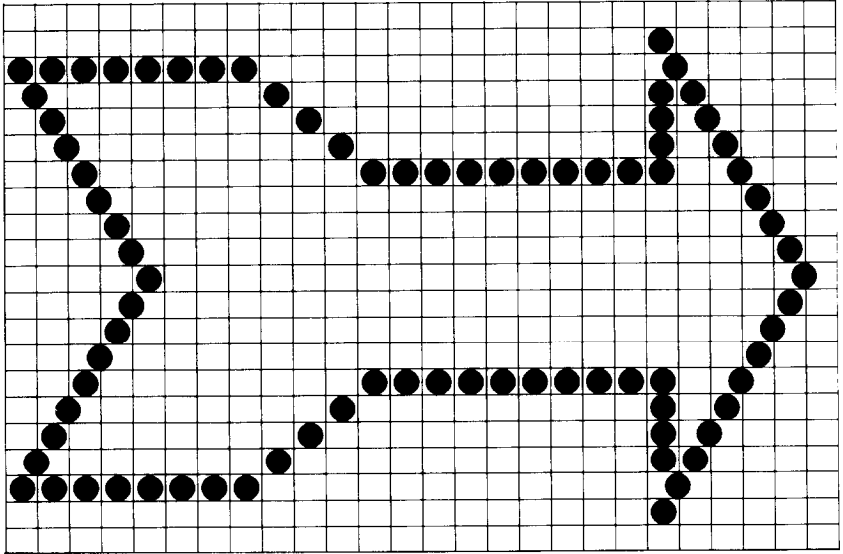


Figure 8-4. Arrow design

After plotting all the dots as in Figure 8-4, 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 8-5. The pin values are on the left side and the sums are at the bottom of each column.

Because IBM Personal Computer BASIC will not send CHR\$(26), do not use that number in any of your graphics programs.

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

In this program the number 128 in the DATA statements signals 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, using negative DATA numbers for repetitions saves typing. 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 6 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 ‘-/-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".

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 WIDTH "LPT1:",255
20 G$=CHR$(27)+"K"+CHR$(100)+CHR$(0)
30 A$=CHR$(85)+CHR$(42)
40 B$=CHR$(42)+CHR$(85)
50 LPRINT CHR$(27)"A"CHR$(7)
60 FOR R=1 TO 3
70 LPRINT G$;
80 FOR X=1 TO 50: LPRINT A$;; NEXT X
90 LPRINT
100 LPRINT G$;
110 FOR X=1 TO 50: LPRINT B$;; NEXT X
120 LPRINT: NEXT R
130 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.

Appendix A

LX-90 Characters

This appendix is a listing of the characters produced by the decimal codes from 0 through 255. For each code the listing provides the decimal number (Dec), the hexadecimal number (Hex), and a printout of the character that is printed by that code (Char). If the code does not produce a printable character, the word none or the abbreviation for its control code is in the Char column.

This listing is given four times: standard draft, standard NLQ, alternate draft, and alternate NLQ. The alternate character mode can be selected with a DIP switch (see Appendix D) or an ESCape code (see Appendix B) .

The codes for printer instructions, such as expanded and emphasized printing, are in Appendix B.

Standard Character Mode (Draft)

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	00	none	32	20	blank	64	40	@	96	60	°
1	01	none	33	21	!	65	41	A	97	61	a
2	02	none	34	22	"	66	42	B	98	62	b
3	03	♥	35	23	#	67	43	C	99	63	c
4	04	♦	36	24	⌘	68	44	D	100	64	d
5	05	♣	37	25	%	69	45	E	101	65	e
6	06	♠	38	26	&	70	46	F	102	66	f
7	07	♣	39	27	'	71	47	G	103	67	g
8	08	♣	40	28	(	72	48	H	104	68	h
9	09	HT	41	29	)	73	49	I	105	69	i
10	0A	LF	42	2A	*	74	4A	J	106	6A	j
11	0B	VT	43	2B	+	75	4B	K	107	6B	k
12	0C	FF	44	2C	,	76	4C	L	108	6C	l
13	0D	CR	45	2D	-	77	4D	M	109	6D	m
14	0E	SO	46	2E	.	78	4E	N	110	6E	n
15	0F	SI	47	2F	/	79	4F	O	111	6F	o
16	10	▸	48	30	0	80	50	P	112	70	p
17	11	▹	49	31	1	81	51	Q	113	71	q
18	12	DC2	50	32	2	82	52	R	114	72	r
19	13	!!	51	33	3	83	53	S	115	73	s
20	14	DC4	52	34	4	84	54	T	116	74	t
21	15	§	53	35	5	85	55	U	117	75	u
22	16	■	54	36	6	86	56	V	118	76	v
23	17	‡	55	37	7	87	57	W	119	77	w
24	18	CAN	56	38	8	88	58	X	120	78	x
25	19	↓	57	39	9	89	59	Y	121	79	y
26	1A		58	3A	:	90	5A	Z	122	7A	z
27	1B	ESC	59	3B	;	91	5B	[	123	7B	{
28	1C	┌	60	3C	<	92	5C	\	124	7C	|
29	1D	┐	61	3D	=	93	5D	]	125	7D	}
30	1E	▲	62	3E	>	94	5E	^	126	7E	~
31	1F	▼	63	3F	?	95	5F	_	127	7F	none

Standard Character Mode (Draft)

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
128	80		160	A0	À	192	C0		224	E0	œ
129	81		161	A1	Á	193	C1		225	E1	Û
130	82		162	A2	Â	194	C2		226	E2	Ü
131	83		163	A3	Ã	195	C3		227	E3	Ý
132	84		164	A4	Ä	196	C4		228	E4	ÿ
133	85		165	A5	Å	197	C5		229	E5	ÿ
134	86		166	A6	Æ	198	C6		230	E6	ÿ
135	87		167	A7	Ç	199	C7		231	E7	ÿ
136	88		168	A8	È	200	C8		232	E8	ÿ
137	89		169	A9	É	201	C9		233	E9	ÿ
138	8A		170	AA	Ê	202	CA		234	EA	ÿ
139	8B		171	AB	Ë	203	CB		235	EB	ÿ
140	8C		172	AC	Ì	204	CC		236	EC	ÿ
141	8D		173	AD	Í	205	CD		237	ED	ÿ
142	8E		174	AE	Ï	206	CE		238	EE	ÿ
143	8F		175	AF	Ð	207	CF		239	EF	ÿ
144	90		176	B0	Ñ	208	D0		240	F0	ÿ
145	91		177	B1	Ò	209	D1		241	F1	ÿ
146	92		178	B2	Ó	210	D2		242	F2	ÿ
147	93		179	B3	Ô	211	D3		243	F3	ÿ
148	94		180	B4	Õ	212	D4		244	F4	ÿ
149	95		181	B5	Ö	213	D5		245	F5	ÿ
150	96		182	B6	×	214	D6		246	F6	ÿ
151	97		183	B7	Ø	215	D7		247	F7	ÿ
152	98		184	B8	Ù	216	D8		248	F8	ÿ
153	99		185	B9	Ú	217	D9		249	F9	ÿ
154	9A		186	BA	Û	218	DA		250	FA	ÿ
155	9B		187	BB	Ü	219	DB		251	FB	ÿ
156	9C		188	BC	Ý	220	DC		252	FC	ÿ
157	9D		189	BD	Þ	221	DD		253	FD	ÿ
158	9E		190	BE	ÿ	222	DE		254	FE	ÿ
159	9F		191	BF	ÿ	223	DF		255	FF	none

Standard Character Mode (NLQ)

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	00	none	32	20	blank	64	40	@	96	60	'
1	01	none	33	21	!	65	41	A	97	61	a
2	02	none	34	22	"	66	42	B	98	62	b
3	03	♥	35	23	#	67	43	C	99	63	c
4	04	♦	36	24	\$	68	44	D	100	64	d
5	05	♣	37	25	%	69	45	E	101	65	e
6	06	♠	38	26	&	70	46	F	102	66	f
7	07	♣	39	27	'	71	47	G	103	67	g
8	08	♠	40	28	(	72	48	H	104	68	h
9	09	HT	41	29	)	73	49	I	105	69	i
10	0A	LF	42	2A	*	74	4A	J	106	6A	j
11	0B	VT	43	2B	+	75	4B	K	107	6B	k
12	0C	FF	44	2C	,	76	4C	L	108	6C	l
13	0D	CR	45	2D	-	77	4D	M	109	6D	m
14	0E	SO	46	2E	.	78	4E	N	110	6E	n
15	0F	SI	47	2F	/	79	4F	O	111	6F	o
16	10	▮	48	30	0	80	50	P	112	70	p
17	11	▮	49	31	1	81	51	Q	113	71	q
18	12	DC2	50	32	2	82	52	R	114	72	r
19	13	!!	51	33	3	83	53	S	115	73	s
20	14	DC4	52	34	4	84	54	T	116	74	t
21	15	§	53	35	5	85	55	U	117	75	u
22	16	■	54	36	6	86	56	V	118	76	v
23	17	‡	55	37	7	87	57	W	119	77	w
24	18	CAN	56	38	8	88	58	X	120	78	x
25	19	↓	57	39	9	89	59	Y	121	79	y
26	1A		58	3A	:	90	5A	Z	122	7A	z
27	1B	ESC	59	3B	;	91	5B	[	123	7B	{
28	1C	↳	60	3C	<	92	5C	\	124	7C	|
29	1D	↔	61	3D	=	93	5D	]	125	7D	}
30	1E	▲	62	3E	>	94	5E	^	126	7E	~
31	1F	▼	63	3F	?	95	5F	_	127	7F	none

Standard Character Mode (NLQ)

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
128	80	Ç	160	A0	á	192	C0		224	E0	œ
129	81	Û	161	A1	í	193	C1		225	E1	ÿ
130	82	é	162	A2	ó	194	C2		226	E2	Γ
131	83	â	163	A3	ú	195	C3		227	E3	π
132	84	ä	164	A4	ñ	196	C4		228	E4	Σ
133	85	à	165	A5	ñ	197	C5		229	E5	σ
134	86	â	166	A6		198	C6		230	E6	μ
135	87	ç	167	A7		199	C7		231	E7	τ
136	88	ê	168	A8		200	C8		232	E8	ϋ
137	89	ë	169	A9		201	C9		233	E9	θ
138	8A	è	170	AA		202	CA		234	EA	Ω
139	8B	ÿ	171	AB		203	CB		235	EB	δ
140	8C	î	172	AC		204	CC		236	EC	∞
141	8D	ï	173	AD		205	CD		237	ED	∅
142	8E	À	174	AE	«	206	CE		238	EE	€
143	8F	Á	175	AF	»	207	CF		239	EF	Π
144	90	É	176	B0	⋮	208	D0		240	F0	≡
145	91	æ	177	B1	⋯	209	D1		241	F1	±
146	92	Æ	178	B2	⋯	210	D2		242	F2	≥
147	93	ö	179	B3	|	211	D3		243	F3	≤
148	94	ö	180	B4	†	212	D4		244	F4	ƒ
149	95	ò	181	B5	†	213	D5		245	F5	J
150	96	û	182	B6	†	214	D6		246	F6	÷
151	97	ù	183	B7	‡	215	D7		247	F7	≈
152	98	ÿ	184	B8	‡	216	D8		248	F8	°
153	99	ÿ	185	B9	†	217	D9		249	F9	•
154	9A	Û	186	BA	|	218	DA		250	FA	-
155	9B	Φ	187	BB	‡	219	DB	■	251	FB	√
156	9C	£	188	BC		220	DC	■	252	FC	∩
157	9D	¥	189	BD		221	DD	■	253	FD	z
158	9E	ℓ	190	BE		222	DE	■	254	FE	■
159	9F	ƒ	191	BF	‡	223	DF	■	255	FF	none

Alternate Character Mode (Draft)

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	00	none	32	20	blank	64	40	@	96	60	ˆ
1	01	none	33	21	!	65	41	A	97	61	˜
2	02	none	34	22	"	66	42	B	98	62	b
3	03		35	23	#	67	43	C	99	63	c
4	0 4		36	24	\$	68	44	D	100	64	d
5	05		37	25	%	69	45	E	101	65	e
6	06		38	26	&	70	46	F	102	66	f
7	07		39	27	'	71	47	G	103	67	g
8	08		40	28	(	72	48	H	104	68	h
9	09	HT	41	29	)	73	49	I	105	69	i
10	0A	LF	42	2A	*	74	4A	J	106	6A	j
11	0B	VT	43	2B	+	75	4B	K	107	6B	k
12	0C	FF	44	2C	,	76	4C	L	108	6C	l
13	0D	CR	45	2D	-	77	4D	M	109	6D	m
14	0E	SO	46	2E	.	78	4E	N	110	6E	n
15	0F	SI	47	2F	/	79	4F	O	111	6F	o
16	10	▸	48	30	0	80	50	P	112	70	p
17	11	▹	49	31	1	81	51	Q	113	71	q
18	12	DC2	50	32	2	82	52	R	114	72	r
19	13	!!	51	33	3	83	53	S	115	73	s
20	14	DC4	52	34	4	84	54	T	116	74	t
21	15	§	53	35	5	85	55	U	117	75	u
22	16	■	54	36	6	86	56	V	118	76	v
23	17	‡	55	37	7	87	57	W	119	77	w
24	18	CAN	56	38	8	88	58	X	120	78	x
25	19	↓	57	39	9	89	59	Y	121	79	y
26	1A		58	3A	:	90	5A	Z	122	7A	z
27	1B	ESC	59	3B	;	91	5B	[	123	7B	{
28	1C	└	60	3C	<	92	5C	\	124	7C	|
29	1D	┘	61	3D	=	93	5D	]	125	7D	}
30	1E	▲	62	3E	>	94	5E	^	126	7E	~
31	1F	▼	63	3F	?	95	5F	_	127	7F	none

Alternate Character Mode (Draft)

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
128	80	none	160	A0	␣	192	C0	␣	224	E0	α
129	81	none	161	A1	␣	193	C1	␣	225	E1	β
130	82	none	162	A2	␣	194	C2	␣	226	E2	Γ
131	83	♥	163	A3	␣	195	C3	␣	227	E3	π
132	84	♦	164	A4	␣	196	C4	␣	228	E4	Σ
133	85	♣	165	A5	␣	197	C5	␣	229	E5	σ
134	86	♠	166	A6	␣	198	C6	␣	230	E6	μ
135	87	♣	167	A7	␣	199	C7	␣	231	E7	τ
136	88	♣	168	A8	␣	200	C8	␣	232	E8	ϕ
137	89	HT	169	A9	␣	201	C9	␣	233	E9	θ
138	8A	LF	170	AA	␣	202	CA	␣	234	EA	Ω
139	8B	VT	171	AB	␣	203	CB	␣	235	EB	⊗
140	8C	FF	172	AC	␣	204	CC	␣	236	EC	⊗
141	8D	CR	173	AD	␣	205	CD	␣	237	ED	⊗
142	8E	SO	174	AE	␣	206	CE	␣	238	EE	⊗
143	8F	SI	175	AF	␣	207	CF	␣	239	EF	⊗
144	90	▶	176	B0	␣	208	D0	␣	240	F0	⊗
145	91	◀	177	B1	␣	209	D1	␣	241	F1	⊗
146	92	DC2	178	B2	␣	210	D2	␣	242	F2	⊗
147	93	!!	179	B3	␣	211	D3	␣	243	F3	⊗
148	94	DC4	180	B4	␣	212	D4	␣	244	F4	⊗
149	95	⊙	181	B5	␣	213	D5	␣	245	F5	⊗
150	96	■	182	B6	␣	214	D6	␣	246	F6	⊗
151	97	⊕	183	B7	␣	215	D7	␣	247	F7	⊗
152	98	CAN	184	B8	␣	216	D8	␣	248	F8	⊗
153	99	↓	185	B9	␣	217	D9	␣	249	F9	⊗
154	9A	→	186	BA	␣	218	DA	␣	250	FA	⊗
155	9B	ESC	187	BB	␣	219	DB	■	251	FB	⊗
156	9C	␣	188	BC	␣	220	DC	■	252	FC	⊗
157	9D	↔	189	BD	␣	221	DD	■	253	FD	⊗
158	9E	▲	190	BE	␣	222	DE	■	254	FE	■
159	9F	▼	191	BF	␣	223	DF	■	255	FF	none

Alternate Character Mode (NLQ)

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	00	none	32	20	blank	64	40	@	96	60	'
1	01	none	33	21	!	65	41	A	97	61	a
2	02	none	34	22	"	66	42	B	98	62	b
3	03	☹	35	23	#	67	43	C	99	63	c
4	04	☼	36	24	\$	68	44	D	100	64	d
5	05	☼	37	25	%	69	45	E	101	65	e
6	06	☼	38	26	&	70	46	F	102	66	f
7	07	☼	39	27	'	71	47	G	103	67	g
8	08	☼	40	28	(	72	48	H	104	68	h
9	09	HT	41	29	)	73	49	I	105	69	i
10	0A	LF	42	2A	*	74	4A	J	106	6A	j
11	0B	VT	43	2B	+	75	4B	K	107	6B	k
12	0C	FF	44	2C	,	76	4C	L	108	6C	l
13	0D	CR	45	2D	-	77	4D	M	109	6D	m
14	0E	SO	46	2E	.	78	4E	N	110	6E	n
15	0F	SI	47	2F	/	79	4F	O	111	6F	o
16	10	☼	48	30	0	80	50	P	112	70	p
17	11	☼	49	31	1	81	51	Q	113	71	q
18	12	DC2	50	32	2	82	52	R	114	72	r
19	13	!!	51	33	3	83	53	S	115	73	s
20	14	DC4	52	34	4	84	54	T	116	74	t
21	15	☼	53	35	5	85	55	U	117	75	u
22	16	☼	54	36	6	86	56	V	118	76	v
23	17	☼	55	37	7	87	57	W	119	77	w
24	18	CAN	56	38	8	88	58	X	120	78	x
25	19	↓	57	39	9	89	59	Y	121	79	y
26	1A		58	3A	:	90	5A	Z	122	7A	z
27	1B	ESC	59	3B	;	91	5B	[	123	7B	{
28	1C	☼	60	3C	<	92	5C	\	124	7C	|
29	1D	↔	61	3D	=	93	5D	]	125	7D	}
30	1E	☼	62	3E	>	94	5E	^	126	7E	~
31	1F	☼	63	3F	S?	95	5F	_	127	7F	none

Alternate Character Mode (NLQ)

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
128	80	none	160	A0	á	192	C0	ˆ	224	E0	α
129	81	none	161	A1	í	193	C1	±	225	E1	β
130	82	none	162	A2	ó	194	C2	τ	226	E2	γ
131	83	♥	163	A3	ú	195	C3	†	227	E3	π
132	84	♦	164	A4	ñ	196	C4	—	228	E4	Σ
133	85	♣	165	A5	Ñ	197	C5	+	229	E5	σ
134	86	♠	166	A6	⊖	198	C6	‡	230	E6	μ
135	87	♣	167	A7	⊕	199	C7	‡	231	E7	τ
136	88	⊠	168	A8	¿	200	C8	ˆ	232	E8	⊖
137	89	HT	169	A9	ˆ	201	C9	ˆ	233	E9	⊖
138	8A	LF	170	AA	ˆ	202	CA	±	234	EA	Ω
139	88	VT	171	AB	½	203	CB	τ	235	EB	δ
140	8C	FF	172	AC	¼	204	CC	‡	236	EC	∞
141	8D	CR	173	AD	ı	205	CD	—	237	ED	∅
142	8E	SO	174	AE	«	206	CE	+	238	EE	€
143	8F	SI	175	AF	»	207	CF	±	239	EF	∩
144	90	▶	176	B0	⋮	208	D0	±	240	F0	≡
145	91	◀	177	B1	⋮	209	D1	τ	241	F1	±
146	92	DC2	178	B2	⋮	210	D2	τ	242	F2	≥
147	93	!!	179	B3	|	211	D3	ˆ	243	F3	≤
148	94	DC4	180	B4	†	212	D4	ˆ	244	F4	∫
149	95	⊠	181	B5	†	213	D5	ˆ	245	F5	J
150	96	⊠	182	B6	†	214	D6	ˆ	246	F6	÷
151	97	⊠	183	87	ˆ	215	D7	+	247	F7	≈
152	98	CAN	184	B8	ˆ	216	D8	+	248	F8	°
153	99	↓	185	B9	†	217	D9	ˆ	249	F9	•
154	9A	→	186	BA	|	218	DA	ˆ	250	FA	-
155	9B	ESC	187	BB	ˆ	219	DB	■	251	FB	√
156	9C	⋮	188	BC	ˆ	220	DC	■	252	FC	∩
157	9D	↔	189	BD	ˆ	221	DD	■	253	FD	z
158	9E	♠	190	BE	ˆ	222	DE	■	254	FE	■
159	9F	♥	191	BF	ˆ	223	DF	■	255	FF	none

Appendix E

Troubleshooting and Advanced Features

This appendix presents explanations of the LX-90's advanced features and solutions for possible problems. If you have trouble or want to know more about some of the LX-90 features, consult the appropriate section in this appendix.

Installation of Commercial Software Programs

Many commercial software programs require that you specify which printer you are using. Because the LX-90 has many capabilities but is not listed on the menus of many software programs, you may want to experiment a bit to see which choice will be best for your program. A few examples may help.

For WordStar® install the printer as a serial printer and as COM1: with 1200 baud, no parity, 8 data bits, and 2 stop bits. Also use WordStar's install program to remove all codes from the initialization sequence. Removing the codes from the initialization sequence allows SelecType to work correctly. Follow the instructions in the WordStar manual for custom installation, and consult your dealer if you need more information.

For Artpak™ use the "Set-up of System" operation to select Epson with Grafrax. Also select the alternate character set with DIP switch 1 - 6 (see Appendix D) because Artpak uses some of the control codes above 137 decimal.

Even if you are not using either of these programs, the settings for one of them may work for your program. Consult the manual for your software. If you are still not sure, consult your dealer or simply try different options. Remember to try changing DIP switch 1-6 if you do not get the correct results. (See Appendix D.) If the installation program asks whether your printer can backspace, choose non-backspacing.

SelecType Features and Solutions

Some software sends a reset code before it begins printing. This cancels any SelecType settings. If you find that SelecType does not change your printing, the reset code is probably the reason. The solution is to use the installation program for your software to remove all codes from the initialization sequence. See your software manual for details.

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 left side of the printer. This cancels all SelecType settings, returns your LX-90 to its defaults, resets the top of page, and empties the contents of the buffer, including any user-defined characters that you have stored 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 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 in Chapter 2.

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 cancelled.
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.

Troubleshooting

If the printer freezes and a program will not run, try turning off both the computer and the printer, then turn the printer on first and the computer on second before you try the program again.

If you're printing labels and a self-adhesive label comes off of the backing, it may stick behind the platen and cause problems with paper feeding and irregular darkness of printing. If this happens, take your LX-90 to a qualified service person; do not attempt to remove the label yourself.

Beeper Error Warnings

When the LX-90's beeper sounds, it usually indicates that the printer is out of paper. The beeper can also be sounded 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.

Graphics

There are three common sources of problems with graphics programs in BASIC:

1. Unwanted codes for carriage returns and line feeds may be inserted by BASIC if lines are over 80 columns long or if semicolons are not used at the end of program lines between the graphics command and its data. See Chapter 8 for the proper format for a WIDTH statement and for sample programs that show the proper use of semicolons.
2. Some software will not send certain codes. For example, IBM PC BASIC will not send CHR\$(26). Do not use such codes in graphics programs.
3. If the printer stops during a graphics program, it may not have received enough data. The printer expects a certain number of pin patterns, determined by n1 and n2 in the graphics command. It will wait patiently until the quota is full. Note that 9-pin Graphics Mode requires two bytes for each column of graphics.

Data Dump Mode

The LX-90 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.

Enter this mode by turning on the power switch on the right side of 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-90 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-90 was in the data dump mode, you would get the printout below it. The printer will print all but the 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...E..
0001 53 61 6D 70 6C 65 20 74 65 78 74 0D 0A 1B 40 0D  Sample text...@.
0002 0A
```

You can consult Appendix A to see the meaning of the hexadecimal codes. The explanation below of the first line will 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, BASIC 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 software changes one or more codes when sending them to the printer. The ability of the LX-90 to dump in hexadecimal lets you determine which codes are creating problems for your system.

A data dump 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 software. This program is in BASIC; use an equivalent program for another programming language.

```
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-90 print the final line. Then compare your printout with the list of hex codes in order in Appendix A. If any are skipped or repeated, you will know that your software changes some codes before it sends them to the printer.

For example, in the lines below, which are the first two lines of the printout of the test program run with IBM PC BASIC, you can see that in this case BASIC adds hex 0A, which is the code for line feed, after hex 0D, the code for a carriage return. You will also notice that the program does not send hex 1A, which is decimal 26. Both of these characteristics are discussed in the next section.

```
Data Dump Mode
0000 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E .....
0001 0F 10 11 12 13 14 15 16 17 18 19 1B 1C 1D 1E 1F .....
```

The data dumping capability can help you debug a program quickly. Appendix A will help you translate the hex codes to ASCII equivalents.

IBM PC BASIC Solutions

There are three 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. Third, it will not send hex 1A (decimal 26).

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 columns per line in a graphics program, you must therefore change your opening statement to include the appropriate WIDTH statement:

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

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

There is no easy solution to the problem with CHR\$(26). It is best to change any instance of decimal 26 (hex 1A) in your programs to another number.

Appendix B

Control Codes in Numeric Order

Different programs use different methods to send these control codes to your LX-90. If you use BASIC, 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"
```

Some applications programs can use control key codes for decimal codes 0-27. See the control key chart at the end of this appendix 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.
—	9	09	HT	Horizontal tab. Empties the printer buffer, then moves the print head to the next tab stop. Default setting is every eight spaces.
—	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 the buffer and turns compressed mode (17.16 cpi) ON. Cannot work with emphasized or pica mode. Can also be set with DIP switch I-I.
—	18	12	DC2	Device control 2. Turns compressed mode OFF
—	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 <i>n</i> where <i>n</i> toggles the cut-sheet feeder on and off: 0 turns it OFF and 4 turns it ON. You cannot use "EM" in place of 25 for this command. Can also be turned ON and OFF with DIP switch 1-3.
—	27	1B	ESC	ESCape. Prepares the printer to receive control codes.
ESC	33	21		Master Select. Selects 1 of 48 unique print mode combinations. Format: ESC "!" <i>n</i> where <i>n</i> stands for a number between 0 and 255. See Chapter 5 for details.
ESC	37	25	%	Activates user-defined 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 c1 c2 a d1 . . . d11

The 0 is for future use, c1 is the starting character, c2 is the ending character. Both c1 and c2 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 c1 - c2 requires an attribute byte (**a**) and 11 data bytes (d1 - d11).

If NLQ mode is selected first, the command requires 3 bytes for a. The first, a0, is ignored, the second, a1, is the printing width and values above 12 are ignored. The third, a2, is the value of the right spacing and is automatically adjusted to 12-a1. In NLQ the command also requires **3xa1** data bytes.

ESC 42 2A *

Turns graphics mode ON. Format:

ESC "*" **m n1 n2**

followed by n data numbers, where

n = total number of dot columns,

n1 = n MOD 256,

n2 = INT(n/256)

m selects mode 0 - 6.

See Chapter 8 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 48 30 0

Sets line spacing to 1/9-inch.

ESC 49 31 1

Sets line spacing to 1/9-inch.

ESC 50 32 2

Returns line spacing to the default of 1/6-inch.

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 53	35	5	ESCape "5" 1 causes the LX-90 to perform an automatic line feed with each carriage return. ESCape "5" 0 cancels ESCape "5" 1.
ESC 54	36	6	Selects standard character set if alternate character set has been previously selected. See Appendix A for character set tables.
ESC 55	37	7	Selects alternate character set. See Appendix A for character set tables.
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 60	3C	<	Turns one-line unidirectional mode ON. Prints each line from left to right.
ESC 58	3A	:	Copies the ROM character set to RAM. Format: <p style="text-align: center;">ESC ":" <i>n1 n2 n3</i></p> <p>where <i>n1</i>, <i>n2</i>, and <i>n3</i> are all 0. They are included for future expansion. The RAM character set must be activated with ESC "%".</p>
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: <p style="text-align: center;">ESC "?s" <i>n</i></p> <p>where s is K,L,Y, or Z and <i>n</i> is 0 - 6.</p>
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 <i>n</i> /72 inch (<i>n</i> -dot). Format: <p style="text-align: center;">ESC "A" <i>n</i></p> <p>where <i>n</i> = 0-255.</p>

- 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" ***n1 n2 ... nk 0***
where ***nk*** = 1 - 255. Terminate this tab sequence with 0 or a number less than the last defined tab (***nk***).
- ESC 67 43 C Sets the form length to ***n*** lines in the current line spacing. The default line is 66 lines. Also resets top of form. Format:
ESC "C" ***n***
where ***n*** = 1-127.
- ESC 67 43 CO Sets the form length to ***n*** inches, regardless of the current line spacing. The default is 11 inches. Also resets top of form. Format:
ESC "C" 0 ***n***
where ***n*** = 1 - 22.
- 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" ***n1 n2 ... nk 0***
Terminate this tab sequence with 0 or a number less than the last defined tab (***nk***).
- ESC 69 45 E Turns emphasized mode ON. Cannot mix with elite or compressed modes.
- ESC 70 46 F Turns emphasized mode OFF.
- ESC 71 47 G Turns double-strike mode ON. Cannot mix with NLQ.
- 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" ***n1 n2***
followed by ***n*** data numbers, where
n = total number of dot columns,
n1 = ***n*** MOD 256,
n2 = INT (***n/256***).
For example, to print 480 dots, ***n1*** = **244**,
n2 = 1 .
- ESC 76 4C L Turns low-speed double-density graphics mode ON. Prints 960 dots per 8-inch line. Format:
ESC "C" ***n1 n2*** followed by ***n*** data numbers, where
n = total number of dot columns,
n1 = ***n*** MOD 256,
n2 = INT (***n/256***).
For example, to print 960 dots, ***n1*** = **192**,
n2 = **3**.
- ESC 77 4D M Turns elite mode (12 cpi) ON. Cannot mix with NLQ, pica, or emphasized.
- ESC 78 4E N Sets skip over perforation to ***n*** lines. Format:
ESC "N" ***n***
where ***n*** = 1 - 127.
- ESC 79 4F 0 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.
ESC 82 52 R	Returns tabs to default setting.
ESC 83 53 S	Turns subscript or superscript 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 "C" but cannot print two adjacent dots in the same row.

- ESC 90 5A Z Turns quadruple-density graphics mode ON. Prints 1920 dots per 8-inch line. Format:
ESC "Z" ***n1 n2***
followed by *n* data numbers, where
n = total number of dot columns,
n1 = *n* MOD 256
n2 = INT (***n/256***).
For example, to print 1920 dots, ***n1*** = 128,
n2 = 7.
- ESC 94 5E ^ Turns nine-pin graphics ON. Format:
ESC "d" ***d n1 n2***
followed by 2 times *n* data numbers, where
n = total number of dot columns,
n1 = *n* MOD 256,
n2 = INT (***n/256***).
The printer expects 2 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 auto justification (justification on both sides).
- ESC 108 6C I Sets the left margin. Format:
ESC "l" (***n***)
where ***n*** ranges from:
0 - 78 in pica
0 - 93 in elite
0 - 133 in compressed
0 - 156 in compressed elite
- 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.

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-@.

Decimal	Hexadecimal	Control key
0	00	@
	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
27	1B	[

Appendix C

Control Codes by Function

This appendix shows the control codes that are in Appendix B, but this time they are arranged by categories.

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 OFE
- ESC "WO" 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 OFE

Print Enhancement

- ESC "S0" Turns superscript mode ON.
- ESC "S1" Turns subscript mode ON.
- ESC '7" Turns either script mode OFF.
- ESC "-0" Turns underline mode OFF.
- ESC "-1" Turns underline mode ON.

Mode and Character-Set Selection

- ESC "!" n Master select.
- ESC "6" Returns to standard character mode.
- ESC "7" Selects alternate character mode.
- ESC "@ " Reset code.

Special Printer Features

- ESC 25 Enables and disables the optional cut-sheet feeder.
- ESC "5" Selects or cancels automatic line feed.
- ESC "<" Turns one-line unidirectional mode ON.
- ESC "U0" Turns continuous unidirectional mode OFE
- 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 1/9-inch.
- ESC "1" Sets line spacing to 1/9-inch.
- ESC "2" Sets line spacing to 1/6-inch (default).
- ESC "3" n Sets line spacing to n/216-inch.
- ESC "A" n Sets line spacing to n/72-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" n Turns variable skip over perforation ON.
- ESC "0" Turns skip over perforation OFF.

Page Format

- ASCII 9 Horizontal tab.
- ASCII 10 Line feed.
- ASCII 11 Vertical tab.
- ASCII 12 Form feed.
- ASCII 13 Carriage return.
- ESC "D" Sets horizontal tab stops.
- ESC "Q" n Sets the right margin.
- ESC "I" n 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 "A" 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-90 printer. These switches control a number of important printer functions. Although the factory settings are the best for most uses, you may want to change some of them.

The design of the LX-90 gives you easy access to the switches, which you can locate using Figure D-1.

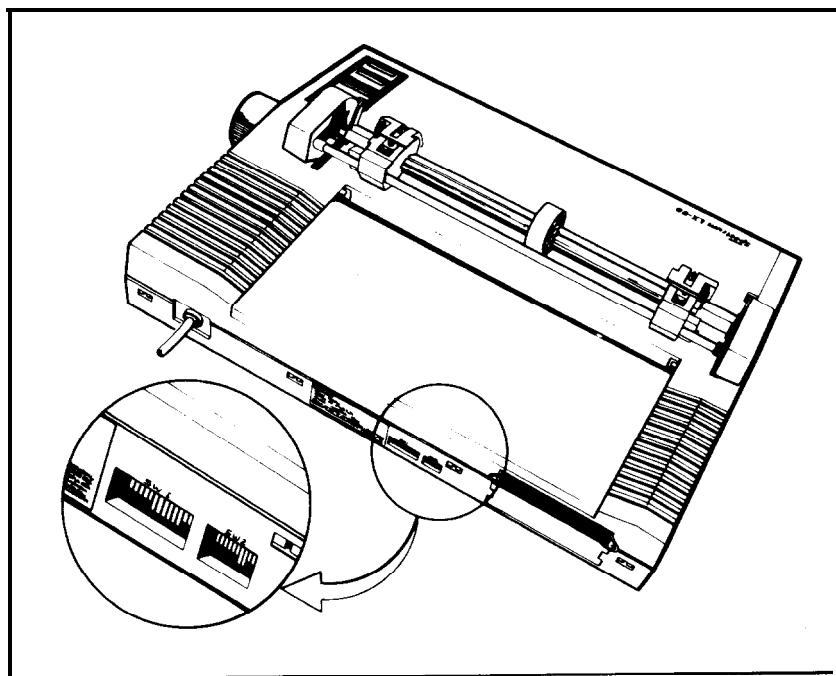


Figure D-1. DIP switch location

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.

Table **D-1** shows you the functions of all the switches, and the rest of the appendix explains each of them.

Table D-1. DIP switch functions

Switch 1

No.	ON	Function	OFF
1-1	Compressed	Print mode	Pica
1-2	NLQ	Print mode	Draft
1-3	Active	Cut-sheet feeder	Inactive
1-4	12 inches	Page length	11 inches
1-5	Inactive	Paper end detector	Active
1-6	Alternate	Character set selection	Standard
1-7		Baud rate selection See Table D-2	

I-8

Switch 2

No.	ON	Function	OFF
2-1	0 (slashed)	Zero character	0
2-2		Not used	
2-3	CR + LF	(Automatic line feed)	CR only
2-4	Mute	Beeper	Active

Note: The factory setting of all these switches is OFF.

Switch 1-1 selects pica or condensed 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 7-2 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 select the NLQ mode with SelecType or an ESCape code.

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 7-4 selects the paper length. When it is OFF, the length is **11"**; when it is ON, the length is **12"**.

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. See Paper Out Sensor in Chapter 6.

Switch 1-6 selects the character set. When it is OFF, the standard character set is used, when it is ON, the alternate character set is used. See Appendix A for listings of both character sets. Notice that the alternate character set has some control codes between 137 and 152 (decimal). If a software program prints a character instead of performing a printer function, such as a line feed, try selecting the alternate character set.

Switch Z-7 and 1-8 select the baud rate as shown in Table D-2.

Table D-2

Baud rate	SW 1-7	SW 1-8
9600	ON	ON
4800	ON	OFF
2400	OFF	ON
1200	OFF	OFF

Many software programs require a baud rate of 1200, but a higher baud rate may increase the speed of other programs. The software documentation or experimentation should be your guide to the best baud rate for each program.

Switch 2-1 controls the printing of zeroes. When it is ON, the zeroes are slashed (0); when it is OFF they are not.

Switch 2-2 is not used. It must remain OFF.

Switch 2-3 controls line feeds. When it is ON, the LX-90 adds an automatic line feed to each carriage return; when it is OFF it does not. 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.

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

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