EPSON®

Printer Interface Cartridge

for parallel interface systems

Operation Manual

Y497991200

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Introduction

The Epson LX-90™ printer with the PIC for parallel interface systems 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 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.

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 (PIG™) 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. The PIC has a grounding wire. Attach it as shown in Figure l-1.

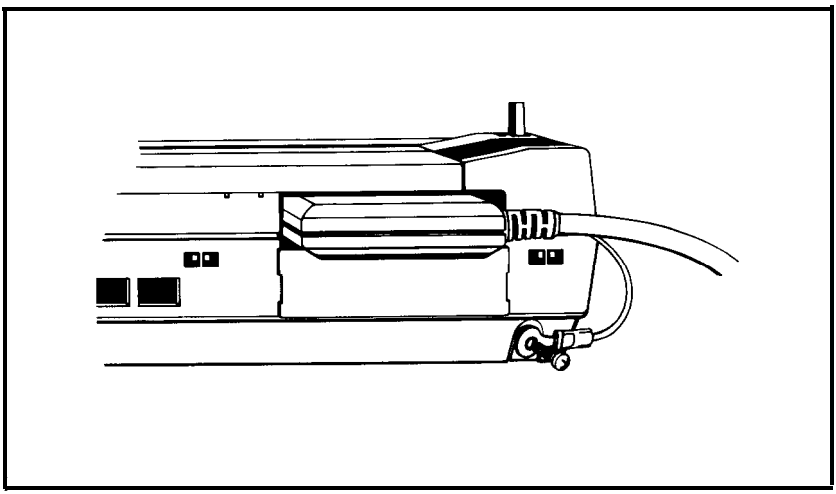


Figure 1-l. Attaching the grounding wire

Now that the PIC is installed, you need to change the settings of three small switches, called DIP switches, in the back of the printer, Figure 1-2 shows where the DIP switches are.

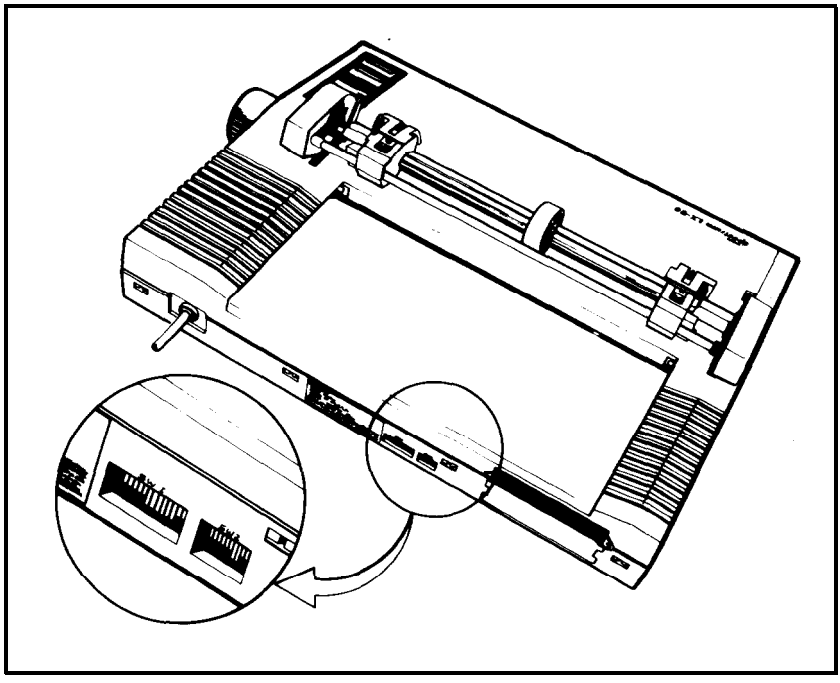


Figure l-2. DIP switch location

The functions of these switches are explained in detail in Appendix D, but all that you need to do now is turn three of them on. All the others should be off. (The switches are down when they are off and up when they are on.) Before you change any of the DIP switch settings make sure that the power switch on the right side of the printer is turned off.

The DIP switches are in two groups, with eight in the first group and four in the second. Turn on switches 6, 7, and 8 in the first group. Now you are ready to test your printer.

Printing the Self Test

It's time to see the LX-90 in action. You'll start with a self test. 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. Hold down the LF button on the control panel while you 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 1-3 shows partial results of both tests.

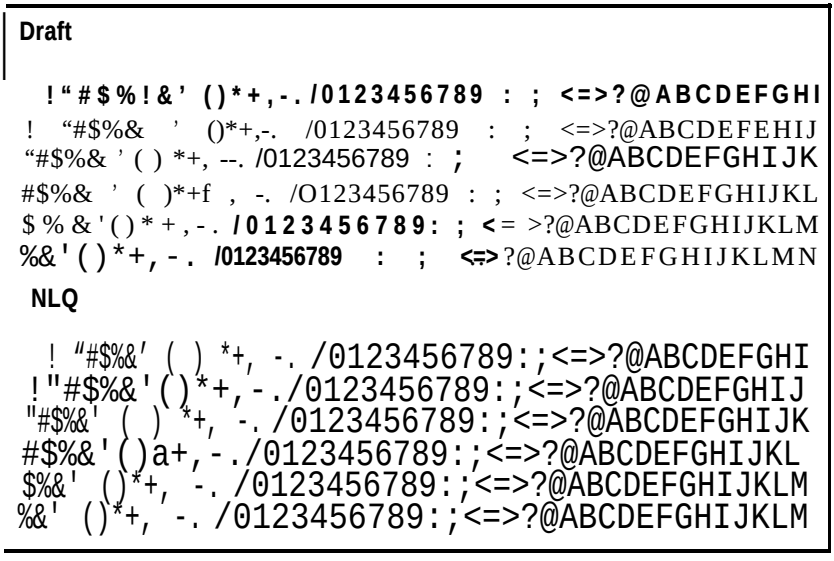


Figure 1-3. Self-test printouts

Connecting the Printer to Your Computer

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

Because different computers require different printer connections, you need a separate cable to connect the PIC cable to your computer. Connect the separate cable to the plug on the end of the PIC cable and then plug the other end into your computer. Your computer manual or your dealer will tell you what you need.

Control Panel

After connecting your LX-90 to your computer, turn on the printer and look at the control panel, which is shown in Figure 1-4.

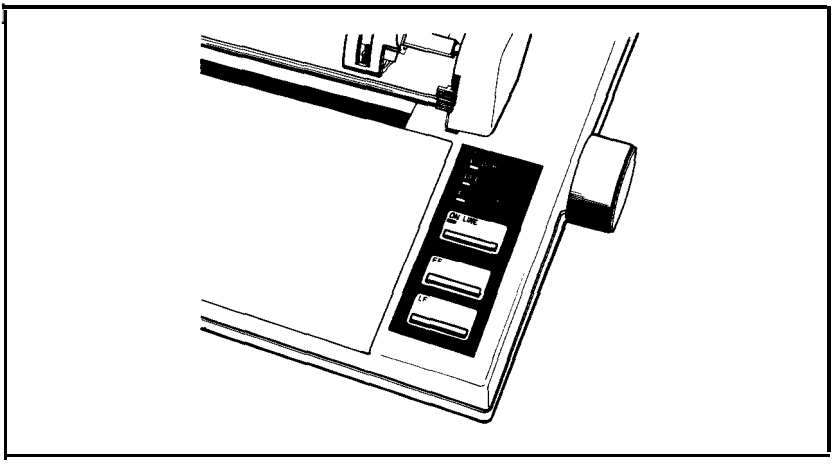


Figure 7-4. Control panel

You have already used the control panel for a special purpose, printing the self test. 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.

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 typestyles:

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

Choosing typestyles with SelecType is simple. A few taps on the printer's control panel tells the printer which style you want, and SelecType lets you choose the typestyle 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 typestyle, 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.

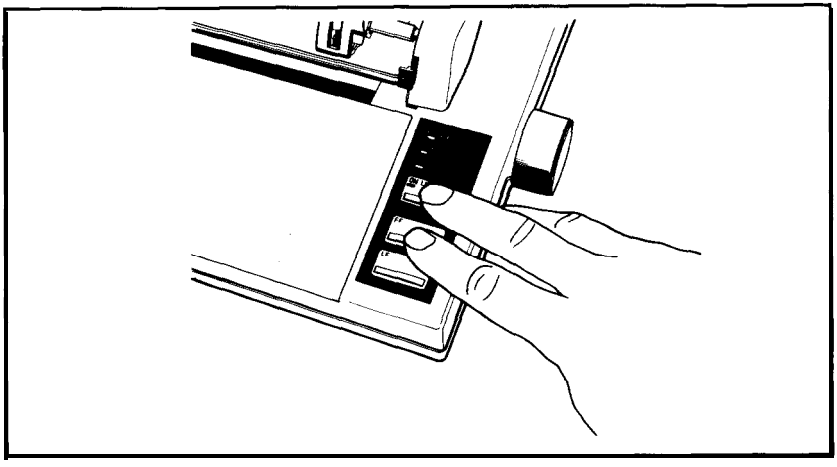


Figure 2-1. Turning SelecType on

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 typestyles

In SelecType, each button has a function:

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

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

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

Table 2-1. ***SelecType modes***

Mode	Typestyle	
1	NLQ	ABCDEFGHJIJKLMNopqrstuvwxyz
2	Emphasized	ABCDEFGHIJKLMnopqrstuvwxyz
3	Double-strike	**ABCDEFGHIJKLMnopqrstuvxyz**
4	Compressed	**ABCDEFGHIJKLMnopqrstuvwxzyz**
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 SelecType 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.

SelecType Exercise

You will probably use SelecType mainly with commercial software, but since there are so many different commercial software programs, the sample exercises are in Microsoft™ BASIC (MBASIC), the most widely used BASIC in personal computers. Consequently, most users can enter and run the programs exactly as the programs appear in these pages.

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.

```
18 LPRINT "This is an example of"
28 LPRINT "LX-90 printing."
```

Now, run the program by typing RUN and pressing **RETURN,** or print your file or document by following the printing instructions of your software. The LX-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

emphasiaed 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 typestyles in this chapter, 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 1/72nd 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 (shown in Figure 3-l), the head fires the top pin, moves 1/60th of an inch, fires the top pin again, moves 1/60th of an inch, fires the top pin and the six below it at the same time, moves 1/60th of an inch, fires the top pin, moves another 1/60th of an inch, and fires the top pin once more to finish the letter. All this happens in only l/lOOth of a second.

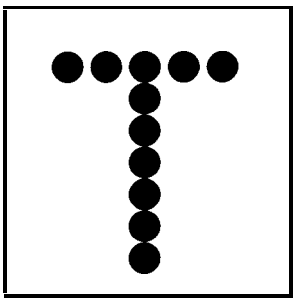


Figure 3-1. A capital T

Other 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).

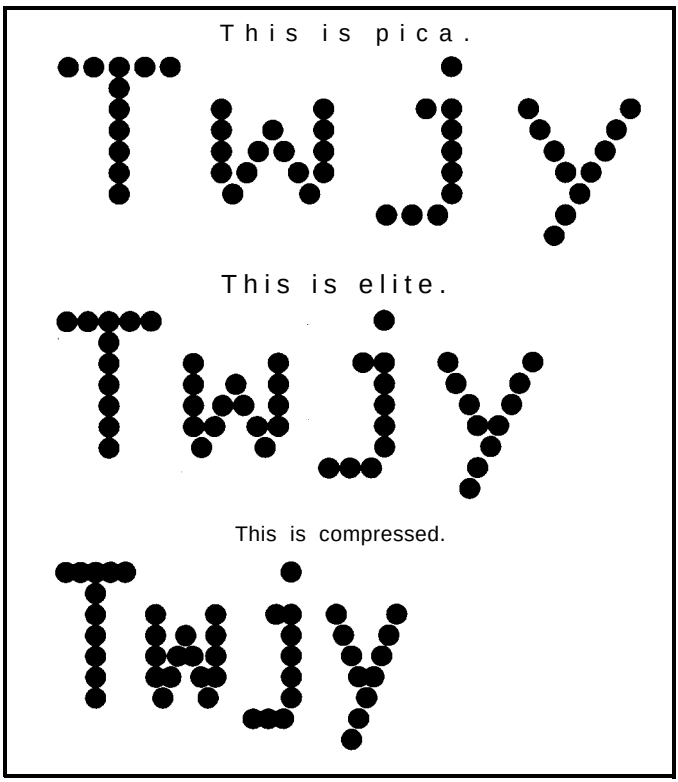


Figure 3-2. The three pitches of the LX-90

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 I-X-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.

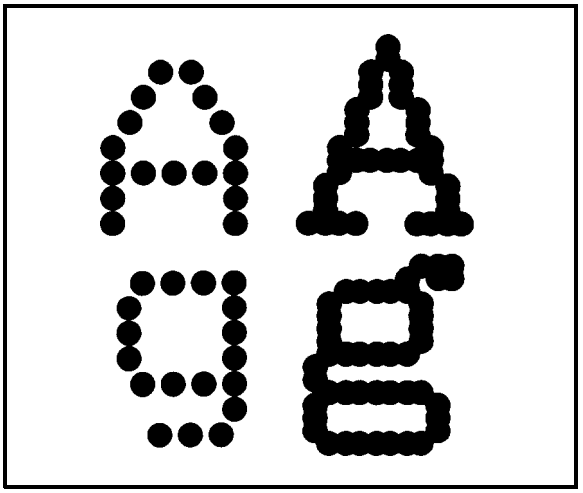


Figure 3-3. Near Letter Quality and draft characters compared

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.

SelecType 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 DIP switch in the back of your printer. You can find the software command in Chapter 4 and the operation of the 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 Microsoft BASIC programming language.

- 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.
- LPRINT sends text or commands to the printer.

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 B and C of this manual to find the proper codes. Appendix E also has some suggestions on using LX-90 features with applications software.

Chapter 4
PIC Features

The next four chapters describe many of the printing features of the PIC. 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 a discussion and examples of the PIC 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 comes with most computers.

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 a Greek letter, 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.

Running BASIC Programs

This section describes how to run the BASIC demonstration programs in this manual; it is not a tutorial in BASIC programming.

Although there are many versions of BASIC, the programs in this manual are designed to work with the two most popular ones: Microsoft BASIC and IBM@ PC BASIC. If you have another version, you can run these demonstration programs by making a few changes. Appendix D has instructions for using Applesoft'" BASIC; for other versions of BASIC, consult the appropriate manual.

When you type these programs, be sure to include all spaces and punctuation marks, especially semicolons. Press **RETURN** at the end of each line. (On your computer the **RETURN** key may be marked ↵ or **ENTER.)** Computers that use a 40-column display may break 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, including the line number; the new line will replace the old one.

When you have typed all the lines, type RUN and press **RETURN** to run the program.

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

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.

```
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [\]^-`a b c d e f g h i
```

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 **RETURN;** 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.

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

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

```
30 LPRINT  CHR$(27);"P";CHR$(15);
```

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

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

Cancelling Codes

As you saw in the third version of the print pitch program, you must cancel a code when you 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 "I" 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 "a") 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$(27); "x"; CHR$(l);
28 FOR X=65 TO 105
30 LPRINT  CHR$(X);
40 NEXT X: LPRINT
```

```
ABCDEFGHINKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
```

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 <- inch ->	CPI	codes	
		On	Off
Near Letter Quality	10.00	ESC "x" 1	ESC "x" 0
Pica print.	10.00		
Elite print	12.00	ESC "M"	ESC " P"
Compressed print	17.16	15	18
Compressed elite print	20.00	ESC "M" 15	ESC "P" 18

Remember that you don't have to use BASIC to change modes; you can use any method 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.

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 "Running 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 to print 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

Another 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."
29 LPRINT CHR$(27) ; "W1";
30 LPRINT "This is expanded."
100 LPRINT CHR$(27);"@"
```

```
This is standard printing.
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 "Wl" turns on expanded and ESCape "WO" 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 "WO".

Mode Combinations

You can also use control codes to combine modes. 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) ; "Wl" ; 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.
Emphaasized expanded
```

A later section in this chapter explains a special ESCape code, Master Select, which allows you to control six 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$( 27);"-1";
30 LPRINT "This text is underlined."
100 LPRINT CHR$(27);"@"
```

```
This text is not underlined.
This text is underlined
```

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.

```
This uses the underline character
```

If your software prints this type of underline, it is using the LX-90's underline character (ASCII 93, 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 italic. 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:

italic	64
expanded	32
double-strike	16
emphasized	8
compressed	4
elite	1
pica	0

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

italic	64
expanded	32
pica	0
	96

To print this combination, therefore, you use ESCape "!" followed by the number 96. In the BASIC programming language the command is CHR$ (27) "!" CHR$ (96).

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.

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

Here is a sample using Master Select number 96:

```
This sample of printing uses
Master Select number 96
```

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 list below shows the results of trying to combine emphasized with either or both of these modes.

Emphasized + compressed + emphasized
Emphasized + elite + elite
Emphasized + compressed + elite → compressed elite

Master Select is a powerful code that gives you an easy way to produce multiple combinations with a single command. To see double-strike emphasized 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 in double-strike. If you use ESCape "I" 16 to turn on double-strike, your LX-90 will begin printing in double-strike pica instead of double-strike elite because the 16 code does not include elite. Use 17 for double-strike 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 "Sl" 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$(27);"Sl";"2";CHR$(27);"T";
30 LPRINT "0."
40 LPRINT  CHR$(27);"@"
```

The formula for water is H_2O

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

International Characters

As you know, languages other than English require a few extra characters. The LX-90 has provided for printing in many languages by having nearly 100 international characters in its ROM (Read Only Memory). This total includes characters in three sets: draft, draft italic, and NLQ (Near Letter Quality).

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

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

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

```
LPRINT CHR$(27);"R";CHR$(n)
```

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

```
LPRINT CHR$(27);"R";CHR$(1)
```

The other method of selecting an international character set is to reset a DIP switch. If you plan to use one of the international sets quite a bit, see Appendix D for instructions for using the DIP switches.

Once you have selected a character set, whether you do it with the ESCape code or the DIP switches, you will be able to print several new characters. The character sets are shown in Tables 5-1, 5-2, and 5-3.

Table 5-l. International characters *in NLQ mode*

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

Table 5-2. *International characters in draft mode*

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

Table S-3. International characters in draft italic mode

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

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

Once you have selected an international character set with the DIP switches or the ESCape "R" code, you can use the tables to see which keys on your standard keyboard can produce the international characters you want. Simply type the character from the top row of one of the figures in order to print the corresponding character in the row of the set you have chosen.

For example, if you have reset the DIP switches for the UK character set and you press the # key, the £ symbol will be generated. Even though you will see the # symbol on the screen, the £ symbol will be printed on the paper. For another example, if you have selected the Swedish character set and you press the @ key, the 6 symbol will be generated.

Special Graphics Character Set

The LX-90 printer's Read Only Memory (ROM) also contains the 32 graphics characters that you see in Figure 5-1.

128	129	130	131	132	133	134	135	136	137	138
┼	┴	┬	┤	├	─	│	┌	┐	└	┘
139	140	141	142	143	144	145	146	147	148	149
▒	■	▬	▮	◆	○	♣	♥	♦	♠	♪
150	151	152	153	154	155	156	157	158	159	
◘	±	◙	◡	◝	↑	↓	×	÷	±	

Figure 5-l. Special graphics characters

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

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

Sending the codes for these characters to the printer is a two-step process just as it is for the international characters. In BASIC, first you send CHR$(27)"m"CHR$(4) to turn on the graphics character set, then you send the code numbers given in Figure 5-l. After you have used the ESCape code to turn on the graphics character set, the LX-90 prints the codes from 128 through 159 as graphics characters.

You can change pitch and weight with the graphics characters just as you can with the other characters in the ROM of the LX-90. The characters in Figure 5-1 are printed in expanded elite. The printout below shows the characters in pica:

The next printout shows the characters in emphasized expanded pica:

Because normal line spacing leaves space between the lines of graphics characters just as it does between lines of text, you must change the line spacing when you combine line graphics characters to form boxes or other figures. For most programs ESCape "1" gives you the best line spacing for combinations of graphics characters. Further details on line spacing are in Chapter 6.

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

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 "I" 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 location of 5 and a right margin location of 70, but you can use any numbers you prefer for the margin commands.

```
NEW
18 LPRINT CHR$(27);"1";CHR$(5);
20 LPRINT CHR$(27);"Q";CHR$(70);
```

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 the program's margin command.

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 (l/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 l/6-inch, six lines of print per inch.

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" changes the line spacing to l/B-inch, ESCape "1" changes the line spacing to 7/72-inch, and ESCape "2" returns it to l/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 C 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 DIP switches described in Appendix D. Some computers ignore the DIP switch setting and ESCape "8". See Appendix D.

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 probably need to use a WIDTH statement at the beginning of your program. The following line shows one format for the WIDTH statement. Consult your software documentation for the proper format for your system.

```
7 WIDTH LPRINT 255
```

This statement prevents BASIC from inserting unwanted carriage returns.

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 processing program that has its own justificationcommand.**

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 two 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 

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-l 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.

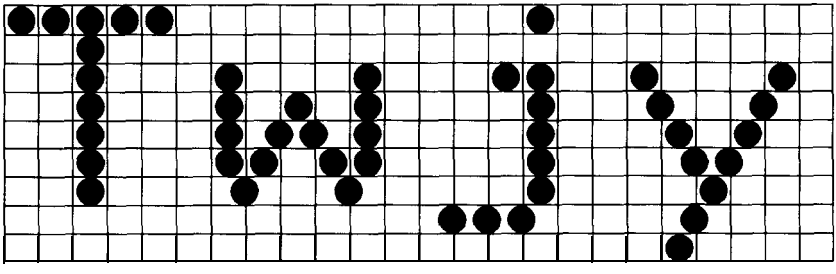


Figure ***7-l. LX-90 dot-matrix characters***

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.

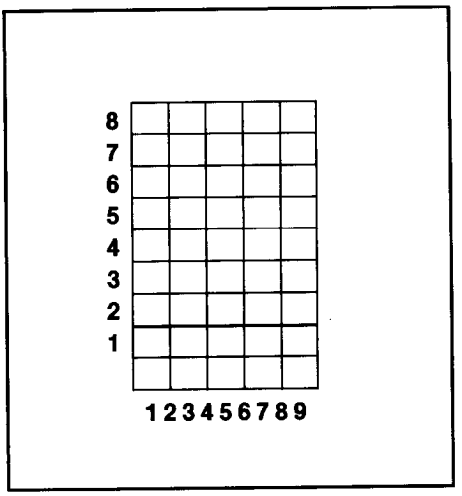


Figure **7-2.** *Grid for designing draft characters*

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.

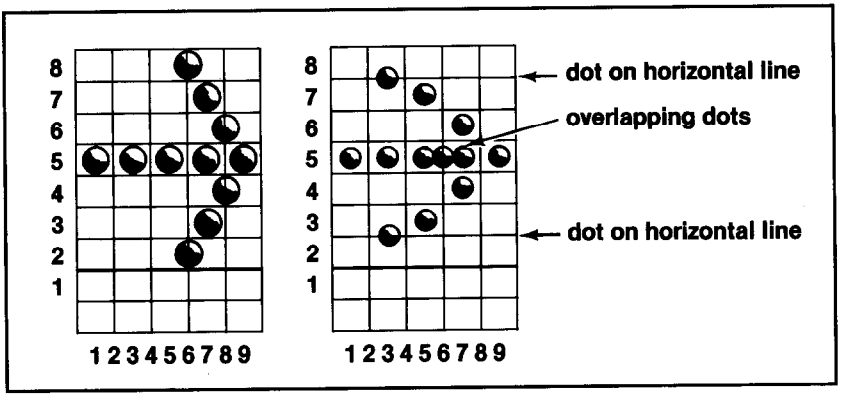


Figure 7-3. ***Correct and*** incorrect ***designs***

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)+2^(R-1)
150 IF R=0 THEN NEXT I ELSE GOTO 130
160 LPRINT CHR$(27)":"CHR$(0)CHR$(0)CHR$(0);
179 LPRINT CHR$(27)"%"CHR$(l)CHR$(0);
180 LPRINT CHR$(27)"&"CHR$(0)"<<";
190 LPRINT CHR$(128);
200 FOR X=1 TO 9
210 LPRINT CHR$(F(X));: NEXT X
220 LPRINT CHR$($l)CHR$(0);
239 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=l 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.

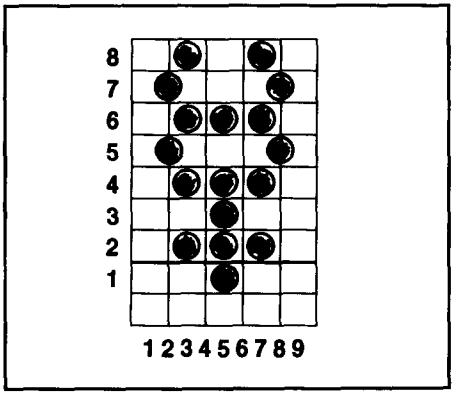


Figure 7-4. Design for character

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 **RETURN** key after each one. When you have entered all the numbers for a column or when you want no dots in a column, press **RETURN** without a number. Remember that the vertical lines in the grid are the even-numbered columns.

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 **RETURN** to indicate that no dots go in that column. For column 2 (the vertical line), press **7, RETURN,** 5, and **RETURN** again to indicate that you want dots in rows 7 and 5. Then press **RETURN** alone to indicate that no more dots go in column 2. For column 3 press 8, 6, 4, and 2, with an **RETURN** after each of them. Then press **RETURN** to finish with column 3 and go on to column 4.

For column **4** press **RETURN** only. (The rest of the directions assume that you **know** to press **RETURN** 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 **RETURN** only; for column 7 enter 8, 6, 4, and 2; for column 8 enter 7 and 5; and for column 9 press **RETURN 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 typestyles. Your printout also gives you nine numbers, which you will use in the next program. You should get the printout you see below:

```
YOUR CHARACTER IN PICA:
IN 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 rerun 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.

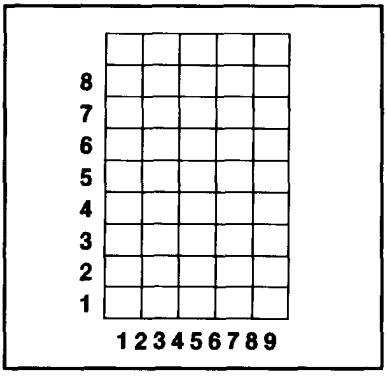


Figure 7-5. *Using the* bottom *eight* **rows**

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$(P);: NEXT P
95 LPRINT
100 K=l: IF K>3 THEN A=58 ELSE A=60
110 LPRINT CHR$(27) ":"CHR$(@)CHR$(@)CHR$(@);
120 LPRINT CHR$(27)"%"CHR$(l)CHR$(@);
138 LPRINT CHR$(27)"&"CHR$(0)CHR$(A)CHR$(A-l+K);
140 FOR Z=l 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.

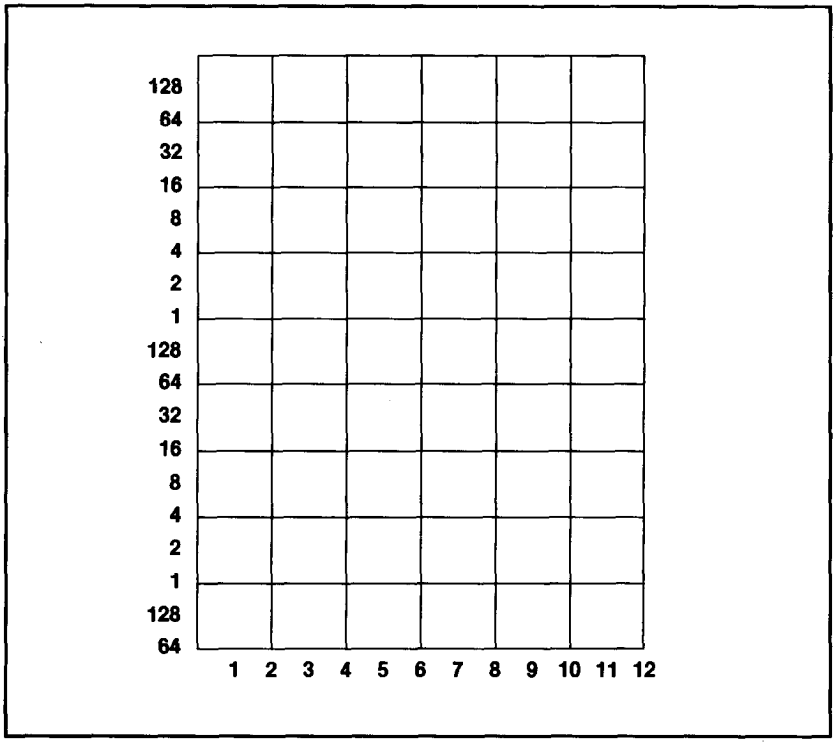


Figure 7-6. *Grid* **for** *NLQ characters*

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.

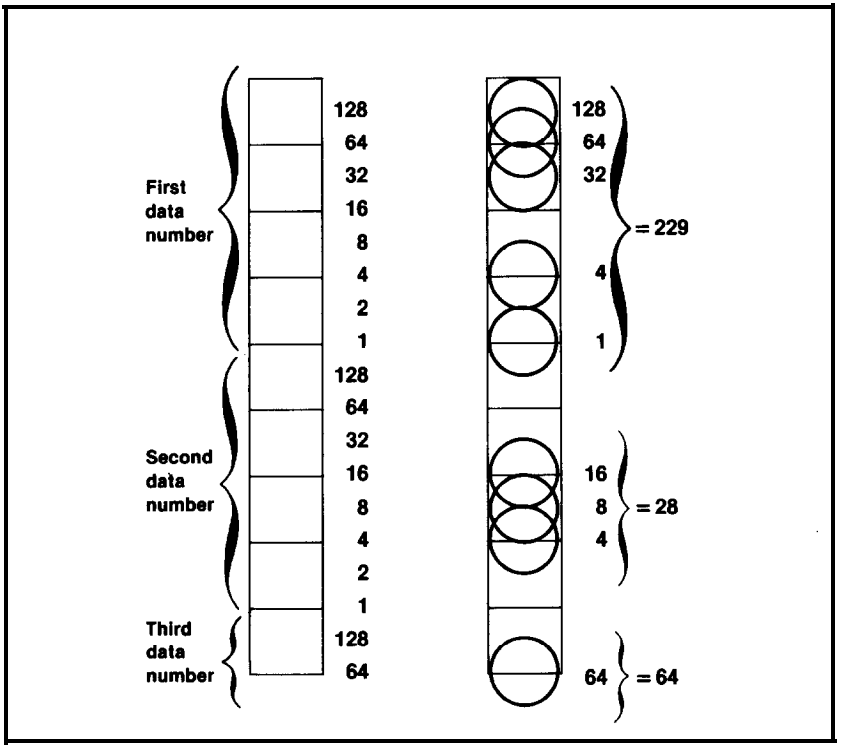


Figure** 7-7. **Data numbers for one column

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.

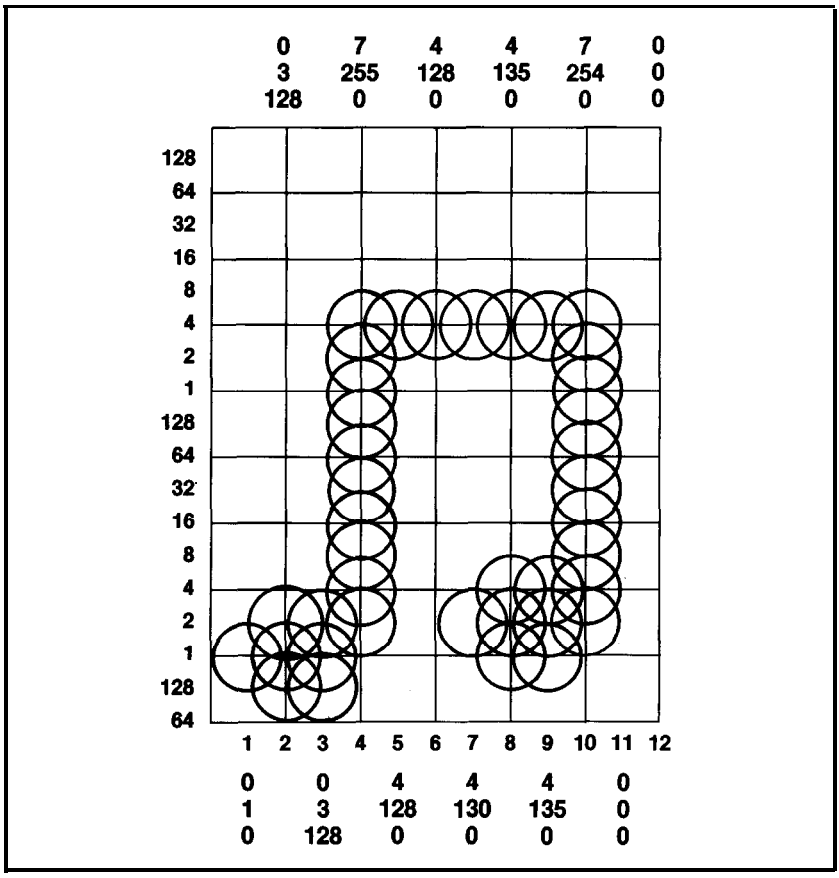


Figure 7-8. Musical design and data numbers

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$(27)"x"CHR$(l)
20 LPRINT CHR$(27) ":"CHR$(0)CHR$(0)CHR$(0);
30 LPRINT  CHR$(27)"%"CHR$(l)CHR$(0);
40 LPRINT  CHR$(27)"&"CHR$(0)"<<";
50 LPRINT  CHR$(0)CHR$(l2)CHR$(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 0,1,0,0,3,128,0,3,128,7,255,0
140 DATA 4,128,0,4,128,0,4,130,0,4,135,0
150 DATA 4,135,0,7,253,0,0,0,0,0,0,0
```

```
YOUR CHARACTER IN PICA:♫ ♫ ♫
IN EXPANDED EMPHASIZED PICA:♫  ♫  ♫
```

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$(1)CH$(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
```

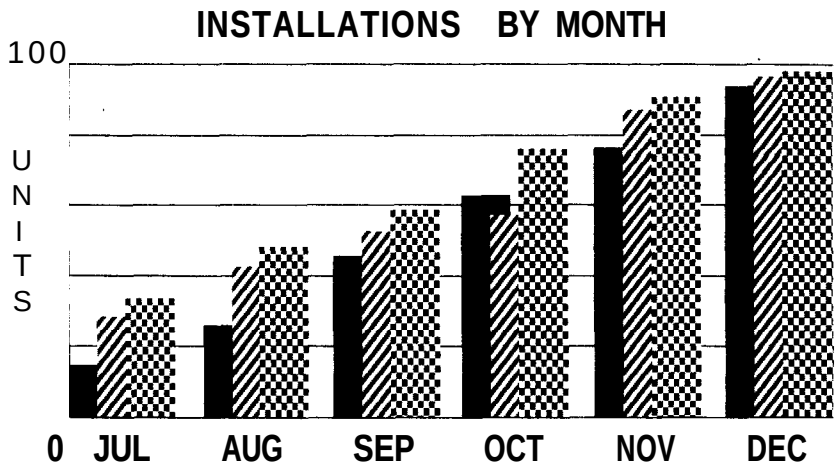
```
: ; < = > ?
: ; ♫ = > ?
```

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 a short time.



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 S-1.

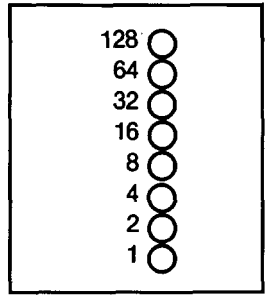


Figure 8-l. Pin labels

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.

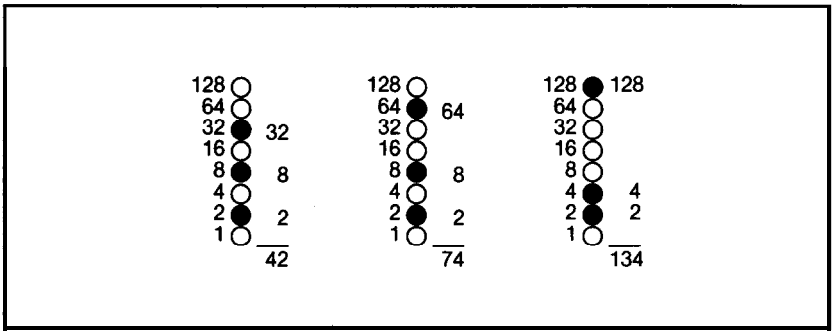


Figure 8-2. Calculating numbers **for** *pin patterns*

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. One format is shown below. Consult your software manual to find the proper format for your system.

```
WIDTH LPRINT 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.

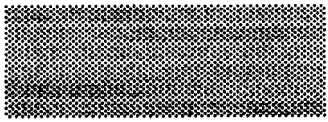
```
NEW
10 WIDTH LPRINT 255
40 LPRINT CHR$(27)"K"CHR$(100)CHR$(0);
50 FOR X=1 TO 50: LPRINT CHR$(85)CHR$(42);
60 NEXT X: LPRINT
100 LPRINT CHR$(27)"@"
```

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 LPRINT 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 20 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 30 begins a loop to produce multiple print lines. Lines 40 and 50 were explained previously. Lines 70 and 80 are similar to lines 40 and 50 except that line 80 uses a reversal of the patterns in line 50. As the loop is executed, the program prints lines 50 and 80 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 40 and 70 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 100 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 "^") 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, nl 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 (O-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 nl 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 (nl) indicates a number of columns, but the second does not represent a number of columns; it is multiplied by 256 and added to nl. The command for the maximum number of dots you can reserve on the LX-90, then, is:

```
CHR$(27)"Z"CHR$(l28)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 nl, 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 among the three most-used graphics modes so that you can choose the one you want.

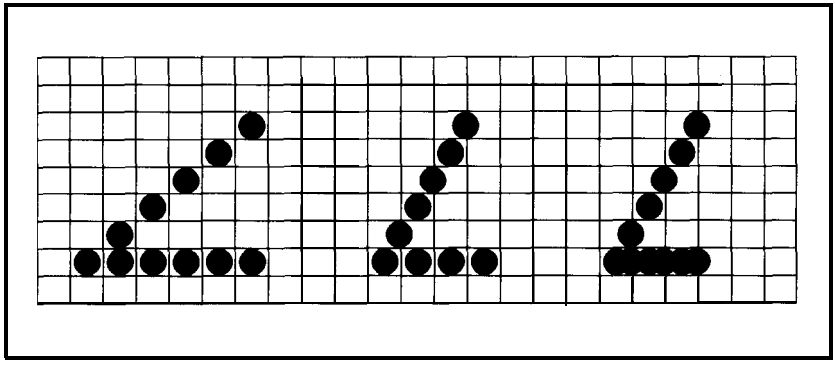


Figure 8-3. Designing in different densities

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.

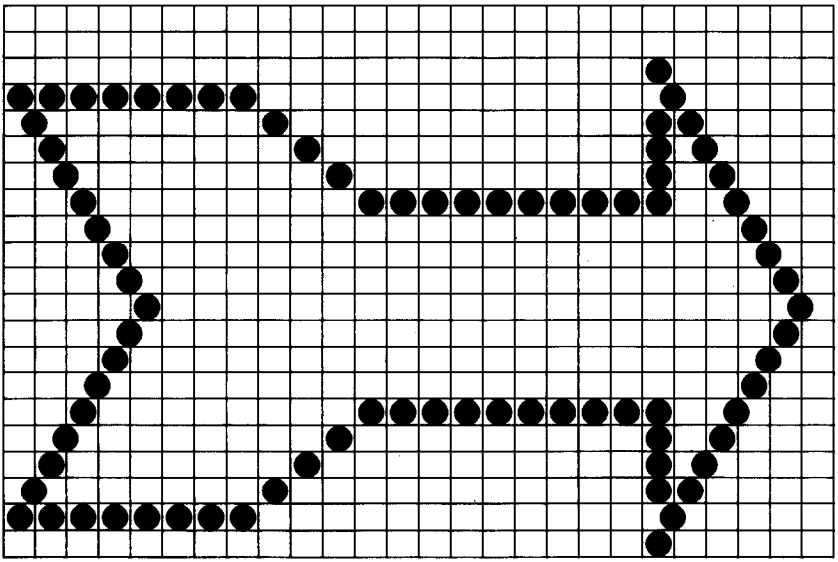


Figure 8-4. Arrow design

Although the top pin (value 128) can be used in any graphic you design, this exercise uses only seven pins (values 1-64). This was done because the graphic has twenty-one rows-using only seven pins produces three lines of seven rows each.

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.

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

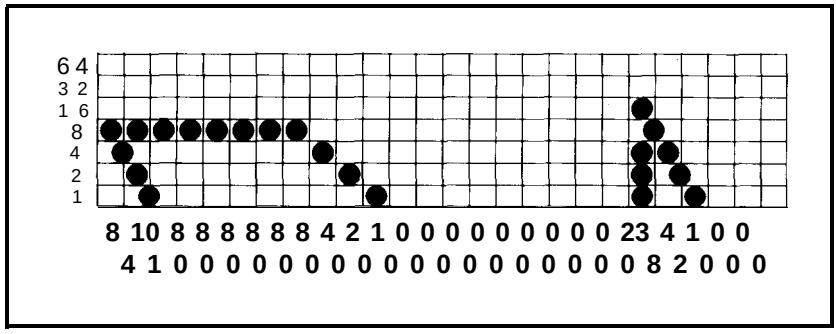


Figure 8-5. First line of arrow figure

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

First is the whole program and its printout, then an explanation of two techniques not used before:

```
NEW
90 WIDTH LPRINT 255
100 LPRINT CHR$(27)"A"CHR$(7)
590 FOR K=1 TO 3
600 LPRINT CHR$(27)"Y"CHR$(50)CHR$(0);
610 READ N: IF N=128 THEN 650
620 IF N>=0 THEN LPRINT CHR$(N);: GOT0 610
630 READ P,R: FOR J=1 TO -N
632 LPRINT CHR$(P)CHR$(R);: NEXT J
640 GOT0 610
650 LPRINT: NEXT K: LPRINT CHR$(27)"@": END
800 DATA 8,4,10,1,-6,8,0,4,0,2,0,1,-9,0,0,0
805 DATA 23,8,4,2,1,-2,0,0,0,128
810 DATA 0,0,0,0,64,32,17,10,4,0,-6,0,0,-10
815 DATA 64,0,0,0,0,64,32,17,10,4,128
820 DATA 2,4,10,16,34,64,-5,2,0,4,0,8,0,16
825 DATA 0,-9,32,0,61,2,4,8,16,32,64,0,0,0,128
```

In this program 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 7-dot line spacing and reads numbers from DATA statements and sends them to the printer. If you want to see the figure in other densities, change the "Y" in line 600 to "L" or "Z".

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 LPRINT 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 twice: once for draft and once for NLQ.

See Chapter 5 for the international characters.

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

Draft Mode

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	**00**	**NUL**	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	none	35	23	#	67	43	C	99	63	c
4	04	none	36	24	$	68	44	**D**	100	64	d
5	05	none	37	25	%	69	45	**E**	101	65	e
6	06	none	38	26	&	70	46	**F**	102	66	f
7	**07**	**BEL**	39	27	'	71	47	**G**	103	67	g
8	**08**	**BS**	40	28	(	72	48	**H**	104	68	h
9	**09**	**HT**	41	29	)	73	49	I	105	69	i
10	OA	LF	42	2A	*	74	4A	J	106	6A	j
11	OB	VT	43	2B	+	75	4B	K	107	6B	k
12	OC	FF	44	2C	,	76	4C	**L**	108	6C	l
13	OD	CR	45	2D	-	77	4D	**M**	109	6D	m
14	**OE**	**SO**	46	2E	.	78	4E	**N**	110	6E	n
15	OF	SI	47	2F	/	79	4F	**O**	111	6F	o
16	10	none	48	30	0	80	50	**P**	112	70	p
17	11	DC1	49	31	1	81	51	**Q**	113	71	q
18	12	DC2	50	32	2	82	52	**R**	114	72	r
19	13	DC3	51	33	3	83	53	**S**	115	73	s
20	14	DC4	52	34	4	84	54	**T**	116	74	t
21	15	none	53	35	5	85	55	**U**	117	75	u
22	16	none	54	36	6	86	56	V	118	76	v
23	17	none	55	37	7	87	57	**W**	119	77	w
24	18	CAN	56	38	8	88	58	**X**	120	78	x
25	19	EM	57	39	9	89	59	**Y**	121	79	y
26	1A	none	58	3A	:	90	5A	**Z**	122	7A	z
27	1B	ESC	59	3B	;	91	5B	**[**	123	7B	{
28	1C	none	60	3C	<	92	5C	****	124	7C	|
29	1D	none	61	3D	=	93	5D	]	125	7D	}
30	1E	none	62	3E	>	94	5E	^	126	7E	~
31	1F	none	63	3F	?	95	5F	_	**127**	**7F**	**DEL**

Draft Mode

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
128	80	NUL	160	A0	blank	192	co	@	224	E0	`
129	81	none	161	A1	!	193	CI	A	225	E1	a
130	82	none	162	A2	"	194	C2	B	226	E2	b
131	83	none	163	A3	#	195	C3	C	227	E3	c
132	84	none	164	A4	$	196	C4	D	228	E4	d
133	85	none	165	A5	%	197	C5	E	229	E5	e
134	86	none	166	A6	&	198	C6	F	230	E6	f
135	87	BEL	167	A7	'	199	C7	G	231	E7	g
136	88	BS	168	A8	(	200	C8	H	232	E8	h
137	89	HT	169	A9	)	201	C9	I	233	E9	i
138	8A	LF	170	AA	*	202	CA	J	234	EA	j
139	8B	VT	171	AB	+	203	CB	K	235	EB	k
140	8C	FF	172	AC	,	204	CC	L	236	EC	l
141	8D	CR	173	AD	-	205	CD	M	237	ED	m
142	8E	SO	174	AE	.	206	CE	N	238	EE	n
143	8F	SI	175	AF	/	207	CF	O	239	EF	o
144	90	none	176	BO	0	208	DO	P	240	F0	p
145	91	DC1	177	B1	1	209	D1	Q	241	F1	q
146	92	DC2	178	B2	2	210	D2	R	242	F2	r
147	93	DC3	179	B3	3	211	D3	S	243	F3	s
148	94	DC4	180	B4	4	212	D4	T	244	F4	t
149	95	none	181	85	5	213	D5	U	245	F5	u
150	96	none	182	B6	6	214	D6	V	246	F6	v
151	97	none	183	B7	7	215	D7	W	247	F7	w
152	98	CAN	184	B8	8	216	D8	X	248	F8	x
153	99	EM	185	B9	9	217	D9	Y	249	F9	y
154	9A	none	186	BA	:	218	DA	Z	250	FA	z
155	9B	ESC	187	BB	;	219	DB	[	251	FB	{
156	9C	none	188	BC	<	220	DC	\	252	FC	/
157	9D	none	189	BD	=	221	DD	]	253	FD	}
158	9E	none	190	BE	>	222	DE	^	254	FE	~
159	9F	none	191	BF	?	223	DF	_	255	FF	none

NLQ Mode

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	00	NUL	32	20	blank	64	40	@	96	60	`
1	01	none	33	21	!	65	41	A	97	61	
2	02	none	34	22	"	66	42	B	98	62	b
3	03	none	35	23	#	67	43	C	99	63	c
4	04	none	36	24	$	68	44	D	100	64	d
5	05	none	37	25	%	69	45	E	101	65	e
6	06	none	38	26	&	70	46	F	102	66	f
7	**07**	**BEL**	39	27	'	71	47	G	103	67	g
8	08	BS	40	28	(	72	48	H	104	68	h
9	09	HT	41	29	)	73	49	I	105	69	i
10	OA	LF	42	2A	*	74	4A	J	106	6A	j
11	OB	VT	43	2B	+	75	4B	K	107	6B	k
12	OC	FF	44	2C	,	76	4C	L	108	6C	1
13	OD	CR	45	2D	-	77	4D	M	109	6D	m
14	OE	SO	46	2E	.	78	4E	N	110	6E	n
15	OF	SI	47	2F	/	79	4F	0	111	6F	0
16	10	none	48	30	0	80	50	P	112	70	**p**
17	11	DC1	49	31	1	81	51	Q	113	71	**q**
18	12	DC2	50	32	2	82	52	R	114	72	r
19	13	DC3	51	33	3	83	53	S	115	73	s
20	14	DC4	52	34	4	84	54	T	116	74	t
21	15	none	53	35	5	85	55	U	117	75	u
22	16	none	54	36	6	86	56	V	118	76	v
23	17	none	55	37	7	87	57	W	119	77	w
24	18	CAN	56	38	8	88	58	X	120	78	x
25	19	EM	57	39	9	**89**	**59**	Y	121	79	**y**
26	IA	none	58	3A	:	90	5A	Z	122	7A	z
27	1B	ESC	59	3B	;	91	5B	[	123	7B	{
28	1C	none	60	3C	<	92	5C	\	124	7C	|
29	ID	none	61	3D	=	93	5D	]	125	7D	}
30	1E	none	62	3E	>	94	5E	^	126	7E	~
31	1F	none	63	3F	?	95	5F	_	127	7F	DEL

NLQ Mode

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
128	80	NUL	160	A0	blank	192	C0	@	224	E0	`
129	81	none	161	Al	!	193	C1	**A**	225	E1	a
130	82	none	162	A2	"	194	C2	B	226	E2	b
131	83	none	163	A3	#	195	C3	C	227	E3	c
132	84	none	164	A4	$	196	C4	D	228	E4	d
133	85	none	165	A5	%	197	C5	E	229	E5	e
134	86	none	166	A6	&	198	C6	F	230	E6	f
135	87	**BEL**	167	A7	'	199	C7	G	231	E7	g
136	88	BS	168	A8	(	200	C8	H	232	E8	h
137	89	HT	169	A9	)	201	C9	I	233	E9	i
138	8A	LF	170	AA	*	202	CA	J	234	EA	j
139	8B	VT	171	AB	+	203	CB	K	235	EB	k
140	8C	FF	172	AC	,	204	CC	L	236	EC	l
141	8D	CR	173	AD	-	205	**CD**	M	237	ED	m
142	8E	SO	174	AE	.	206	CE	N	238	EE	n
143	8F	SI	175	AF	/	207	CF	O	239	EF	o
144	90	none	176	BO	0	208	DO	P	240	FO	p
145	91	DC1	177	B1	1	209	D1	Q	241	F1	q
146	92	DC2	178	B2	2	210	D2	R	242	F2	r
147	93	DC3	179	B3	3	211	D3	S	243	F3	s
148	94	DC4	180	B4	4	212	D4	T	244	F4	t
149	95	none	181	B5	5	213	D5	U	245	F5	u
150	96	none	182	B6	6	214	D6	V	246	F6	v
151	97	none	183	B7	7	215	D7	W	247	F7	w
152	98	CAN	184	B8	8	216	D8	X	248	F8	x
153	99	EM	185	B9	9	217	D9	Y	249	F9	y
154	9A	none	186	BA	:	218	DA	Z	250	FA	z
155	9B	ESC	187	BB	;	219	DB	[	251	FB	{
156	9C	none	188	BC	<	220	DC	\	252	FC	|
157	9D	none	189	BD	=	221	DD	]	253	FD	}
158	9E	none	190	BE	>	222	DE	^	254	FE	~
159	9F	none	191	BF	?	223	DF	_	255	FF	none

Appendix B

Software Commands in Numerical Order

The following list shows the control codes and ESCape sequences that the LX-90 uses along with their decimal values. For further details on their use, consult the index to find out where they are discussed in the text, or Appendix C for details of the correct syntax for their use. (The number after each name is the number of the page in Appendix C where the command is described.)

ESC	47	ESC /	Select Vertical Tab Channel	C-17
ESC	48	ESC 0	Select 1/B-Inch Line Spacing	C-13
ESC	49	ESC 1	Select 7/72-Inch Line Spacing	C-13
ESC	50	ESC 2	Select 1/6-Inch Line Spacing	C-13
ESC	51	ESC 3	Select n/216-Inch Line Spacing	C-14
ESC	52	ESC 4	Select Italic Mode	C-9
ESC	53	ESC 5	Cancel Italic Mode	C-10
ESC	56	ESC 8	Disable Paper-Out Sensor	C-25
ESC	57	ESC 9	Enable Paper-Out Sensor	C-25
ESC	58	ESC :	Copy ROM Into RAM	C-22
ESC	60	ESC <	Select Unidirectional Mode	C-26
ESC	63	ESC ?	Reassign Graphics Mode	C-21
ESC	64	ESC @	Initialize Printer	C-26
ESC	65	ESC A	Select n/72-Inch Line Spacing	C-14
ESC	66	ESC B	Select Vertical Tabs	C-17
ESC	67	ESC C	Select Page Length in Lines	C-15
ESC	67	ESC C 0	Select Page Length in Inches	C-15
ESC	68	ESC D	Set Horizontal Tabs	C-16
ESC	69	ESC E	Select Emphasized Mode	C-7
ESC	70	ESC F	Cancel Emphasized Mode	C-7
ESC	71	ESC G	Select Double-Strike Mode	C-7
ESC	72	ESC H	Cancel Double-Strike Mode	C-8
ESC	74	ESC J	Immediate n/216-Inch Line Feed	C-14
ESC	75	ESC K	Single-Density Graphics Mode	C-19
ESC	76	ESC L	Double-Density Graphics Mode	C-19
ESC	77	ESC M	Select Elite Pitch	C-6
ESC	78	ESC N	Select Skip-Over-Perforation	C-12
ESC	79	ESC O	Cancel Skip-Over-Perforation	C-12
ESC	80	ESC I'	Select Pica Pitch	C-6
ESC	81	ESC Q	Set Right Margin	C-11
ESC	82	ESC R	International Character Set	C-10
ESC	83	ESC S 0	Select Superscript	C-8
ESC	83	ESC S 1	Select Subscript	C-8
ESC	84	ESC T	Cancel Superscript/Subscript	C-8
ESC	85	ESC U	Select Unidirectional Mode	C-26
ESC	87	ESC W	Select/Cancel Expanded Mode	C-6
ESC	89	ESC Y	High-Speed Double-Density Graphics	C-20
ESC	90	ESC Z	Quadruple-Density Graphics Mode	C-20
ESC	94	ESC [A]	Select 9-Pin Graphics Mode	C-21
ESC	97	ESC a	NLQ Justification	C-3

ESC 98 ESC b	Select Vertical Tabs in Channels	**C-17**
ESC 101 ESC e	Set Horizontal and Vertical Tabs	**C-18**
ESC 102 ESC f	Print Spaces or Line Feeds	C-18
ESC **108** ESC l	Set Left Margin	**C-11**
ESC 109 ESC m	Select Special Graphics Characters. ...	**C-10**
ESC 115 ESC s	Select Half-Speed Mode	**C-27**
ESC 120 ESC x	Select NLQ or draft	C-3

Appendix C
Command Summary

This appendix describes all the PIC control codes. They are divided into these categories:

Near Letter Quality (NLQ)
Character Width (Pitch)
Print Enhancement
Page Formatting
Graphics
User-Defined Characters
Other Codes

Each command has a format section and a comment section. The format section gives the ASCII, decimal, and hexadecimal codes for the command. In some cases there is also a control key code because some commercial software programs can use a control key for a code between **0** and **27** (decimal). In this section, CTRL 0, for example, means hold down the control key while you press 0.

Letters in parentheses, such as (n) or (d), are variables, which are explained in the comments sections.

In BASIC you can use either decimal or hexadecimal numbers, and if there is a single letter in the second ASCII code column, you can use that letter in quotation marks instead of the number below it. For example, the format section for the right margin command is as follows:

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

In BASIC you can send the command to set the right margin to 60 in three ways:

```
Decimal :              LPRINT CHR$(27);CHR$(81);CHR$(60)
Hex:                   LPRINT CHR$(&HlB);CHR$(&H51);CHR$(&H3C)
Decimal with quotes: LPRINT CHR$(27);"Q";CHR$(60)
```

ESCape sequences that require a 0 or 1 with a letter, such as ESC 'Wl" to turn on expanded, can use either the ASCII code or the numeral in quotation marks for the 0 or 1. For example, in BASIC you can turn on expanded with either of the formats below:

```
LPRINT CHR$(27);"Wl"   or LPRINT  CHR$(27);"W";CHR$(1)
```

Near Letter Quality Mode

ESC x — Select NLQ or draft

Format:

ASCII code:	**ESC**		**(n)**
Decimal:	**27**	**120**	**(n)**
Hexadecimal :	**1B**	**7 8**	**(n)**

Comments:

n = 0 selects draft mode

n = **1** selects Near Letter Quality (NLQ) mode

ESC a — NLQ Justification

Format:

ASCII code:	**ESC**		**(n)**
Decimal :	27	**97**	**(n)**
Hexadecimal :	**1B**	**61**	**(n)**

Comments:

This sequence selects justification as follows:

n = 0: Selects left justification

n = **1:** Selects centering

n = 2: Selects right justification

n = 3: Selects full justification

The default setting is n = 0.

Full justification (n = 3) is performed when the buffer becomes full.

HT and BS are invalid except in n = 0 mode.

For n = 3 a WIDTH command may be required.

For n = 3 there should be no carriage returns within a paragraph.

NLQ only.

Character Width (Pitch)

SI — Select Compressed Mode

Format:

ASCII code: SI
Decimal : **15**
Hexadecimal: **OF**
Control: **CTRL O**

Comments:

Compressed mode has **17.16** characters per inch. Not available in NLQ.

ESC SI — Select Compressed Mode

Format:

ASCII code:	**ESC**	**SI**
Decimal:	27	15
Hexadecimal:	**1B**	**0F**

Comments:

Duplicates the SI command.

DC2 — Cancel Compressed Mode

Format:

ASCII code: **DC2**
Decimal: **18**
Hexadecimal: **12**
Control: **CTRL R**

Comments:

Cancels compressed printing set by SI or ESC SI.

SO — Select Expanded Mode (one line)

Format:

ASCII code: **S O**
Decimal: **14**
Hexadecimal: **0E**
Control: **CTRL N**

Comments:

Doubles the width of all characters. It can be cancelled by a carriage return, DC4, ESC W0 or ESC !.

ESC SO — Select Expanded Mode (one line)

Format:

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

Comments:

Duplicates the SO command.

DC4 — Cancel Expanded Mode (one line)

Format:

ASCII code: **DC4**
Decimal : **20**
Hexadecimal: **14**
Control: **CTRL T**

Comments:

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

ESC W — Select/Cancel Expanded Mode

Format:

ASCII code:	**ESC**	**W**	**(n)**
Decimal :	27	87	(n)
Hexadecimal:	**I B**	**57**	**(n)**

Comments:

Expanded mode doubles the width of all characters.
n = **1** selects the mode
n = 0 cancels it

ESC M — Select Elite Pitch

Format:

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

Comments:

Elite pitch has 12 characters per inch. Not available in NLQ.

ESC P — Select Pica Pitch

Format:

ASCII code:	**ESC**	**P**
Decimal:	27	80
Hexadecimal:	**I B**	**50**

Comments:

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

Print Enhancement

ESC E — Select Emphasized Mode

Format:

ASCII code:	**ESC**	**E**
Decimal:	27	69
Hexadecimal :	**I B**	**45**

Comments:

In emphasized each dot is printed twice, with the second dot slightly to the right of the first. Reduces print head speed.
Valid only in pica mode.

ESC F — Cancel Emphasized Mode

Format:

ASCII code:	**ESC**	**F**
Decimal:	27	70
Hexadecimal:	**I B**	**46**

Comments:

Turns off the mode selected by ESC E.

ESC G — Select Double-Strike Mode

Format:

ASCII code:	**ESC**	**G**
Decimal:	**27**	**71**
Hexadecimal:	**I B**	**47**

Comments:

In double-strike each line is printed twice, with the second printing slightly below the first. Not valid in NLQ mode.

ESC H — Cancel Double-Strike Mode

Format:

ASCII code:	**ESC**	**H**
Decimal :	27	72
Hexadecimal:	**I B**	**48**

Comments:

Turns off the mode selected by ESC G.

ESC SO — Select Superscript

Format:

ASCII code:	**ESC**	**s**	**0**
Decimal:	27	83	0
Hexadecimal :	**I B**	**53**	**0**

Comments:

Selects superscript mode.

ESC S1 — Select Subscript

Format:

ASCII code:	**ESC**	**s**	**I**
Decimal:	27	83	**I**
Hexadecimal:	**I B**	53	**I**

Comments:

Selects subscript mode.

ESC T — Cancel Superscript/Subscript

Format:

ASCII code:	**ESC**	**T**
Decimal:	27	84
Hexadecimal:	**I B**	**54**

Comments:

Cancels either mode.

ESC - Select/Cancel Underlining

Format:

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

Comments:

n = **1** selects underlining
n = 0 cancels it.

ESC ! Master Select

Format:

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

Comments:

Selects any valid combination of the following modes: pica, elite, compressed, emphasized, double-strike, expanded, italic, underline. Elite, compressed, double-strike, and italic are not available in NLQ. Further details in Chapter 5.

ESC 4 Select Italic Mode

Format:

ASCII code:	**ESC**	4
Decimal:	27	52
Hexadecimal:	**I B**	**34**

Comments:

Causes characters to be printed in the italic character set.
Not valid in NLQ.

ESC 5 — Cancel Italic Mode

Format:

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

Comments:

Cancels the mode selected by ESC 4.

ESC R — Select an International Character Set

Format:

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

Comments:

See Chapter 5 for details on this command.

ESC m — Select Special Graphics Characters

Format:

ASCII code:	**ESC**	**m**	**(n)**
Decimal :	**27**	**109**	**(n)**
Hexadecimal:	**I B**	6D	**(n)**

Comments:

Selects the special graphics character set, which is stored in ASCII positions **128 to 159.** Format in BASIC:

CHR$(27);“m”;CHR$(n)

where n toggles the character set on and off:

4 turns the graphics characters ON,

0 turns them OFF.

Page Formatting

Margins

ESC Q — **Set Right Margin**

Format:

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

Comments:

Sets the right margin. Also cancels all text in the print buffer.
The range of n is shown below:

2-80 in pica
3-96 in elite
4-137 in compressed
4-160 in compressed elite

ESC l — **Set Left Margin**

Format:

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

Comments:

Sets the left margin.
n = first printing column in the current pitch
Maximum value of n is:

78 in pica
93 in elite
133 in compressed
156 in compressed elite

Clears previous tab settings; therefore should be set before tabs are set. Use lowercase 1, not the numeral one.

ESC N — Select Skip-Over-Perforation

Format:

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

Comments:

The variable n is the number of lines skipped between the last line printed on one page and the first line on the next page. For example, with the standard settings for line spacing and page length (66 lines) ESC N 6 will cause the LX-90 to print 60 lines and then skip 6.

ESC O — Cancel Skip-Over-Perforation

Format:

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

Comments:

Cancels the mode selected by ESC N.

Line spacing

LF — Line Feed

Format:

ASCII code:	**L F**
Decimal:	**IO**
Hexadecimal:	**OA**
Control:	**CTRL J**

Comments:

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

ESC 0 — Select l/&-Inch Line Spacing

Format:

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

Comments:

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

ESC 1 — Select 7/72-Inch Line Spacing

Format:

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

Comments:

Sets the line spacing to **7/72** of an inch for subsequent line feed commands. The **"1"** is the digit one and not lower case L or ASCII code **1.**

ESC 2 — Select l/6-Inch Line Spacing

Format:

ASCII code:	**ESC**	2
Decimal:	27	50
Hexadecimal:	**I B**	**32**

Comments:

Sets the line spacing to **1/6** of an inch for subsequent line feed commands. The **"2"** is the digit two and not ASCII code **2.** This is the default at power on.

ESC 3 — Select n/216-Inch Line Spacing

Format:

ASCII code:	**ESC**	3	(n)
Decimal:	27	51	(n)
Hexadecimal:	I3	**33**	**(n)**

Comments:

Sets the line spacing to **n/216** of an inch for subsequent line feed commands. The "3" is the digit three and not ASCII code **3.** The value of n should be in the range **0** to **255.**

ESC J — Immediate n/216-Inch Line Feed

Format:

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

Comments:

Advances the paper by one line at a spacing of **n/216** of an inch. The value of n should be in the range **0** to **255.** This produces an immediate line feed but does not affect subsequent line spacing and does not produce a carriage return.

ESC A — Select n/72-Inch Line Spacing

Format:

ASCII code:	**ESC**	**A**	**(n)**
Decimal:	27	65	(n)
Hexadecimal:	I3	**41**	**(n)**

Comments:

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

Form feed and page length

FF — Form Feed

Format:

ASCII code: **F F**
Decimal: 12
Hexadecimal: 0C
Control: **CTRL L**

Comments:

Prints the data in the print buffer and advances the paper to the top of the next page according to the current page length.

ESC C — Select Page Length in Lines

Format:

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

Comments:

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

ESC CO — Select Page Length in Inches

Format:

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

Comments:

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

Tabs

HT — Tab Horizontally

Format:

ASCII code: **H T**
Decimal: 9
Hexadecimal: 09
Control: **CTRL I**

Comments:

Advances the print position to the next horizontal tab setting.

ESC D — Set Horizontal Tabs

Format:

ASCII code:	**ESC**	**D**	**(n1)**	**(n2)**	**...**	**0**
Decimal:	27	**68**	**(n1)**	**(n2)**	**...**	**0**
Hexadecimal:	1B	44	**(n1)**	**(n2)**	**...**	**00**

Comments:

This command allows setting of up to 32 horizontal tabs. These are entered as nl, n2, n3 etc. (in the range **1** to 255) with ASCII 0 as the terminator. The tab settings nl, n2, n3 etc. must be entered in ascending order. If nl = 0, all tabs are cleared. The settings on power up or after an ESC @ command are every eight characters.

VT — Tab Vertically

Format:

ASCII code: VT
Decimal: **11**
Hexadecimal: **0B**
Control: **CTRL K**

Comments:

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

ESC B — Select Vertical Tabs

Format:

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

Comments:

Sets up to **16** vertical tabs in the current line spacing. Tab settings are not affected by subsequent changes in line spacing. Terminate this tab sequence with 0 or a number less than that of the last tab.

ESC b — Select Vertical Tabs in Channels

Format:

ASCII code:	ESC	b	(c)	(n1)	(n2)	...	0
Decimal:	27	98	(c)	(n1)	(n2)	...	0
Hexadecimal:	1B	62	(c)	(n1)	(n2)	...	00

Comments:

c=0to7

Sets up to 16 vertical tabs for channel c.

The tab settings can be cleared by giving a value of zero to nl.

Tab settings are not affected by subsequent changes in line spacing.

ESC l — Select Vertical Tab Channel

Format:

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

Comments:

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

ESC e — Set Horizontal and Vertical Tabs

Format:

ASCII code:	**ESC**	**e**	**(n1)**	**(n2)**
Decimal:	**27**	**101**	**(n1)**	**(n2)**
Hexadecimal:	**1B**	**85**	**(n1)**	**(n2)**

Comments:

Sets horizontal and vertical tab increments.

Horizontal format when nl = 0. In BASIC:

CHR$(27);"eO";CHR!$(n)

where n is the number of spaces and equals:

0 - 21 in pica, 0 - 25 in elite, 0 - 36 in compressed.

Vertical format when nl = 1. In BASIC:

CHR$(27);"el";CHR$(n)

where n is the number of line feeds and equals:

INT(255/x) for x/216-inch line spacing,

INT(85/x) for x/72-inch line spacing.

7 for 12-dot line spacing.

ESC f — Print Spaces or Line Feeds

Format:

ASCII code:	**ESC**	**f**	**(n1)**	**(n2)**
Decimal:	**27**	**102**	**(n1)**	**(n2)**
Hexadecimal:	1B	**66**	**(n1)**	**(n2)**

Comments:

Prints spaces or line feeds without carriage returns.

Horizontal format when nl = 0. In BASIC:

CHR$(27);"fO";CHR$(n)

where n is the number of spaces and equals 0 - 127.

Vertical format when nl = 1. In BASIC:

CHR$(27);"fl";CHR$(n)

where n is the number of line feeds and equals 0 - 127.

Graphics

Note: See Chapter 8 for sample graphics programs.

ESC K -Select Single-Density Graphics Mode

Format:

ASCII code:	**ESC**	**K**	**(n1)**	**(n2)**
Decimal:	**27**	**75**	**(n1)**	**(n2)**
Hexadecimal:	**1B**	**4B**	**(n1)**	**(n2)**

Comments:

Turns on single-density graphics mode with 480 possible dots per 8-inch line.

If d is the total number of columns required,

nl = d MOD 256

n2 = INT(d / 256)

This command must be followed by d data numbers.

ESC L Select Double-Density Graphics Mode

Format:

ASCII code:	**ESC**	**L**	**(n1)**	**(n2)**
Decimal:	**27**	**76**	**(n1)**	**(n2)**
Hexadecimal:	**1B**	**4C**	**(n1)**	**(n2)**

Comments:

Turns on low-speed double-density graphics mode with 960 possible dots per 8-inch line.

If d is the total number of columns required,

n1 = d MOD 256

n2 = INT(d / 256)

This command must be followed by d data numbers.

ESC Y Select High-Speed Double-Density Graphics Mode

Format:

ASCII code:	**ESC**	**Y**	**(n1)**	**(n2)**
Decimal:	**27**	**89**	**(n1)**	**(n2)**
Hexadecimal:	1B	**59**	**(n1)**	**(n2)**

Comments:

Turns on high-speed double-density graphics mode with 960 possible dot positions per B-inch line. Will not print consecutive dots in a row.

If d is the total number of columns required,

nl = d MOD 256

n2 = INT(d / 256)

This command must be followed by d data numbers.

ESC Z Select Quadruple-Density Graphics Mode

Format:

ASCII code:	**ESC**	**Z**	**(n1)**	**(n2)**
Decimal:	**27**	**90**	**(n1)**	**(n2)**
Hexadecimal:	**1B**	**5A**	**(n1)**	**(n2)**

Comments:

Turns on quadruple-density graphics mode with 1920 possible dot positions per B-inch line. Will not print consecutive dots in a row.

If d is the total number of columns required,

n1 = d MOD 256

n2 = INT(d / 256)

This command must be followed by d data numbers.

ESC * — Select Graphics Mode

Format:

ASCII code:	**ESC**	*****	**(m)**	**(n1)**	**(n2)**
Decimal :	**27**	42	**(m)**	**(n1)**	**(n2)**
Hexadecimal:	1B	2A	**(m)**	**(n1)**	**(n2)**

Comments:

Turns on graphics mode m. See Chapter 8 for details on the 7 modes available.

If d is the total number of dots required,

nl = d MOD 256

n2 = INT(d / 256)

This command must be followed by d data numbers.

ESC ? — Reassign Graphics Mode

Format:

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

Comments:

Changes one graphics mode to another. The variable s is a character K, L, Y, or Z, which is reassigned to a mode O-6.

ESC ^ — Select 9-Pin Graphics Mode

Format:

ASCII code:	**ESC**	**^**	**(m)**	**(n1)**	**(n2)**
Decimal:	**27**	**94**	**(m)**	**(n1)**	**(n2)**
Hexadecimal :	1B	**5E**	**(m)**	**(n1)**	**(n2)**

Comments:

Turns on 9-pin graphics mode. Where m defines density of print (0 for single and 1 for double) and d is the total number of dots required nl and n2 are as below:

nl = d MOD 256 and n2 = INT(d / 256)

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

User-Defined Characters

Note: See Chapter 7 for sample programs and further information.

ESC & — Define User-Defined Characters

Format:

ASCII code:	**ESC**	**&**	**NUL**	**(d1)**	**(d2)**	**...**	**(dn)**
Decimal:	27	38	**0**	**(d1)**	**(d2)**	**...**	**(dn)**
Hexadecimal:	**1B**	26	**00**	**(d1)**	**(d2)**	**...**	**(dn)**

Comments:

This command allows characters to be re-defined in the currently selected mode. Only characters from ASCII 58 through 63 can be re-defined.

ESC : — Copy ROM Into RAM

Format:

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

Comments:

This code allows the characters in the LX-90 ROM to be copied into RAM so that specific characters can be redefined.

ESC % — Select User-Defined Set

Format:

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

Comments:

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

Other Codes

BEL — Beeper

Format:

ASCII code: **BEL**
Decimal: 7
Hexadecimal: 07
Control: **CTRL G**

Comments:

Sounds the printer's beeper.

BS — Backspace

Format:

ASCII code: **B S**
Decimal: 8
Hexadecimal: 08
Control: **CTRL H**

Comments:

Prints out data in the print buffer, then moves the print position one space to the left. If this code is received immediately after graphics printing, the print position of subsequent data is moved back to the point at which graphics printing started.

CR — Carriage Return

Format:

ASCII code: **C R**
Decimal : **13**
Hexadecimal : 0D
Control: **CTRL M**

Comments:

Prints the data in the buffer and returns the print position to the left margin.

DC1 — Select Printer

Format:'

ASCII code: **DC1**
Decimal : **17**
Hexadecimal : 11
Control: **CTRL Q**

Comments:

Returns the printer to the on-line mode if it has been switched off by the printer deselect code, DC3. It will not switch the printer on line if it has been switched off using the ON LINE switch on the control panel.

DC3 — Deselect Printer

Format:

ASCII code: **DC3**
Decimal: **19**
Hexadecimal: 13
Control: **CTRL S**

Comments:

Places the printer in off-line mode until the select printer code DC1 is received.

CAN — Cancel Line

Format:

ASCII code: **CAN**
Decimal: 24
Hexadecimal: **18**
Control: **CTRL X**

Comments:

Removes all text in the print buffer, but does not affect control codes.

ESC EM — Cut Sheet Feeder Control

Format:

ASCII code:	**ESC**	**EM**	**(n)**
Decimal:	27	25	(n)
Hexadecimal:	**1B**	**19**	**(n)**

Comments:

Used with the optional cut-sheet feeder. When n = 0 the feeder is turned off, when n = 4 it is turned on. Using DIP switch 1-3 produces the same effect.

ESC a — Disable Paper-Out Sensor

Format:

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

Comments:

Turns off the paper-out sensor **so that** you can print to the end of a single sheet of paper. This command duplicates the function of DIP switch 1-5. Some computer systems ignore this command. See page D-3.

ESC 9 — Enable Paper-Out Sensor

Format:

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

Comments:

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

ESC < — Select Unidirectional Mode (one line)

Format:

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

Comments:

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

ESC @ — Initialize Printer

Format:

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

Comments:

Resets the printer to the power-on state, including top of form. Clears the buffer of all data entered before the command but not after.

ESC U — Select Unidirectional Mode

Format:

ASCII code:	**ESC**	**U**	**(n)**
Decimal:	27	65	(n)
Hexadecimal:	**1B**	55	(n)

Comments:

Selects unidirectional printing for more accurate positioning during text printing.

n = 1 selects the feature

n = **0** cancels it.

(Graphics printing is always unidirectional.)

ESC s — Select Half-Speed Mode

Format:

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

Comments:

n = 1 selects the mode
n = 0 cancels it.

DEL — Delete Character

Format:

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

Comments:

Removes the last text character in the print buffer but does not affect control codes. It cannot be guaranteed in the italic mode. Not valid in NLQ.

Appendix D

DIP Switches and Interface

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. This appendix also describes the interface.

DIP Switches

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

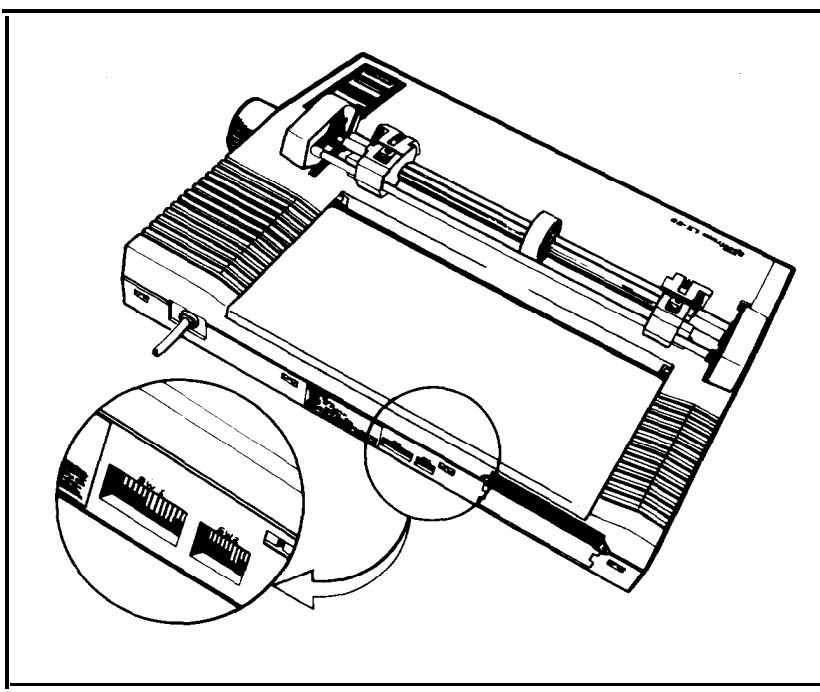


Figure D-l. DIP switch location

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-l shows you the functions of all the switches, and the rest of the appendix explains each of them.

Table D-7. 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	International character set See Table D-2.		
1-7			
1-8			

Switch 2

No.	ON	Function	OFF
2-1	0 (slashed)	Zero character	0
2-2	Inactive	Printer select	Active
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 compressed printing. ON is compressed; OFF is pica. Regardless of the setting, you can still select compressed with SelecType and either compressed or pica with ESCape codes.

Switch Z-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** l-3* controls the optional cut-sheet feeder, a device that automatically loads single sheets of paper into the printer. When it is ON, the cut-sheet feeder is enabled. When it is OFF, the cut-sheet feeder is disabled. Keep it off unless you are using a cut-sheet feeder.

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

Switch 1-5 controls the paper-end detector. When it is ON, the detector is inactive, causing printing to continue 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. The ESCape "8" command also performs this function, but computer systems that monitor printer cable pin 12 will ignore both ESCape 8 and the setting of switch 1-2. If you have such a system and want to print on the bottom two inches of a sheet of paper, there are two solutions to this problem. Buy a computer cable designed to overcome the problem; or use longer paper as a backing sheet.

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

Table D-2. International DIP switch settings

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

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 regulates printer selection. When it is ON, DC1 and DC3 do not affect the printer. When it is OFF, DC1 selects the printer and DC3 deselects the printer.

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* controls the beeper. When it is OFF, the beeper can sound; when it is ON, the beeper cannot sound.

Interface

The PIC uses an &bit, Centronics®-compatible, parallel interface.

Connector pin assignments and a description of respective interface signals are shown in Table D-3.

Table D-3. Pins and signals

	Return Pin	Signal	Direc. tion	Description
1	19	$\overline{\text{STROBE}}$	IN	STROBE pulse to read data in. Pulse width must be more than 0.5 microseconds at the receiving terminal.
2 3 4 5 6 7 8 9	20 21 22 23 24 25 26 27	DATA 1 DATA 2 DATA 3 DATA 4 DATA 5 DATA 6 DATA 7 DATA 8	IN IN IN IN IN IN IN	These signals represent information of the 1st to 8th bits of parallel data, respectively Each signal is at HIGH level when data is logical 1 and LOW when it is logical 0.
10	28	$\overline{\text{ACKNLG}}$	OUT	Approximately 12-microsecond pulse. LOW indicates that data has been received and that the printer is ready to accept more data.
11	29	BUSY	OUT	A HIGH signal indicates that the printer cannot receive data. The signal goes HIGH in the following cases: 1) During data entry (ea. char. time) 2) During printing 3) When Off-Line 4) During printer-error state
12	30	PE	OUT	A HIGH signal indicates that the printer is out of paper.

Table D-3, continued

Signal Pin	Return Pin	Signal	Direction	Description
13	-	SLCT	OUT	Pulled up to + 5 volts through 3.3K ohm resistance.
14	-	NC	-	Unused.
15	-	NC	-	Unused.
16	-	NC	-	Unused.
17	-	CHASSIS GND	-	Printer's chassis ground, which is isolated from the logic ground.
18	-	NC	-	Unused.
19 - 30	-	GND	-	Twisted-pair return signal ground level.
31	-	$\overline{\text{INIT}}$	IN	When this level becomes LOW, the printer controller is reset to its power-up state and the print buffer is cleared. This level is usually HIGH; its pulse width must be more than 50 microseconds at the receiving terminal.
32	-	$\overline{\text{ERROR}}$	OUT	This level becomes LOW when the printer is in: 1) Paper-end state. 2) Off-line. 3) Error state.
33	-	NC	-	Unused.
34	-	NC	-	Unused.
35	-	NC	-	Unused
36	-	NC	-	Unused.

Notes:

1. The column heading "Direction" refers to the direction of signal flow as viewed from the printer.
2. "Return" denotes the twisted-pair return, to be connected at signal ground level. For the interface wiring, be sure to use a twisted-pair cable for each signal and to complete the connection on the return side. To prevent noise, these cables should be shielded and connected to the chassis of the host computer or the printer but not at both ends.
3. All interface conditions are based on TTL level. Both the rise and the fall times of each signal must be less than 0.2 microseconds.

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

Data Transfer Sequence

Interface timing

Figure **D-2** shows the timing for the parallel interface.

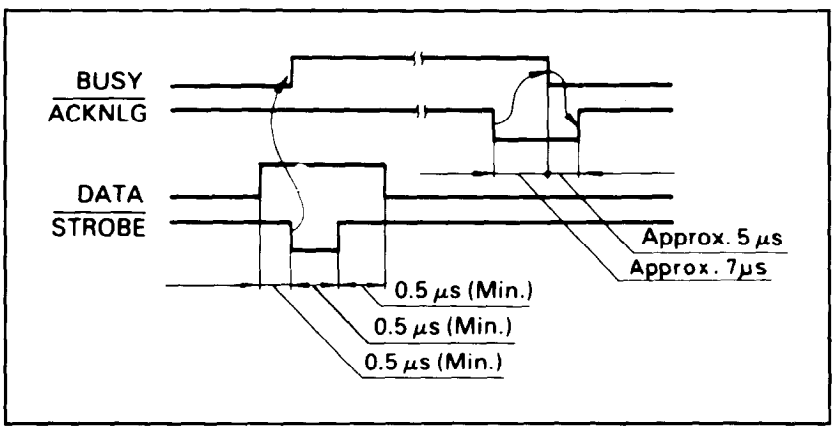


Figure D-2. Parallel interface timing

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. When the program asks you the name or type of printer you are using, select one of the following from the menu. The ones at the top of the list are preferable to the ones at the bottom.

Epson LX-90
Epson HomeWriter-
Epson FX
Epson RX
Epson printer
Epson MX
Draft printer

Some programs allow you to install the LX-90 as a custom printer and specify its characteristics. If you choose to do this, follow the instructions in your software manual and use the appendixes to find the print codes and other specifications required.

SelecType Features and Solutions

This section explains why SelecType does not work with some software and how to cancel modes with SelecType.

Reset codes

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 can't disable the reset code, you can use the DIP switches to produce NLQ or compressed. See Appendix D for details.

Cancelling modes

If you want to cancel the modes you have set with SelecType, you can turn your printer off and back on with the power switch on the right side of the printer. This cancels all SelecType settings, returns your LX-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.

Printing on Self-adhesive Labels

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 the ASCII code 7 or 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.

Applesoft BASIC Solutions

Applesoft BASIC does not use PRINT to send data to the screen and LPRINT to send data to the printer as Microsoft BASIC does. Therefore, you need to change the programs in this manual somewhat. In most cases all you need to do is to add two lines to each program and change all instances of LPRINT to PRINT. Add a line at the beginning of the program that states PR#l and a line at the end that states PR#0.

For the programs in this manual that contain INPUT statements, put the line that states PR#l after the INPUT statement.

QX-l0® and QX-l6™ Solutions

The format for the WIDTH statement for the Epson QX-10 and QX-16 computers is:

```
WIDTH LPRINT 255
```

Graphics

There are two 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 7 for the proper format for the WIDTH statement and for sample programs that show the proper use of semicolons.

2. 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 *nl* 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 OD OA 47 OD OA 48 OD OA 49 OD OA 1B 45 OD OA F..G..H..I...E..
0001 53 61 6D 70 60 65 20 74 65 78 74 OD OA 1B 40 OD Sample text ...@.
0002 OA
```

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 OD and OA. 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,** OD, and OA, 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 exactly what the printer is receiving, regardless of what the computer is sending. The following program run in the data dump mode can show how the computer and BASIC handle certain codes.

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

After you type this program, put the printer in data dump mode and 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 Figure **E-l.** If any are skipped or repeated, you will know that your software changes some codes before it sends them to the printer.

The data dumping capability can help you find problems and debug programs quickly.

00	01	02	03	04	05	06	07	08	09	OA	OB	OC	OD	OE	OF
10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
60	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F
70	71	72	73	74	75	76	77	78	79	7A	7B	7C	7D	7E	7F
80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F
90	91	92	93	94	95	96	97	98	99	9A	9B	9C	9D	9E	9F
A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA	AB	AC	AD	AE	AF
BO	B1	B2	B3	B4	B5	B6	B7	B8	B9	BA	BB	BC	BD	BE	BF
C0	Cl	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF
D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	DA	DB	DC	DD	DE	DF
E0	El	E2	E3	E4	E5	E6	E7	E8	E9	EA	EB	EC	ED	EE	EF
F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	FA	FB	FC	FD	FE	FF

Figure E-l. Hexadecimal codes in order

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