



LaserPrinter 4 III

APPLICATIONS MANUAL

Trademark Acknowledgements

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PageMaker: Aldus Corporation

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PREFACE

About this manual

This *Star LaserPrinter 4III Applications Manual* gives you the information you need to program the Star Micronics LaserPrinter 4III.

Why would you read this book? Most people using a laser printer just run software packages with built-in *printer drivers*, which look after everything their computers send their printers. But many of us — small business people and home computer users, not to mention the wizards who write those software packages — want to benefit from all the new features offered by our printers.

Do you want complete control over the characters and images you print? This manual provides the software help you need to get the most from your LaserPrinter 4III.

Though this *Applications Manual* is really intended for intermediate to advanced computer users, we've tried to accommodate relative novices too. The information is organized so you can walk through the general theory underlying printer programming before dancing into specific details. It makes sense, therefore, to read the first three chapters before jumping into the middle.

There's a good reason to read each chapter from its start too. People learning how to use a new printer often find the terminology a barrier. So instead of burying what may be new jargon in a Glossary at the back, we define each new term the first time it appears. The whole first part of the chapter on fonts, for example, defines different aspects of a *font* (a collection of characters of the same size and style).

What's in this manual?

- In “Getting to Know Your Star LaserPrinter 4III” we provide a list of the features that make this a splendid printer, to help you choose which features you want to exploit. There’s a bit on how laser printers work, inside and out. The chapter then explains software in general terms, including how to write control and Escape commands to make those features work.
- “Controlling Your Printer” examines the parameters you give the Star LaserPrinter 4III to direct precisely how you want it to behave. These let you control the printer, manage page formats, and specify what you want printed.
- For most of us, the “Fonts” chapter will be useful: how to use the fonts built into the LaserPrinter 4III, plus those that come on cartridges or computer disks.
- You may look at chapters 4 and 5, which cover Star LaserPrinter 4III commands. Your LaserPrinter 4III *emulates* (imitates) Hewlett-Packard LaserJet III by accepting the same commands they do.

If you want to write or modify a program that uses the Hewlett-Packard LaserJet III, chapters 4 and 5 show how your Star LaserPrinter 4III can emulate to accordingly.

The chapter on “Printer Control Language” is longer and more detailed than the other. That’s because you are more likely to use laser printer commands than commands for vector graphics.

- The final “Technical Supplement” containing the command and character reference tables will probably get thumbed the most.

Conventions

Incidentally, one of those Technical Supplement tables suggests a couple of typographic conventions we'll use. Base ten (decimal) numbers will generally be used here; if we have to use base sixteen numbers (*hexadecimal*) we'll expressly say so.

And second, the lowercase L is practically identical to the number one (l versus 1). Because lowercase L is used in many command descriptions, we'll use the character ℓ to avoid confusion.

The Star LaserPrinter 4III Operations Manual

This manual is the companion to the *Star LaserPrinter 4III Operations Manual* that came with your printer. A laser printer is a fairly complex tool that requires care and delicate handling. So to use this *Applications Manual* best, make sure you understand that *Operations Manual* first.

Your *Operations Manual* holds essential information about the LaserPrinter 4III, such as how to:

- unpack and set up your laser printer,
- connect the Star LaserPrinter 4III to your computer's serial or parallel port,
- link the LaserPrinter 4III into a network of several computers,
- configure the LaserPrinter 4III to your needs (with variables such as paper size and speed of data transfer),
- load paper and the toner cartridge,
- operate the panel switches and display,
- run the LaserPrinter 4III self-test,
- look after your printer to keep it in peak condition.

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Getting to Know Your Star LaserPrinter 4III

CHAPTER 1

This chapter introduces both the hardware and software aspects of the Star LaserPrinter 4III's personality, from fonts and print engine to ASCII and Escape sequences.

1.1 STAR LASERPRINTER 4III HARDWARE

1.1.1 Versatility

Your Star Micronics Star LaserPrinter 4III works with practically all commercial software programs and computers. With features that go beyond Star's easy, affordable 9-pin and fast, quality-printing 24-pin dot matrix printers, the Star Laser Printer is the logical next step in the series of fine Star Micronics printers.

Your Star LaserPrinter 4III produces pages that look close to typeset quality, with up to 90,000 dots per square inch — no more NLQ (near letter quality) compromises. The Star LaserPrinter 4III produces four of those pages a minute. These numbers translate to about five times more resolution and about three times more speed than the average dot-matrix printer.

Star's new printer is remarkably versatile. You can print complicated forms (widthwise if you want) ... detailed graphs ... your own customized typestyles ... digitized photographs ... other languages (including Arabic and Japanese).

You can even print your letterhead and logo as you print your letter, and reprint them directly onto a business envelope. You don't even need to remove the paper tray to print the envelope: just slide it into the manual feed slot.

The Star LaserPrinter 4III is ideal for desktop publishing. The pages it produces make perfect photocopy or instant-print masters. And all the main desktop publishing systems, including Aldus Corporation's *PageMaker* and Xerox *Ventura* Publisher, work splendidly with the Star LaserPrinter 4III. With "page makeup" programs like these you will be able — maybe for the first time — to deliver communications with the impact of top-notch graphics.

1.1.2 Font options

You can print with an amazingly wide variety of type fonts and sizes. The Star LaserPrinter 4III comes with two built-in bit-mapped fonts and two built-in scalable fonts, which can be printed from 3 points to 999.75 points in size (a point is about 1/72 of an inch).

These fonts are:

CG Times Font
Univers Font
Courier Font
Line Printer Font

Besides these, you may be able to use optional cartridges and disks to give your Star LaserPrinter 4III a variety of extra fonts, such as these:

Prestige fonts
Letter Gothic fonts
H Gothic fonts
Roman fonts
Presentation fonts
Optical Character Reader fonts
Line drawing
Bar codes

You can load your Star LaserPrinter 4III's memory with fonts stored on computer disks. Literally hundreds of fonts are marketed by font-supply companies. Some fonts are even obtainable from computer "user groups" or "electronic bulletin boards". Fonts you get this way are in the public domain, which means you don't need to pay a licence fee to use them.

Ask your Star LaserPrinter 4III dealer about resources like these. Desktop publishing with laser printers is fast-changing territory, and some Star Micronics staff people have found electronic bulletin boards and computer user groups quite helpful in keeping up with the changing pace. If you invest a little time this way it may repay you well.

1.1.3 How your laser printer communicates

Your computer communicates with the Star LaserPrinter 4III through either a *parallel* cable or one of two kinds of *serial* cable. The printer's *interface*, the link or boundary it shares with your computer, defines whether the printer will accept characters and commands from your computer one *byte* or one *bit* at a time.

A bit is the smallest unit of computer or printer memory. It has either a low or high electric charge, which we represent with the digits 0 and 1. Usually eight adjacent bits are grouped to form a byte. Since a byte normally represents one character, this string of bits — 01000001 — might represent the letter A.

The serial interface accepts just one bit at a time from your computer. A parallel interface can handle a whole byte at once, by moving data bits side-by-side along separate wires. You choose which interface method you want to use by selecting it on the operator panel, as explained in your *Star LaserPrinter 4III Operations Manual*.

1.1.4 The Star LaserPrinter 4III is a computer

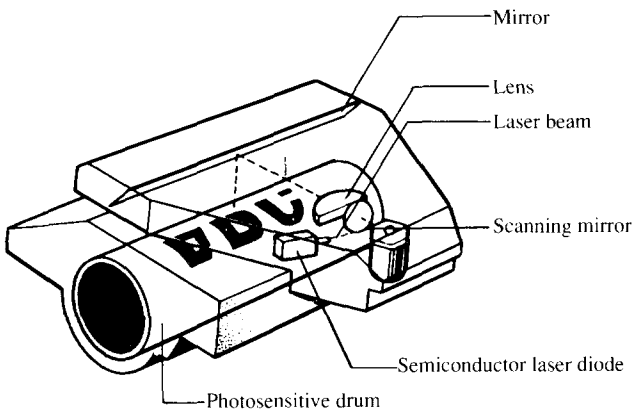
The Star LaserPrinter 4III first *maps* the characters to be printed into its own *random access memory* (RAM). That is, the printer builds a “picture” in its memory corresponding to the page you want to print. When that's done the printer can reproduce the page onto paper on its own, letting your computer get on with other work.

Your Star LaserPrinter 4III comes with one *megabyte* of RAM — the equivalent of about one million characters. A Star LaserPrinter 4III option lets you add a second megabyte of RAM if, say, you need to map full-page graphics or store more fonts. Accompanying all that RAM is another 2 megabytes of read only memory (ROM), containing a library of internal fonts and the programs that let the Star LaserPrinter 4III emulate other printers.

An Intel 80960SA computer chip controls both the memory and the printing mechanism in the printer, called the print engine. The printer stores a whole page in RAM before printing it. (If a page is so dense that it overflows memory — a most unlikely event — the Star LaserPrinter 4III prints the page on two sheets.)

1.1.5 The Print engine

It's the print *engine* that forms the actual characters and graphics. The engine directs its laser, a pinpoint stream of light pulses, through mirrors and lenses onto the surface of a positively-charged rotating drum.



As the laser scans, it “draws” the page-map stored in your printer’s memory. Wherever a light pulse strikes, that tiny part of the drum drops to a neutral electrical charge. That spot then attracts fine toner powder as the drum rotates past the powder compartment.

As the drum rotates further it meets the paper. The paper itself is negatively charged by passing by a fine *corona* wire. Since opposite charges attract, the negative paper clings to the positive drum. Then heat and pressure from a roller melt or *fuse* the dots of toner onto the paper, precisely reproducing the image.

Finally the paper slides into the output bin. The paper usually comes out face down, so it stacks in the correct sequence.

1.2 STAR LASERPRINTER 4III SOFTWARE

1.2.1 *Binary and hexadecimal arithmetic*

If you already know what hexadecimal numbers are, you can skip this section and go ahead to read about ASCII.

The decimal number system with which we're all familiar is a *positional* counting system. There's the "ones" position, the "tens" position, the "hundreds" position and so on. Each higher position is worth ten times more than the position to the right of it, since the decimal system uses the *base* of ten. Moreover, we need ten symbols to show the actual values that may be in each position.

The binary system is positional too. There's the "ones" position, the "twos" position, the "fours" position, the "eights" position and so on. In binary each position is worth only twice that of the position to its right. And we only need two symbols — 0 (zero) and 1 (one) — to show the values that may be in any position. So in binary we get numbers that look like 1010 or 10001100.

The hexadecimal system is made of base-sixteen numbers. Hexadecimal is positional like the other counting systems. And each higher position is worth sixteen times as much as the position to its right.

We need sixteen different symbols to show all the possible values one hexadecimal digit could have. We can use our decimal system's ten symbols, but we've had to borrow a few more from our alphabet to get all the symbols we need. In hexadecimal, therefore, you can have a number that looks like 2C7C, or even FACE.

Here's how the decimal, binary and hexadecimal number systems compare:

<i>Decimal</i>	<i>Binary</i>	<i>Hexadecimal</i>	<i>Decimal</i>	<i>Binary</i>	<i>Hexadecimal</i>
0	0000	0	8	1000	8
1	0001	1	9	1001	9
2	0010	2	10	1010	A
3	0011	3	11	1011	B
4	0100	4	12	1100	C
5	0101	5	13	1101	D
6	0110	6	14	1110	E
7	0111	7	15	1111	F

The important thing to realize is that there's more than one way to show the same numeric value. Computer programmers, for example, occasionally use the hexadecimal system because it's so compact. (Programmers often just say "hex".) This binary number:

101001011111110100110111111011010010110100001001

looks quite a bit tidier when it is written as A5 FD 37 ED 2D 09, which means the same thing.

1.2.2 The ASCII table

Where does the Star LaserPrinter 4III get the characters and instructions it needs to print in the first place? It gets them from your computer, which sends a stream of text and commands to your printer.

The program in your computer that controls everything sent to the printer (called the *printer driver*) will usually be included with your computer programs, such as your word processor. But the commands could also come from a program you've written, perhaps in *BASIC*, a programming language that uses common English words.

Internally, computers and printers use only the binary number system to represent both commands and all the alphabetic, numeric and other keyboard symbols. Nearly all of those machines use the same scheme to code those symbols, the American Standards Code for Information Interchange (ASCII).

An example: in our familiar decimal system, binary 01001010 adds up to the number 74. Depending on which program your printer is using, it can interpret that binary string 01001010 as either the number 74 or the symbol *J*. The printer stores the symbol *J* at position 74 in a table in its memory.

That eight-bit binary string, or byte, can be broken into two halves. The left or high-order part containing 0100 is called the zone portion; the right part holding the 1010 is called the digits portion. And in the hexadecimal number system, the zone and digit parts of that byte are represented as 4 and A respectively (look them up in the list above).

So the laser printer understands the symbol *J* as 01001010, which we can also represent as the decimal number 74 or the hexadecimal number 4A. We've printed this byte vertically and horizontally below, showing how it adds up to decimal 74 and hex 4A.

0×2^7	=	0	
1×2^6	=	64	
0×2^5	=	0	
0×2^4	=	0	
1×2^3	=	8	
0×2^2	=	0	
1×2^1	=	2	
0×2^0	=	0	
		74	Decimal
zone	digits		
0100	1010	Binary	
4	A	Hexadecimal	

The ASCII table in the Technical Supplement shows all these equivalent representations for the symbols your laser printer understands. The table organizes them in ascending order. In fact, ASCII is organized in a way that actually makes sense.

Flip back there for a quick look right now. See how you can slice the table into clumps of 16 or 32, based on what's in the zone portion under the hexadecimal column? These clumps make subgroups of similar symbols:

- hex 00 to 1F are the command symbols called control codes,
- hex 20 to 40 are the common keyboard symbols and numerals,
- hex 41 to 60 are capital letters and the less common keyboard symbols,
- hex 61 to 7F are lowercase letters and a few final symbols.

That takes care of the first 128 ASCII symbols. However, nearly every computer and printer manufacturer treats the second half of the table differently. Hewlett-Packard, for example, puts a variety of accented foreign language characters into positions 128-255 (often referred to as *high ASCII*). Epson gives you a choice of either italics characters or IBM character graphics.

1.2.3 Control codes

The ASCII table shows symbols like *J* or 2 the way they actually print on the laser printer. But ASCII includes more than just printable characters: none of the control code commands at the beginning of the table actually print. Instead, when your computer sends a control code to the laser printer it makes your printer do other things, such as sound its beeper.

Control codes mostly handle communications between your computer and the printer at the lowest level, at cable level. For example, a couple of control codes make sure the printer *buffer* (your printer's storage memory) doesn't overflow. In this book we'll indicate control codes enclosed by angle brackets to their abbreviations in the table: <FF> means the Form Feed control code, which advances the printer to the next page just as the [PRINT] button does.

1.2.4 Escape sequences

Control code 27, <ESC> or Escape, is a particularly important one for printers. To tell your printer all the things you might need — setting margins, saying where to print, choosing a particular font, starting graphics and so on — requires many more than just two or three dozen control codes. So the <ESC> control code has a special meaning: <ESC> means “the next character specifies a command, not something to be printed”.

Therefore if you send just the character *z* to the printer it will print a *z* and that's all. But if you send the <ESC> code just before the *z* then the printer will switch over to print self test. Extending the control codes this way gives you many more commands to control your printer. In fact, these “Escape sequences” make up most of the Star Laser Printer's language.

In this book we'll leave spaces between characters when we show escape sequences. You'll find

<ESC> (s 0p 10h 12v 0s 3T

a bit more readable than

<ESC> (s0p10h12v0s3T

But remember that you are not to send those spaces if you send commands to the printer.

To sum up, printer commands are of two types. A *control code* is a single-character command that tells your printer to do something, like move down one line. An *Escape sequence* controls a printer operation too, but is more than one character long. Since they are commands, neither control codes nor escape sequences are usually printable characters.

1.2.5 Printer drivers

Most software packages already include the printer commands they need. The programs that send commands to the printer so you don't have to enter them yourself are called *printer drivers*.

Many programs ask you to *install* or *configure* your printer, which usually means keying into a menu the particular setup information describing your Star LaserPrinter 4III. You enter such things as how you want to underline, alter line spacing, or move to a new print position.

Some programs, such as *WordPerfect* and the systems from Lotus Development Corporation, let you put printer Escape sequences before or right inside the document you want to print. To turn on boldface, for example, you might hold down special keys on your keyboard, often labelled CONTROL or ALT, as you press another key. Or you might use a special Function key, such as F6.

In fact, to take real advantage of your Star LaserPrinter 4III's special abilities, you might opt for a word processor that lets you specify font changes easily. *WordPerfect* and Microsoft *Word* are strong at this, but are by no means the only good font manipulators.

If you have trouble using a particular program with your Star LaserPrinter 4III, you'll probably get answers most quickly by asking your software supplier how the program interacts with your printer.

In this manual we refer to programs, fonts and other products sold by several companies. Please realize that mentioning these products does not mean Star Micronics endorses them in any way.

1.2.6 Sending your own printer commands

Without a printer driver, sending control codes and Escape sequences to your printer properly requires some knowledge of a programming language like BASIC or Pascal, or at least of how to put such codes into a program. With programming languages, the computer doesn't act on the commands you put into a program until you tell it to run that program.

When you give a command to the printer from a computer program, you normally enter each part of the command as a separate character. This way you don't affect anything else happening on the computer. You often send each code or character in the command by giving its position in the ASCII table, as a decimal or hex number.

1.2.7 A BASIC example

Here's an example you can type in right now, to clarify what we're saying. It's written in Microsoft BASIC for a computer that uses the MS-DOS operating system, so if you have a different computer or BASIC you may have to translate a bit.

The LPRINT commands all send data to the printer. If the data is something you want printed you just put it in quotation marks. If the data is a control code you just say where it is in the ASCII table, giving its position as a regular decimal number.

BASIC usually sends a carriage return after every 80 characters, to keep the print position moving when it hits the end of a line. Unasked-for carriage returns can mess up your printing, however, so it's a good habit to put in a WIDTH statement as shown. That lets us print over the whole page area.

The <BEL> control code — ASCII code 7 — is sent in BASIC as CHR\$(7). The <ESC> code itself is CHR\$(27). And because we're using the character z as part of an <ESC> command, we type CHR\$(112) instead of "z". So if you start BASIC and type these commands:

```
NEW
10 ' EXAMPLE
20 WIDTH "LPT1:",255
30 LPRINT CHR$(7)
40 LPRINT CHR$(27);CHR$(112)
50 END
RUN
```

you make the printer first sound its bell — most people call it a beeper — and then print the self test.

Generally, when you send a control or Escape code it stays active until you deactivate it.

Most programming languages, and some versions of BASIC, let you treat the printer as a file to which you can send data. When you write a program with one of these languages you “open” the printer file, print into it, and then “close” the file when you’re done. This programming jargon sounds funny if you’re not used to it — but it works.

A few programming languages let you send commands to the printer a third way. Applesoft BASIC is one. With it, you can switch between printer output and screen output.

1.2.8 Printer emulations

Your Star LaserPrinter 4III responds to the same escape sequence commands that the Hewlett-Packard LaserJet III printer uses.

Macros are single control codes you can define yourself, which do the work of a whole long series of printer commands. If you are a programmer you will be happy to hear the Star LaserPrinter 4III supports up to 99 macros at once.

MEMO

Controlling Your Printer

CHAPTER 2

You can control your Star LaserPrinter 4III in two ways, either through control panel *parameters* or through software *commands*. In this chapter we will consider printer controls mostly from the perspective of the control panel.

2.1 PRINTER PARAMETERS

2.1.1 The control panel

The easiest way to control your Star LaserPrinter 4III is through its control panel, as explained in your *Star LaserPrinter 4III Operations Manual*.

When your printer is *online* (connected to and under the control of your computer), its control panel display shows you the printer's status. For example, the READY light blinks when the printer is warming up. The DATA light comes on whenever the printer is holding data it hasn't printed yet.

When you press the [ON LINE] button, the printer changes from normal to *offline* mode and cannot accept data from your computer. When the printer is offline you can use the other panel buttons. For instance, if you press the [TEST/>] button for two seconds and release it just after STATUS SHEET is displayed when the laser printer is offline, it finishes printing the current page and then feeds in and prints a status sheet.

Some buttons on the panel let you perform two functions. Holding one of those buttons down, rather than quickly pressing it, selects a different operation. For example, holding down the [TEST/>] button for over five seconds makes the Star LaserPrinter 4III print its font list.

2.1.2 Parameter settings

From the panel you can also change the parameters that define how your printer works. *Parameter* just means “variable”. If you’re familiar with earlier kinds of printers, you’ll understand that laser printer parameters control pretty much the same things *DIP switches* do. (A *DIP* switch or “dual in-line package switch” is a set of small switches that control various printer functions.)

The printer stores these parameters as easy-to-use *program menu* items that you can select from the control panel. These parameters specify:

- number of copies (how many sheets of each page to be printed)
- character (what character font to print)
- page size (what size the printer will use)
- layout (how pages will be formatted)
- paper feed (what paper the printer will use)
- input buffer (what size the printer can store the input buffer)
- interface (how the printer communicates with your computer)

A *default* is the setting the Star LaserPrinter 4III will use if none is specifically selected by a program. When you first turn on or later reset your printer these default settings will take effect.

Your main use for the control panel will likely be to set the default settings you want for these parameters. However, you will probably find the panel convenient too when you want to switch between manual and automatic paper feed.

2.1.3 Four versions of parameters

The Star LaserPrinter 4III actually stores four versions of these parameters:

- its “ultimate default” factory settings,
- the user default settings in effect when you first turn on the printer,
- your initial settings for one particular session,
- and the current settings that the printer is using now.

These are in priority order. The current settings always override the initial session settings, which in turn override the user default settings, which in turn override the factory settings.

Factory settings are programmed into the Star LaserPrinter 4III when it is built at the factory. Your printer keeps the factory settings for its parameters in ROM; they never change. You can copy them into the current settings or any other settings as needed. But the only way you can return to the factory defaults is from the control panel; no commands do this.

A few factory default settings are as follows:

<i>Item</i>	<i>Factory default setting</i>
Emulation	HP LaserJet III
Feeder	Multi-purpose tray
Number of Copies	1
Orientation	Portrait
Font	10-pitch 12-point Courier (internal)
Lines/inch	6 lines per inch

The *user default settings* are the normal default settings. The printer keeps them even when you turn off the power. There are two settings: Mode 1 and Mode 2. The Mode 1 is the normal default set on power-up or hard reset. You can select either Mode 1 or Mode 2 by using [PROGRAM] button in normal offline mode.

When you turn on the printer, these user default settings get copied into the initial and current parameter settings.

You probably will not often change the Star LaserPrinter 4III's *initial settings* (sometimes called "session settings"). You'll likely only change them when you want to use a different printer emulation than normal. These initial settings stay the same as the user default settings until you change them.

On the other hand, your software will probably change the *current settings* many times within the same document, with every change of font or print style.

2.1.4 How to change parameters

With the printer offline, if you press the [PROGRAM] button the printer goes into “program” mode. You can then step through the laser printer’s four levels of program menu to *configure* your printer. That’s the process of changing certain printer settings so your computer and printer can communicate properly.

It’s actually pretty easy. Flipping through and setting parameters from the panel is described in detail in the *Star LaserPrinter 4III Operations Manual*.

Basically, all you do is press the [<] or [>] buttons to scroll through the sequence of possible parameters and values, which is clearly shown on the panel display. You press [v] when you want to go down and scroll through a lower menu level. And you also press [^] when you want to save a particular menu item as the value for a current parameter setting.

The two last menu headings let you load one version of the parameters into another version. One moves the current parameter values into user default parameters. The final menu option goes the other way, letting you load the factory parameter settings as your current settings.

2.2 CONTROLLING THE PRINTER

In this section you’ll meet two separate controls over how the Star LaserPrinter 4III itself works. The INTERFACE parameter controls communications between the printer and your computer. You can set the INTERFACE parameters on the control panel.

2.2.1 The INTERFACE parameter

The INTERFACE parameter, the most basic of the Star LaserPrinter 4III’s *configuration* settings, defines how your computer connects to the printer. You can set the INTERFACE to either Serial or Parallel. In most single-computer environments you’ll opt for the faster Parallel interface; in a multi-user network you may be better off with Serial.

The particular printer interface settings don’t matter as much as making sure they match those on your computer. If you use an MS-DOS computer, you can set your computer’s parameters with the MODE command. See your MS-DOS manual.

Most MS-DOS and AT-compatible computers support up to three parallel and two serial ports, which come on expansion boards you plug into your computer. When you install such boards you must set switches to indicate the number and addresses of these ports. If you specify the wrong addresses, you won't be able to print.

Serial interface: rate

If you ask for the Serial interface you'll have to tell your printer more about how the data will be coming in — in particular its rate and unit size and the meanings of any special bits.

The Rate parameter specifies how fast data will be arriving, measured in *baud* (named after the French communications engineer Jean Baudot). Pick any of the following data transfer rates:

300 baud
600 baud
1200 baud
2400 baud
4800 baud
9600 baud (the default)
19200 baud
38400 baud.

Roughly, one character a second works out to 11 baud. If you're not sure how fast your computer will transmit, the general rule is to experiment. Try sending a page to print at the highest speed, and work your way down until the printer's output looks OK.

Serial interface: special bits

In Serial mode you'll also have to specify if your computer sends data bits in groups of seven (most computers send eight, the default for a byte).

Sometimes an extra bit gets appended to make the sum of all bits in each character always odd or even; that's called *parity*. A parity bit can help spot transmission errors. If your computer sends that extra parity bit, you'll have to say whether it produces an even or odd number of "on" bits in the character.

You'll also have to indicate if your computer sends two *stop bits* to indicate the end of a byte, instead of one, the default. These serial interface settings are described in more detail in your *Star LaserPrinter 4III Operations Manual*.

Serial interface: protocol

Finally, in Serial mode your computer will use one of two *protocols* to ensure data is sent properly. Protocol (sometimes also called “handshaking”) means “who says what when”, and is the way your printer tells your computer it’s ready to receive data. Your computer and printer communicate by sending protocol control codes (they’re at the front of the ASCII table).

Some programmers call the XON and XOFF control codes “kiss on and kiss off”; others call the same protocol DC1 and DC3 (for device control). Either way, these codes let your printer run the show, telling the computer when to start and stop sending data. Your printer asks to have data held back when its memory is nearly full or when it senses an ERROR condition.

DTR (Data Terminal Ready) protocol does the same thing slightly differently. The printer sends a continuous high-voltage signal over the cable as long as it can accept data, but drops the voltage to say “whoa” to the computer.

Look in your computer’s operations manual, in the section dealing with communications protocols, to see which is best for your system. You can stick to the printer’s defaults if your computer does not use the DTR, but does use XON/XOFF.

2.2.2 Checking your connections

Your computer and printer may have trouble communicating when you first introduce them to each other. The quick way to find out if your settings and printer cable are working is to send your printer a printout from your screen (CTRL-P with MS-DOS).

When that’s done you will also have to press the print button on the printer, which makes the printer advance to a new sheet. No laser printer prints and ejects a page until it’s told to feed a form, or until it has received all the lines the page can hold.

If your Star LaserPrinter 4III doesn't print what's on the computer screen, recheck your connections and interface settings. With an applications program like *Lotus 1-2-3* or *Microsoft Word*, you use a printer setup routine to match your computer with your printer's operating characteristics. So double-check your software settings; your computer's output, for example, might not be going to the proper port.

2.2.3 Hints: The hex dump

To make your Star LaserPrinter 4III print in hexadecimal rather than the usual ASCII symbols, press the control panel buttons that put the printer offline and in PROGRAM mode. Move to the EMULATION parameter's HEX DUMP setting and select it.

Some control or Escape codes can be problems on a few computers; those computers change certain codes when sending them to the printer. If you think you have this problem you need to see exactly what your printer is receiving. We recommend you run a short program that loops through and prints the ASCII table. Print in hexadecimal rather than the usual ASCII symbols.

If you spot a problem code you can try to bypass the problem, either by sending each code directly to the printer, or by changing your system's printer driver. Such computer-specific solutions, though, are beyond the scope of this manual. We suggest that if necessary you consult another programmer more familiar with your computer.

Actually, if you are debugging *any* program you may find this hex-dump mode helpful. It can be a great trouble-shooter.

2.3 CONTROLLING THE PAGE

In this section we look at two controls you have over how the Star LaserPrinter 4III handles and formats its pages: You can set values for the PAPER FEED and LAYOUT parameters on the control panel. At the end of this section we'll also preview different ways to move the print position.

2.3.1 The PAPER FEED parameter

The PAPER FEED parameter lets you specify both what kind of paper you want and how the paper is fed.

One convenient thing about a laser printer is that it doesn't need *continuous* forms, sometimes called *fanfold* paper. Other printers feed in a stack of forms — with pages all joined by perforations — by having sprockets engage and pull along *pinfeed* holes punched along each side of the paper. After it's printed you have to tear off the pinfeed-hole strips and then separate the pages.

With the Star LaserPrinter 4III you can print on a variety of ordinary cut sheet pages.

For the Feeder value of this PAPER FEED parameter, you first enter either multi-purpose tray, manual feed or cassette (option) to indicate where you want paper fed from. The multi-purpose tray handles various types and sizes of paper (Letter, Legal, A4, B5, Executive, OHP sheets, Labels, Envelopes). Manual feed means you feed each sheet by hand from the multi-purpose tray. The cassette tray automatically feeds single sheets, much like sheet feeders on other types of printers.

The default paper size is A4, you can specify other sizes too. A different-sizes tray automatically selects that different paper size.

- **8.5 by 11 inch letter-size paper**
- **8.5 by 14 inch legal-size paper**
- **B5 international (used in every country except North America) (182 by 257 mm)**
- **the narrower "executive" size (7.25 by 10.5 inches)**

One other nice thing you can do is print directly on envelopes. With this Paper Size parameter you can specify envelopes in sizes, Monarch, COM-10, International C5 and DL. Then just work out where to put the address, set the orientation to landscape (see below), and slide your envelope into the multi-purpose tray!

2.3.2 Hints: Paper, labels and transparencies

- The best paper for the Star LaserPrinter 4III has a smooth finish and is of 60 to 105 g/m² (20 to 24 pound) weight. Any paper designed for photocopiers should do the trick though; Xerox 4024 and Canon NP print nicely. High quality *cotton bond* paper, which contains up to 25 percent cotton fibres, works passably well with even heavier weights.

The absolute limits are 16-pound paper at the light end and 35-pound stock at the heaviest. With heavy paper, open the tray so the pages will be delivered face up and won't have to bend over the final rollers.

- Be aware that any puckered or woven finish may not print as sharply as you'd like. Avoid shiny coated paper or multipart forms. And don't even *think* about putting in stapled or ripped pages.
- If you frequently change paper weights, you will probably get skewing problems — lines that print at an angle because of misfeeding. For best results, when your Star LaserPrinter 4III is first set up have the paper feeder “squared” for paper of at least 60 grams (20 pounds). Lighter paper, though cheaper, isn't really the way to economize.
- Want to print on your own preprinted letterhead? Fine — so long as your logo isn't thermographed. Thick colored ink may look luxurious, but it can also wind up stuck all over your printer's roller. Stay away from any inks that soften at relatively low temperatures; your printer fuses pages at 200°C.

This warning applies to colored paper too, if it has been tinted with a low-temperature dye.

- When printing starts fading because the toner is low, remove the cartridge and gently rock it back and forth half a dozen times. Don't tip it up or the toner may spill out. Redistributing the toner powder this way can keep the cartridge going for another tray of paper.

- No question, working with single label sheets is more convenient than with continuous label stock. Laser printers are faster and produce better-looking labels than other printers. But laser printers, which work by electrostatic photography rather than impact pressure, put different stresses on label paper. Each sheet has to bend over and through the guide rollers; moreover, fusing toner to the paper involves heat. You can eliminate trouble by always feeding label sheets manually.

Both Avery's "Lasergraphic" labels and Canon's labels seem to work fine. Your main concern is that the labels completely cover the backing sheet so it shows only at the outside margins. That way individual labels can't easily peel off.

The safest approach is to laser-print sharp master copies on paper and then photocopy those lists onto labels. This will avoid putting your printer's adjustment for paper thickness out of adjustment.

- If you want to print transparencies for your overhead projector, some films will actually melt in your laser printer. Stick to 3M's medium-weight transparency film (type 501) or to Hewlett-Packard's #92285J.

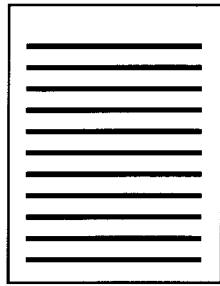
2.3.3 The LAYOUT parameter

The *layout* or *format* or *setup* of a page refers to how text is positioned on the page. Layout includes page orientation, margins and the spacing of characters across and lines down the page. You can control these with the LAYOUT parameter.

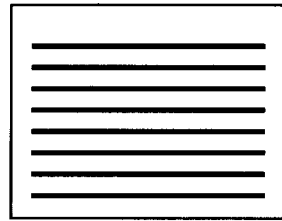
You probably won't use the LAYOUT parameter on the control panel's program menu very much though. Most of the time you'll either leave the Star LaserPrinter 4III with its default settings, or look after page formatting with commands you send from your computer.

Page orientation

A page's *orientation* tells you in which direction the print goes on the page. When you use *portrait* orientation the lines are printed as they are in a normal business letter, across the width of the page. A portrait painting of a person is usually vertical — hence the name.



Portrait



Landscape

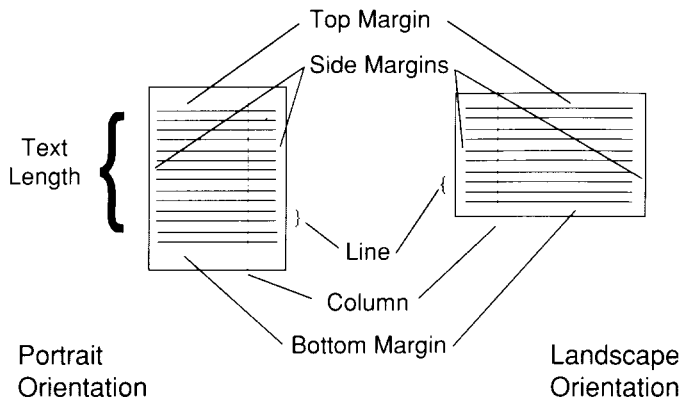
When you use *landscape* orientation the words are printed “on their sides,” vertically up the length of the page. Text written with landscape orientation only looks correct when you turn the page so its length runs side-to-side, just like the painting of a landscape.

Envelopes must be printed with landscape orientation. You also will use landscape regularly to print charts or banners, and spreadsheets or reports with so many columns they wouldn’t otherwise fit on the page.

All internal fonts, and almost all cartridge and downloaded fonts, are stored in the Star LaserPrinter 4III with portrait orientation.

Margins, columns and lines

You can change margin settings for all four edges of a page. The left and right side margins can have values from 0 to 132, defining the margin *columns* between which words and images can be printed. And the top and bottom margins can be set at anywhere from 0 to 112 lines.



The meaning of a line (sometimes called a “row”) is defined by the *vertical motion index* (VMI). The printer moves the print position down a line when it gets a Line Feed code, usually when it bumps into the right margin.

You’ll probably let your computer program set the line depth. But from the panel you can set the VMI value in increments from 1/48 to 255/48 of an inch.

Auto parameters

The print *position* refers to the point on the page where the next character will be printed. When the printer reaches the end of a line, the Auto Parameters settings tell it whether or not to automatically:

- move the print position down one line (*line feed*),
- or keep text out of the side margin (*auto wrap*).

2.3.4 Moving the print position: a preview

With dot-matrix printer, you pick where to print on the page either by moving the printhead back and forth or by moving the paper itself. Laser printers don’t have printheads, but the principle remains the same: you have to say exactly where on the page each picture and string of text is to go, so each page can be constructed in the printer’s memory.

Instead of talking about printheads we talk about moving the print *position* (some people call it moving the “cursor”, using the computer-screen analogy). Horizontally, you can move the print position with backspace and carriage return commands. Vertically, you can move the print position down the page by printing so many lines per inch, or by sending line-feed and half line-feed commands. You can also move to tab settings both horizontally and vertically (handy for tables and blank forms, or making room for your diagrams).

But those aren’t all. You can tell the Star LaserPrinter 4III to move the print position vertically or horizontally in increments of:

- 1/10, 1/12 or similar fractions of an inch (pitch settings),
- 1/48, or 1/120 inch (line or column definitions),
- 1/300 inch (dots), or
- 1/720 inch (tenths of a point).

These increments reflect the history of twentieth century printing. *Pitch*, referring to the number of characters printed in each horizontal inch, derives from how typewriters space their characters. *Lines* and *columns* were first used by earlier computer printers (on which they are called horizontal and vertical motion indexes). You already know about the Star LaserPrinter 4III being able to print 300 dots to the inch. And the unit by which typesetters have measured text for centuries is the *point*, about 1/72nd of an inch.

One hint about moving the print position: you can confuse yourself if you use more than one or two different units during the same session. So decide beforehand how accurately you need to move the print position (not forgetting any graphics you want to include). Then stick to the unit(s) you choose.

The commands that move the print position in all these ways are described in chapter 4.

2.4 CONTROLLING THE PRINTING

The CHARACTER parameter defines font attributes and setup values (if any) for the Star LaserPrinter 4III.

A font's attributes or characteristics determine what that font will look like when it is printed. The next chapter, "Fonts", explores the details of all font attributes in more detail. But let's have a quick overview now, because you'll meet these terms on the control panel's program menu.

Font attributes: a preview

Orientation (portrait or landscape as described earlier) is usually thought of as one attribute of a font; it's not really a page formatting issue. Besides orientation, the fonts with which you print have these attributes:

Symbol set is sometimes called "character set" — which can be confusing, since some people say "character set" when they mean a font. Symbol sets are subgroups of a font's symbols that are most appropriate for particular countries, such as the UK (£), France (à), Latin America (ñ) or Japan (¥).

Spacing and *pitch* are linked. Characters can be spaced on the line *proportionally*, so a narrow letter such as *i* takes less room than a wide letter like *W*. Or characters can be spaced all the same width: twelve characters to the inch is the monospaced spacing called 12 pitch.

Point size defines how big characters will print, such as 10 or 12 points high.

Style defines whether characters print in upright or italic style.

Stroke weight defines how bold a typeface prints.

Finally, *typeface* itself means the artistic design of a font. Your printer's internal typefaces include, Courier and Line Printer. With the Star LaserPrinter 4III you can also use Roman, Prestige, H-Gothic, L-Gothic, Orator and hundreds more typefaces, which you load into the printer from cartridge or computer disk.

When you enable font *setup parameters* on the control panel, it means you start off with particular font attributes as defaults.

2.5 THE STAR LASERPRINTER 4III SUPERSET

Here's an important fact: you can set nearly every one of the above parameters by sending your printer a corresponding Escape sequence command. Those Escape sequence commands will override any setting you make from the control panel.

The main thing to realize about most printer commands, though, is that you probably don't need to use them. Nearly all popular software packages include printer drivers, which send commands to the printer so you don't have to type them yourself. Some of those programs ask you to key in set-up parameters about your printer. Other programs let you put printer commands before or inside the document you want to print.

But maybe the software you use doesn't have printer drivers for any printer your Star LaserPrinter 4III emulates: You still might not have to write printer commands yourself.

Several companies sell programs that look after laser-printing commands for such software. Ask your dealer about *LaserControl*, *Printworks for Lasers*, *PCLPak* and *RAM Resident Printmerge*. There's not much point in reinventing the wheel.

The fonts you use determine what your pages will look like. In this chapter we'll first clarify the meanings of words people use when they talk about fonts.

Next we'll examine the three kinds of fonts (internal, cartridge and downloaded) that you can use on your Star LaserPrinter 4III. We'll cover the particular sets of symbols you can choose for those fonts too. Finally, we'll find out how to load the printer with your selection of fonts.

3.1 FONT TERMINOLOGY

3.1.1 *Typefaces and fonts*

First, a few definitions. A *typeface* is a family of characters with the same basic design. The artistic character design you choose establishes the "tone of voice" for all your documents.

Several variables can characterize typefaces, including weight (light, medium, bold), width (condensed or extended), and style (upright or italic). Courier, for example, is a typeface family that includes the characters in both *Courier medium italic* and **Courier bold upright**.

Let's consider these variables. *Bold* print is sometimes called "emphasized" or "double-strike". On earlier printers boldface is generated by printing each character twice; dot-matrix machines print the second impression just a hair below or to the right of the first one.

With the Star LaserPrinter 4III you can have different stroke weights in two ways. You can have two different fonts, storing and switching between a bold and a medium version of the font. Or you can use just one font and set bold on and off with Escape sequences. The latter way uses just half as much font memory.

Narrow *condensed* faces used to be called “compressed”. They cram about five characters in the space where three usually go — ideal for spreadsheets. An extended face, particularly on a dot-matrix printer, goes by several names: “expanded”, “enlarged” or “double-width” printing. No matter what it’s called, extended print is wider than it is high, and can be fairly effective in page headings.

Italic characters (sometimes called “oblique”) are slanted. Ordinary upright characters are often called “roman”. Your Star LaserPrinter 4III comes with a built-in upright Courier typeface. Moreover, from *any* of the Star LaserPrinter 4III’s built-in typefaces you can select a subset of upright symbols called Roman-8.

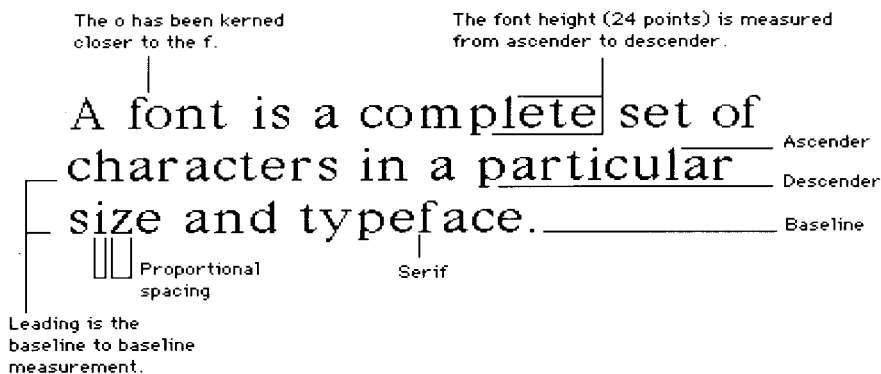
A *font* is a complete set of characters in a particular size and typeface. In the world of laser printers, the three variables mentioned above — weight, width and style — are a few *font attributes* (sometimes called “font characteristics”). Let’s consider three more attributes: font height, spacing and pitch.

3.1.2 Font height

The *baseline* is the invisible line upon which characters of type sit. Since the first letter blocks were made of lead alloy, the distance from one baseline to the next is called *leading* (pronounced “ledding”). Type itself is measured from the top of an *ascender* (the part extending up in the *b* or *k*, for example) to the bottom of a *descender* (the down-stroke of the *y* or *q*).

The measurements used to describe fonts are *points* and *picas* (derived from the marks and letters in medieval church almanacs). There are 12 points to the pica, and almost exactly 6 picas (72 points) to the inch.

Laser printers for computers measure *font height* in points. On laser printers the “white space” above ascenders and below descenders depends on how the *line* is defined, so the line corresponds to leading. This type you’re reading has a font height of 12 points, and is spaced a little less than 5 lines per inch.



3.1.3 Font spacing and pitch

You probably first heard the word *pitch* in connection with typewriters. Typewriters normally use *monospaced* spacing: they give each character the same amount of space on the line.

About half the fonts available for laser printers use monospaced spacing too. Pitch is always expressed as so many characters per inch. Ten-pitch, for example, means a font with ten characters in each inch of the line.

Typesetters for centuries have used two special sizes of type for most text. *Elite* characters are 10 points high and print 12 characters per inch. And *pica* characters are 12 points high and pitched at 10 characters to the inch. You'll often run across these monospaced font sizes in the laser printing world.

Ideally each character in a word should nestle against its neighbours so they appear evenly spaced. But adjacent round characters are apt to look too far apart, while flat-sided characters may appear too close.

Proportional spacing takes into account the differences in widths among letters (compare *ii* with *WW*). Proportionally spaced printing is easier to read than typewriter-style printing in which all characters, including punctuation, have the same width.

Real typesetters equip certain characters with *kerns*, letter parts that extend out to overlap adjoining letters. In this word *Type* the *y* is kerned closely against the *T*. Kerning separates great type from good type.

3.2 HOW THE STAR LASERPRINTER 4III STORES FONTS

3.2.1 *Bit-mapped fonts*

Star Micronics has earned a reputation for attractive, well-designed fonts on its printers, and this laser printer continues the tradition.

The Star LaserPrinter 4III uses *bit-mapped* fonts. Each character is made up of a pattern or “map” of dots, just like characters on a dot-matrix printer or on your computer screen. Resolution makes the difference: to make each character the Star LaserPrinter 4III uses ten or twenty times as many dots as a dot-matrix printer or computer screen does.

Every size of print you want, plus every italic or boldface version, has its own bit map and is normally considered a separate font. It takes a good deal of printer memory to hold all the fonts you might want at any given moment.

Star LaserPrinter 4III fonts can be grouped into three categories: internal, cartridge, and downloadable fonts.

3.2.2 *Internal fonts*

The Star LaserPrinter 4III has seven built-in *internal* fonts that reside permanently in its read-only memory (ROM). That’s why these are sometimes called “resident fonts”:

Courier	10 pitch, 12 point medium
Courier	10 pitch, 12 point bold
Courier	10 pitch, 12 point italic
Courier	12 pitch, 10 point medium
Courier	12 pitch, 10 point bold
Courier	12 pitch, 10 point italic
Line Printer	16.6 pitch, 8.5 point medium

Courier is the face used on the most common electric typewriters. Courier is not printed with proportional spacing. The Line Printer font, designed originally for mainframe computers, is small and designed to pack a lot of characters into every inch of print (great for spreadsheets).

The Star LaserPrinter 4III's scalable fonts have the same relative dimensions and general appearance as the following LaserJet III fonts:

CG Times	regular
CG Times	bold
CG Times	italic
CG Times	bold italic
Univers	regular
Univers	bold
Univers	italic
Univers	bold italic

With these most frequently used fonts in ROM, a page can be assembled much faster than if the fonts had to be loaded into the printer for each printing job.

3.2.3 Cartridge and downloaded fonts

Your Star LaserPrinter 4III can use two other kinds of fonts, along with those built into the printer.

Cartridge fonts, like the internal ones, are permanently stored on ROM chips. The difference is that those ROMs are in removable cartridges. Your Star LaserPrinter 4III has a slot for one font cartridge.

A cartridge may hold anywhere from half a dozen to two dozen fonts, all differing from the internal fonts in size, style, stroke weight or symbol set. You'll find that cartridge fonts open up a wider range of typefaces too, such as Roman, Prestige, H-Gothic and L-Gothic. Generally, cartridge and internal font typefaces are suitable for both text and headlines.

The third kind of font is neither built into your Star LaserPrinter 4III nor available just by slipping in a cartridge. You *download* this kind of font, which means you use a computer program to send characters from a computer disk to your printer's memory. Any downloaded font (sometimes called a "soft" or "installed" font) that you put into the printer's RAM disappears when you turn off the printer, so you have to download that font again next time you want it.

Downloadable fonts run the gamut from Egyptian hieroglyphics to those eye-catching decorative fonts known as *display* fonts. They also include the more exotic foreign-language characters, such as Arabic or Cyrillic, and symbol and mathematical fonts (sometimes with fractions).

How can you compare cartridge and downloadable fonts? When you use cartridge fonts you don't have to take time to download them. They don't take any of your Star LaserPrinter 4III's RAM memory either. But downloadable fonts offer many more choices. Downloadable fonts usually cost less too.

The printer always knows where its internal fonts are. For each emulation program, it also keeps track of cartridge and downloaded fonts in a part of its memory called the *font table*.

So with the Star LaserPrinter 4III you can have many fonts available at any one time — the internal fonts, the fonts on any cassettes you've plugged in, and any fonts you have downloaded. You can change fonts in mid-line to emphasize a word or two whenever you want. You can mix internal, cartridge and downloaded fonts in the same document.

3.2.4 Hints: Where to get fonts

- You can print any downloadable font that works on the HP LaserJet III. Several other companies sell downloadable fonts which are compatible with your Star LaserPrinter 4III. The Bitstream Corporation in Boston is one of the more popular; Conographic is another. Xerox includes a set of fonts with its *Ventura Publisher* desktop publishing software, which you can use with your printer.
- The SoftCraft company now markets a Bitstream-developed product called "Fontware". With Fontware you can generate bit-mapped fonts of any size from a library of *outline* fonts. In outline fonts each character's profile is defined just once and the printer generates any font height from that profile, which saves printer memory.
- Don't hesitate to ask your Star dealer where you can buy cartridge and downloadable fonts. If you really can't find the one you need, you can design and download your own customized fonts. This is no easy job, but if you're curious it's described in chapter 4.

3.3 SYMBOL SETS

Let's summarize briefly, to put the subject of symbol sets in context.

The attributes of a font determine what that font will look like when it is printed. We covered all but orientation at the start of this chapter, and orientation in the last chapter. A font's attributes include:

- orientation (portrait or landscape)
- symbol set (which we'll look at next)
- spacing (monospaced or proportional)
- pitch (10 or 16.66 characters per inch, for example)
- font height (measured in points)
- style (upright or italics)
- stroke weight (light, medium or bold)
- typeface (Line Printer, Courier and so on)

Though they are not font attributes, such printing features as subscripts, superscripts and underlining are treated along with fonts in the following chapters.

Incidentally, the best way to underline is to use the underline command, instead of backspacing and overprinting with the separate underline character (). If you do the latter with proportionally spaced text, you'll usually find the underlining is too long for the text.

3.3.1 What are symbol sets?

Keyboards differ from country to country. The British need their £ symbol, the French need their ç and è, the Spanish need their ç and ñ etc. Scientists need particular mathematical signs too. There easily could be four hundred or more possible symbols for any given font.

However, the number of symbols printers store for a font is limited to 256 slots, as in ASCII. So some symbols, or the order of some symbols, can differ in any font. Each unique selection and arrangement of symbols is a *symbol set* (sometimes called a "graphic set" or "character set").

The symbol at position 91 for example is an open bracket, [, in the usual ASCII symbol set. But the same position holds Ä (capital A with an umlaut) in the German symbol set.

You probably won't change symbol sets very often, unless you need special symbols for your trade or regularly write in a language other than English.

Your printer supports sets containing just symbols, such as the Greek alphabet (β), logic symbols (\leq), arrows (\uparrow), the registered trademark symbol ($\text{\textcircled{R}}$) and so on.

3.3.2 Default font attributes

When you power on your printer, the internal fonts start off with default attributes which you can change as needed. The default symbol sets is Roman-8.

Technically, you can use any of the Star LaserPrinter 4III's resident fonts when you send commands. If you want a character that's not in the font you're using, don't hesitate to grab it. Just send the Escape sequences that select your desired symbol set, print with it, then go back to your original font.

3.4 MANAGING FONTS

You can see which fonts are currently selected on your Star LaserPrinter 4III by printing a status sheet in offline mode, as mentioned at the beginning of this chapter. Another TEST mode menu item, described in the *Star LaserPrinter 4III Operations Manual*, also lets you print out a list of *all* the fonts available on the printer at any given moment.

3.4.1 Selecting fonts

Most popular software packages, particularly word processors, let you choose fonts from within the program. They send the appropriate commands to the printer and you don't need to understand how they do it. *MultiMate* uses pitch to identify different fonts, for example, while *WordPerfect* uses print formats. The point is, you may not even have to worry about selecting which font to use.

But not all packages do the job for you. If you are in this situation, you can select any font attribute mentioned above, either from the control panel or by sending an Escape sequence command.

If you use the control panel in program mode, select CHARACTER. Just press the [>] button to get to the font attribute you want to set, press [v] to get to its possible values, press [>] to scan through them, and finally press [v] to slap in the value you want.

The procedures for selecting a font from a computer program is a bit more complicated. These font selection methods are detailed in the next chapter.

3.4.2 Hints: Desktop publishing and page design

- Desktop publishing systems help you automate your specifications for margins, cover design, typefaces, font sizes, placement of graphics and regular features. You build the specifications you want in *templates*, standard page designs you later simply call up on your screen and fill in with text.
- Some desktop publishing systems, such as Aldus's *PageMaker*, are page-oriented: you put each page together individually. These are great for shorter documents, such as newsletters, brochures and letters. Other systems, such as Xerox's *Ventura Publisher*, are document-oriented. That makes them better suited to technical manuals and long proposals or reports that go through many drafts.

Other ways in which such systems differ include whether they show on your screen what you will get on paper (code-based programs don't), how well they handle pictures, and how hard they are to learn. Think about your needs before choosing a desktop publishing system.

- A few of today's computer programs let you see several different font sizes and typefaces on your computer screen. That capability is necessary if you want to see on-screen exactly what will print on your Star LaserPrinter 4III. Desktop publishers call this capability WYSIWYG — "what you see is what you get".
- When you design your pages, don't vary font size just to fit text into the space available. Go with a size that's easy to read and be consistent.

Never be tempted to use all uppercase letters. When you want to highlight text, switch to a bold font or draw a box around it.

- Don't be afraid to use white space. White space relieves eye fatigue and looks more attractive.

3.4.3 Optional fonts

Many optional fonts available for your Star LaserPrinter 4III complement its internal fonts. These can give you more variety in symbol sets, spacing, font height, style and stroke weight. To your Courier fonts, for example, you might add italics and bold, legal or math symbol sets, and sizes ranging from 7 to 14 points.

Optional fonts offer different typefaces too. Ask your Star Micronics dealer about cartridges or disks for the following:

- Prestige fonts
- Letter Gothic fonts
- H Gothic fonts
- Roman fonts
- Presentation fonts
- Optical Character Reader fonts
- Line drawing
- Bar codes

3.4.4 Using cartridge fonts

To gain access to a font on a cartridge:

1. Slide the cartridge you want into the slot on the front of the printer.
2. Use either the control panel menu or a command from your computer to select the font you want.

Note: Do not insert or pull cartridges out of the printer while the DATA lamp is ON.

An interesting note about default cartridge fonts: Say you have selected on the control panel menu a cartridge font as your default font. Later you turn off the printer. If you slip the cartridge back in before you turn on the printer again, that font will still be your default font.

3.4.5 How to download fonts

To download fonts from computer disk you'll need more than a small 64K microcomputer. We recommend at least a 512K computer with a couple of disk drives (a hard disk is better).

Many commercial font-management programs are now on the market, including Insight Development's *LaserControl*, Blaha Software's *HotLead*, SoftCraft's *LaserFonts*, and the PCL printer driver in Microsoft's *Windows*. These utility programs help you download fonts, then let you access the fonts automatically from your word processor or other programs.

Most font files on disk that you buy to download into your printer have Escape sequences right in the file, which simplify the process. Usually all you have to do is copy the file from your computer into your printer (you must assign a font ID number first). If you download fonts with the MS-DOS COPY utility, make sure to use the COPY /B option. That will keep your computer from "interpreting" the data you send, which sometimes produces badly shaped characters.

OK, let's look at a couple of examples.

3.4.6 Downloading a font: example one

Example one is for a computer running just MS-DOS.

Say you've bought Hewlett-Packard's Century Schoolbook fonts and want to download the regular (upright), italics and boldface characters. The HP disk labels for each file are CN100RPN.R8P, CN100IPN.R8P and CN100BPN.R8P. In case you're interested, that's HP's code for CeNtury, 100 decipoints, Regular (or Italic or Bold), ProportioNal, Roman-8 symbol set, Portrait.

One of the disks you get also contains a batch file named DOWNLOAD.BAT. To load the regular upright font you make sure the printer is online, then after your computer's A> prompt you type:

```
DOWNLOAD CN100RPN.R8P
```

When the program asks for the font ID number you key in a number between 0 and 32767. Then when the program asks whether you want the font stored permanently or temporarily you type either P or T (a temporary font disappears if you press the printer's [RESET] button). Finally the program asks if you want to print a sample of the font and you reply Y or N for yes or no.

You then do the same for the italics and boldface files, for example typing for the italics font:

DOWNLOAD CN100IPN.R8P

The prompts will be the same, but you have to remember to use different font ID numbers for the upright, italic and boldface fonts.

3.4.7 Downloading a font: example two

Example two is for a computer running Aldus Corporation's *PageMaker* desktop publishing program with Microsoft *Windows*.

PageMaker provides a print driver called HPPCL.DRV, and a program called PCLPFM.EXE which creates the data it needs to print a given font. To create font data for your Century Schoolbook fonts, at the A> prompt you type:

PCLPFM CN100*.R8P

The asterisk, a "wildcard character", indicates that PCLPFM is to create a data file for all three fonts — regular, italics and bold. The program asks if you want to create a file called APPNDWIN.INI to append into the *Windows* font menu file: type Y for yes.

After PCLPFM has made the font data file, with your word processor open the *Windows* file called WIN.INI and key in the font defaults you want to apply. At the section referring to the HPPCL printer driver, insert the APPNDWIN.INI file you created earlier.

That's it! From now on your Century Schoolbook fonts will appear on the print menus of all your *Windows* applications.

With both examples, how you use the fonts depends on your applications software. As you know, sending commands to change fonts will probably require some experimenting: be patient. These commands are described in the following chapter.

The process of downloading a font you've designed yourself is not so straightforward. As you can only do this, creating and downloading fonts is described further in chapter 4.

3.4.8 Hints: Managing memory

- Printing fancy stuff can be quite cumbersome for your printer. You trade off fanciness against speed: if you opt for fewer flourishes, you give your printer breathing room in memory. And that rewards you with faster output. Any of the following will slow down your laser printer:
 - text over 20 points,
 - lots of lines or patterns,
 - graphics,
 - macros,
 - justified text.
- You may choose to add an optional RAM board to your Star LaserPrinter 4III if you need to download many fonts.
- Alternatively, consider either a software or hardware print *spooler* if printing holds up your computer more than you'd like. A spooler provides a separate temporary memory space that holds the documents to be printed, and is particularly handy in a multi-user system.
- Some page makeup programs automatically download each font as needed, then flush that font from printer memory to make room for the next font. This approach can make good sense if you're sharing your printer with other people in a computer network. It keeps the printer's RAM from becoming overloaded. However, the downloading time can significantly slow down your printer's throughput.
- More typically, you will download a font in the morning (perhaps with the MS-DOS COPY command) before you print your first document, and that font will then stay in the printer's memory. If you use a single downloaded font (or macro) throughout the day, you will find it most efficient to keep it in the laser printer's memory. You definitely should download fonts this way if you use a print spooler. If you're in a network, however, make sure you don't download duplicate fonts.
- How many downloadable fonts can you have in one document? That's not so easy to answer. Most of your laser printer's memory is not available for storing fonts, because it has to store each page before printing it, as well as any macros or overlays you are using.

To see how much memory is available for extra fonts, put the printer offline and press the [TEST] button to print a status sheet. Your printer will beep and show a control panel message if you try to overload its memory by downloading too many fonts. It then will continue printing with the closest available font to that requested.

As a general rule, you can include at least a dozen downloadable fonts in a document. Added to the internal fonts, that should be plenty — it doesn't make good design to mix many typefaces. A telltale sign of amateurish laser printing is too many fonts in one document.

To keep a wide variety of extra fonts in memory, however, many Star LaserPrinter 4III users (especially those sharing the printer on a network) prefer to add the optional board with the second megabyte of RAM.

Printer Control Language

CHAPTER 4

The Hewlett-Packard LaserJet III is an earlier kind of laser printer than your Star LaserPrinter 4III. You should have no trouble running most popular software packages, as those programs likely can send LaserJet III commands.

Because the LaserJet III *is* a laser printer, though, its commands can give you more control over your Star LaserPrinter 4III than is possible with the other built-in command sets. Recognizing that reality, we've put examples into this chapter.

At the end of the chapter we describe how to create and use your own fonts, and also how to save time by writing command macros.

4.1 PRINTER CONTROL LANGUAGE

4.1.1 *What do Printer Control Language look like?*

The Star LaserPrinter 4III includes a dozen common control codes (such as <CR> for carriage returns) and single-character Escape sequences (such as <ESC> E for resetting the printer). But all the other commands you can send your Star LaserPrinter 4III look like this:

<ESC> *cc n C*

in which the *cc* prefix is a symbol or two showing the general category of commands to which this one belongs, *n* is some variable you want to use in this command, and *C* is the specific command you want performed.

Two important details make PCL commands. First, all Escape sequences end with a capital letter. If you don't make the last character uppercase, your printer won't know when the Escape sequence ends and will treat following characters as part of the same command.

Second, in PCL commands each number or character you put after the <ESC> code is an actual ASCII symbol.

For example, the PCL command that sets the right margin to column 65 is:

```
<ESC> &a 65 M
```

which you would code in BASIC as:

```
10 LPRINT CHR$(27);"&a65M"
```

That command sends your printer the symbols "6" and "5", which its program interprets as the column number.

4.1.2 Combining Escape sequences

Later in this chapter we describe one way to select a font, by just specifying what font attributes you want, such as bold or proportional spacing. If you select a font by specifying every one of its attributes, you can be certain that you're selecting successfully. But it could mean a fair bit of repetitive typing each time you choose a font. This applies to other commands too, not just font selection.

Here's a way you can save yourself a few keystrokes: type in those commands that have the same command-category prefix as just one long Escape sequence. To combine commands this way, type the <ESC> and command-category prefix just once, and capitalize only the last command character.

For example, to define the style, weight and character face for the primary font, you might send these command:

```
<ESC> (s 1S
```

```
<ESC> (s 7B
```

```
<ESC> (s 3T
```

which would produce *italics boldface Courier*. But this single command does the same thing, all with one blow:

```
<ESC> (s 1s 7b 3T
```

4.2 CONTROLLING THE PRINTER

4.2.1 Self test

You can check how your LaserPrinter 4III is printing and have a look at its parameter settings by sending this Self Test command:

```
<ESC> z
```

Notice that the z is lowercase; this is the only PCL command that ends with a small letter. After you send a Self Test command, the printer finishes printing any pages left in its memory. Then on a new page it prints its current parameters (just important items such as number of copies and fonts in use). The printer finishes off the page with a continuous display of all the characters in its default font.

The printer also quickly checks its interface. Assuming it finds no trouble, the printer is then ready for your next page. If the printer detects a problem it shows a control panel message, which you can look up in your *Star LaserPrinter 4III Operations Manual*.

4.2.2 Set number of copies

You can print up to 99 copies of each of the pages you send to the printer. You may send this command anywhere within the text on a page; it will stay in effect for that and all subsequent pages until you send another such command:

`<ESC> &ℓn X`

All you have to do is change the *n* sign in this command to the number of pages you want. (The ℓ character after the & is a lowercase L.)

4.2.3 Set feed selection

One thing you can do is print directly on envelopes as well as regular paper. You use this Feed Select command to tell your printer to select either a page or envelope from the multi-purpose tray, or from the cassette (option):

`<ESC> &ℓn H`

For *n* enter one of the numbers from this table:

<i>n</i>	FEED SELECTED
0 (zero)	the printer only ejects the current page
1 (one)	the printer takes its next page from the multi-purpose tray
2	the printer takes a regular page manually
3	the printer accepts an envelope you feed in manually
4	the printer takes its next page from the paper cassette

Should an unprinted page be in the printer's memory when you give this command, the paper for that page will feed from where you've indicated. Therefore you can make this the last command on a page. The new feed setting stays in operation until you change it.

4.2.4 Reset

Most software packages automatically reset the printer to the initial defaults before starting a print job. It's a good idea for you to follow the same practice, just to make sure you get the settings you want.

When you want to set all your laser printer's parameters back to their initial default values (some people call this "initializing" the printer), send this command:

```
<ESC> E
```

The printer will finish printing any pages left in its memory before resetting the parameters. Resetting clears unneeded temporary fonts from your printer's memory. Any permanent fonts or macros you have downloaded, however, will still be there after you send a reset command. Permanent and temporary fonts are described at the end of this chapter's "Controlling Fonts" section.

4.2.5 Example: Printer controls

Let's see what happens when we put these commands together. Say you have just turned on your laser printer. What happens when you send the following commands to your printer?

```
<ESC> z  
<ESC> E  
<ESC> &l2h 2X
```

As a BASIC program these would look like this:

```
NEW  
10 WIDTH "LPT1:",255  
20 LPRINT CHR$(27);"z"  
30 LPRINT CHR$(27);"E"  
40 LPRINT CHR$(27);"&l2h2X"  
RUN
```

First, if it is working properly the printer prints a test print with all the characters in its default font (Courier).

Next the printer sets all its parameter values — including feed selection and number of copies — to their initial settings.

The last command does two things: it tells the printer to accept paper you will feed in yourself, and to print each page two times. This is handy when you want two copies of a letter on preprinted letterhead.

You can now send your letter from your word processing program to the printer and feed in those pages. When you're done, you may want to send the <ESC> E command one more time.

4.3 PAGE ORIENTATION

You might reasonably think of page orientation as a page formatting issue. To print words widthwise on a page, however, each letter in effect has to lie on its back. So orientation is actually a font attribute, and is treated as such later on in this chapter.

4.3.1 Page Length

The multi-purpose tray sets the default page size for your laser printer. When you want a different size, you'll need to reset that page size. You should always change the page length *before* you send text for printing. The Page Length command sets the number of lines that can print on a page (lines per inch times the number of inches).

The Page Length command format is:

<ESC> &ℓ *n* P

where *n* is the number of text lines on the page; it can be any number between 5 and 128.

The default number of lines is the length of the paper tray times 6 lines per inch. For 11-inch letter-size paper that works out to 66 lines (that's also the default when you haven't put in a tray).

If you don't want the default length, you should send the Page Length command *before* you send text for printing. The table below should help you pick the right number of lines. Decide which orientation and paper size you want, then use the *n* under your preferred lines/inch:

ORIENTATION	PAPER SIZE	@6LINES/INCH ⁿ	@8LINES/INCH
Portrait	Executive	60	80
Portrait	Letter	66	88
Portrait	A4	70	93
Portrait	Legal	84	112
Landscape	Executive	43	58
Landscape	Letter	51	68
Landscape	A4	49	66
Landscape	Legal	*	58

* Printing landscapes on legal paper is trickier. First set on portrait mode and send the command <ESC> &l 84P and then change the orientation to landscape.

An example: Say you want to manually print legal-size pages at eight lines per inch. The following commands combine manual feeding with that page length:

```
<ESC> &l 2h 112P
```

If your command specifies a page length different than the paper in the tray, the printer will go offline and display a message asking for the proper tray. After you change the tray, press the [ON LINE] button to restart the printer. It doesn't hurt to print short pages on long paper. If you inadvertently print a legal-size page onto executive or letter-size paper, the printer will scroll that page across two sheets.

If you have set the paper feeder from the control panel to "AUTO SELECTION", a "select page length" command (<ESC> &l n P) will automatically select the cassette which contains the paper selected by the command. If no cassette currently contains the right size of paper, the display will ask you to insert the appropriate size of paper.

Also, the Page Length command puts all margins back to their defaults. So after you send it, check whether you have to send any of the following margin-setting commands.

4.3.2 Side margins

Margin settings define that part of the page on which the printer can print. You set side margins to particular *columns*. The width of a column differs for each font, depending on its pitch. Ten-pitch Courier, for example, puts column 30 three inches from the left edge of the page (column 0). But 12-pitch Prestige Elite puts column 30 just two and a half inches in.

You cannot set the left margin further over than the right margin. Use the following command to set the left margin, setting *n* to be the column number where you want the left margin to start:

```
<ESC> &a n L
```

Similarly, to set the right margin, you send this command with your desired column number:

```
<ESC> &a n M
```

If you want to put both left and right margins back to the printer's printable limits — in other words, to “clear” the side margins — send this command:

```
<ESC> 9
```

4.3.3 Top margin

Vertically, the LaserPrinter 4III confines its printing to its “text length”, which should always be less than its page length. Both are measured in lines. You can change the meaning of a “line” with line-spacing commands described later in this chapter.

When you set the top margin though, it does not change, even when you change the definition of a line. You can use this command to set the top margin anytime. Just be aware that if the current print position is below your margin, you'll have to move the print position back up. Naturally, you have to keep your top margin inside the page-length limit.

Use this command to set the top margin, setting *n* to be the number of lines down from the top of the page that you want left blank before you start printing:

<ESC> &ℓn E

Note that the character following the “&” is a lowercase “L”.

4.3.4 Text length and the bottom margin

By default, the LaserPrinter 4III automatically gives you top and bottom margins of the same size. So you only need to send the Text Length command when you want different top and bottom margins.

If you want a different bottom margin, first decide how many text lines will produce the margin you want. Check that they won't produce a bottom margin lower than the page length. Then send the following Text Length command, entering for *n* your desired number of lines:

<ESC> &ℓn F

The Page Length, Top Margin and Text Length commands therefore work together to set the bottom margin:

bottom margin = page length – (top margin + text length).

The bottom margin is called the “perforation region” with printers that use continuous forms. You normally want to skip the perforations between the continuous pages, but sometimes you don't (for example when you print labels).

Though you likely won't often want to do it, the Star LaserPrinter 4III will let you completely ignore the bottom margin too. If you choose to print below the bottom margin, remember that you might lose words or graphics in the unprintable region at the edge of the page. The command looks like this:

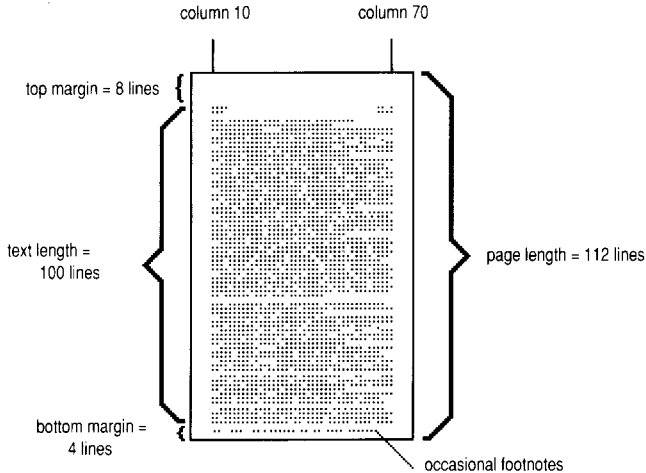
<ESC> &ℓn L

If you want to allow printing below the bottom margin, for *n* enter 0 (zero).

But if you want to forbid printing below the margin, which is the default, enter 1 (one).

4.3.5 Example: Page formatting

OK, let's have a go at formatting a page. The picture of the page we want is just below. The actual width of the text on the page depends on which font we use. Let's plan on using our 16.66-pitch Line Printer font at eight lines per inch.



As it prints, we also want to permit the occasional one-line footnote below the normal bottom margin. And when we're finished printing, let's reset the side margins so we can switch to our usual font width.

Here are the commands that will produce this format for us:

```
<ESC> &l 112P  
<ESC> &a 10l70M  
<ESC> &l 8e 100f 0L  
(We'll send our page here.)  
<ESC> 9
```

4.4 MOVING THE PRINT POSITION

4.4.1 *Many ways to move*

The LaserPrinter 4III provides excellent control over the print position — where you poise your laser “pen”. Horizontally, you can send backspace and carriage return commands. Vertically, you can move the print position down the page by printing so many lines per inch, or by sending line-feed and half line-feed commands. You can move horizontally or vertically to tab settings as well.

Those aren’t all. You can also tell the Star LaserPrinter 4III to move its print position, either vertically or horizontally, in increments of:

- 1/10, 1/12 or 3/50 inch (pitch settings),
- 1/48 or 1/120 inch (line or column definitions),
- 1/300 inch (dots),
- 1/720 inch (tenths of a point).

All these commands are described below.

One hint about moving the print position: you can confuse yourself trying to use more than two different units during the same session. So decide beforehand how precise you need to be in moving the print position, not forgetting any graphics you want to include. Then stick to the unit(s) you choose.

4.4.2 *Lines per inch*

This vertical line-spacing command gives you more options than just the six or eight lines per inch of early printers. Use this command to set how many lines you want in each vertical inch of your page:

`<ESC> &ln D`

For *n* you enter the number of lines per inch you want — any of: 1, 2, 3, 4, 6, 8, 12, 16, 24 or 48. If you enter a number other than these the printer will ignore the command.

4.4.3 Defining the space and column

Before you use print positioning commands, you first may want to change the definitions of the line or space (sometimes called “vertical and horizontal motion indexes”, VMI and HMI). These definitions don’t actually move the print position. Instead, they define two basic units you can use in print position commands.

What’s important about the *space* is that it defines how far the print position travels for every character you print (except for proportionally spaced text). The space can also be thought of as the width of a vertical print *column*. One column width is the width of the space character in the current font, no matter whether it is monospaced or proportionally spaced.

Occasionally you may want to change space width to override the current pitch setting. Let’s look at an example. The space width comes in units of 1/120th of an inch, and the Courier font can print 10 characters per inch. Each character covers a tenth — 12/120ths — of an inch, so that font’s default space width is 12 units. If we change its space width to 6, each character would half-overlap the one before it.

If you are using <SI> and <SO> to shift between a primary and secondary font, it’s a good idea to change the space width after every shift.

To change the space width you send this command:

```
<ESC> &k n H
```

in which for *n* you can enter a number from 0 (zero) to 840. A width of 0 will print characters on top of each other; a width of 840 will print them seven inches apart.

4.4.5 Defining line depth

The *line depth* (sometimes called the “vertical motion index”) specifies how far down a page the print position will move for each line feed. You probably won’t use the line depth as much as lines-per-inch. Line depth can be more precise but it isn’t as easy to calculate. The line depth comes in multiples of 1/48th of an inch.

The important fact about the line depth is that when you change it you are changing the actual meaning of a “line”. When you increase the line depth you effectively decrease the number of lines per inch, and increase the page length.

The command you send to set the line depth looks like this:

```
<ESC> &l n C
```

(note that the character after the “&” is a lower-case “L”) in which for *n* you can enter a number from 0 to 336. If *n* is zero, lines will be printed on top of each other, and if 336, they will be printed 7 inches apart.

4.4.6 Moving the PRINT position horizontally

You can use three different units to move the print position horizontally: columns (space-widths), dots (each 1/300th of an inch), or tenths of a point (decipoints). Both columns and decipoints can be fractions to two decimal places, such as 45.75 decipoints — which provides a great degree of accuracy for graphics applications.

Moreover, for each of these you can move the print position horizontally in two ways. You can move *absolutely* from the left edge of the page. Or you can move *relatively*, away from the current print position. To show you want to move away from the current print position, you put a plus (+) or minus (–) sign before the number of units you want to move.

If you send a command that would put the print position outside either side margin, the LaserPrinter 4III will let you do just that. However, you can't send the print position further than its printable limits at the edges of the page.

4.4.7 Horizontal moves: by columns, decipoints and dots

To move the print position horizontally a number of columns, send the command:

```
<ESC> &a n C
```

in which for *n* you enter the number of columns you wish to move the print position.

So to move to column 45 you send the command:

```
<ESC> &a 45C
```

But to move 45 columns to the right of the current print position, you send:

```
<ESC> &a +45C
```

To move the print position horizontally a certain number of decipoints, send the command:

```
<ESC> &a n H
```

in which for *n* you enter the number of decipoints you wish to move the print position (preceded by a + or – sign if you want to move away from the current position).

You can move the print position horizontally by dots both ways too. You can move a number of dots away from the left edge of the page, or you can move a number of dots away from the current print position.

To move horizontally this way, send the command:

```
<ESC> *p n X
```

in which for *n* you put either the number of dots away from the page edge, or (preceded by a + or – sign) the relative number of dots away from the current position.

So to move 20 dots from the left edge you send this command:

```
<ESC> *p 20X
```

And to move 20 dots to the left of the current position you send:

```
<ESC> *p -20X
```

You can also move the cursor 8 columns at a time horizontally by use of the horizontal tab command. Simply send a tab character:

<HT>

to do this. Reverse tabbing is not possible.

4.4.8 Moving the print position vertically

You can use similar units to move the print position vertically: lines, dots, or decipoints. Both lines and decipoints can be fractions to two decimal places.

You can also move the print position *absolutely* down from the top edge of the page, or *relatively*, away from the current print position. Again, to show you want to move away from the current print position you put a plus (+) or minus (-) sign before the number of units you want to move.

The important difference about moving vertically up or down is what the printer does when the print position hits the page top or bottom. If you try to move above the top margin, the print position stays right at the margin. And if you move the print position down off the page, the page is ejected and printing continues on the next page.

4.4.9 Vertical moves: by lines, decipoints and dots

To move the print position vertically a certain number of lines, send the command:

<ESC> &a *n* R

in which for *n* you enter the number of lines you wish to move the print position. So to move to line 45, measured from the top edge of the page, you send the command:

<ESC> &a 45R

But to move 45 lines down from the current print position, you send:

<ESC> &a +45R

To move the print position vertically a certain number of decipoints, send the command:

`<ESC> &a n V`

in which for n you enter the number of decipoints you wish to move the print position down (or precede the number with a + or – sign if you want to move up or down from the current position).

Finally, you can move a number of dots down from the top edge of the page, or you can move a number of dots up or down from the current print position. To move the print position up or down an absolute or relative number of dots, send the command:

`<ESC> *p n Y`

in which for n you put either the absolute number of dots down, or (preceded by a + or – sign) the relative number of dots up or down from the current position.

So to move 20 dots down you send the command:

`<ESC> *p 20Y`

And to move 20 dots up you send:

`<ESC> *p –20Y`

4.4.10 Combining move commands

One thing about moving the print position with the above commands is that they let you think of your page in terms of Cartesian coordinates.

All we mean is that you can combine horizontal and vertical movements that use the same units. If you send this command,

`<ESC> *p 40x 20Y`

the print position will move to a spot 40 dots from the left edge of the page and 20 dots down from the top edge.

And if you send this one:

<ESC> &a +40h -20V

the print position will move right 40 decipoints and up 20 decipoints.

4.4.11 Backspace

The Backspace control code works exactly as you might expect: it moves the print position one column to the left.

<BS>

Moving the print position back does not destroy any characters already sent. In fact, because of that, this command can be quite useful. It lets you superimpose one character over another.

Say you want to indicate a blank space as the letter b with a slash / through it, an old programming symbol. Just send the b and then follow it with <BS> and the slash, and you get this: b/.

4.4.12 Carriage return

The Carriage Return command by itself only moves the print position back to the left margin of the line on which it currently sits:

<CR>

If you want the print position to move down a line as well, send a separate Line Feed command each time, or use Define Automatic Line Ends (explained below) to couple these two control codes.

4.4.13 Line feeds

The Line Feed command advances the print position one line down the page. The meaning of a line is set by the Line Depth command.

To send a line feed just send this control code:

<LF>

The Half Line Feed command is the one you want for subscripts. This command moves the print position down the page one half the current line depth:

<ESC> =

To send a reverse Half Line Feed, moving the print position up to let you print a superscript, use this command:

<ESC> &a -.5 R

4.4.14 Form feed

This command, like the [PRINT] button, makes the printer advance to a new sheet of paper. When you send the <FF> control code you are also telling the printer to print all its stored page information. Remember to send this command to make sure any last partial page in your printer's memory gets printed:

<FF>

4.4.15 Define automatic line endings

When you press the Carriage Return key what do you expect to happen? Most people think a computer keyboard should work like a typewriter, with a Carriage Return starting a new line as well.

But computer programs don't have to stick to that analogy. Some programs (particularly graphics packages) want a Carriage Return to just move the print position back to the left edge of the page. And they want a Line Feed to move down to a new line without going back to the beginning of the line.

So you can specify exactly how you want <CR>, <LF> and <FF> to work with this command:

<ESC> &k n G

For n enter one of the numbers from this table:

n	AUTOMATIC COMMAND
0 (zero)	<CR>, <LF> and <FF> work according to their basic definitions,
1 (one)	<CR> will also generate a <LF> (but <LF> and <FF> stay the same),
2	<LF> or <FF> will produce a <CR> too (<CR> by itself won't change),
3	<CR> generates a <LF> too, and either <LF> or <FF> produces a <CR>.

After you send the command <ESC> &k 2 G for example, every time the printer gets a Line Feed command it will move the print position down and over to the start of the line. When it gets a Form Feed, the printer will also move the print position back to the left.

4.4.16 Autowrap

One nice thing we get used to with a word processing program is not having to worry about words going past the right margin. We don't have to listen for that typewriter bell at the margin any more.

This command does pretty much the same thing your word processing program does. The important difference is that it does not wrap words. When you turn on Autowrap, if you send too many characters for a line the laser printer prints the overflow on the next line.

If Autowrap is on, when the printer gets a character that would print beyond the right margin, it returns the print position for that character back to the left and one line down (Carriage Return and Line Feed).

The Autowrap command works like a toggle switch:

<ESC> &s n C

If for n you enter 0 (zero) then this wrap-around mode will apply.

But if for n you put 1 (one) this automatic wrapping of characters will not happen. The default if you don't send a command is no wrapping.

Note: Even when Autowrap is on, the printer will print beyond the right margin if you have sent one of the direct positioning commands described above, which move the print position past the margin.

Also, note that Autowrap doesn't move the whole word down to the next line — that's a job for a word processor, not your laser printer.

4.4.17 Pushing and popping the print position

This provides a wonderful way to keep track of the print position. It works by letting you keep a list of up to 20 print positions.

You can “push” the current print position onto the top of the list whenever you want. Later, you can “pop” off whatever position is at the top of the list, making it the current print position.

When would you want to save and restore print positions this way? Whenever you need to interrupt what you're printing now to stick something special onto the page. This is most handy when you need to jump from text to graphics and back.

Say you've written one routine that puts the page number in the same place on every page, and another that under certain circumstances prints two heavy lines. You print merrily along until you have to print the lines. You then push the current print position to execute the line-printing routine.

But part way through that you hit the page-number spot. So you push the print position again and run the page-number routine. Then you can pop the print position to print the second line. And when that's done you pop it again to return to printing text.

As you might suspect, this can involve fairly complicated programming, typically using the macro commands described later in this chapter.

To push or pop a print position you send this command:

`<ESC> &f n S`

For *n* you enter 0 to push (save) the current print position, or 1 to pop (restore) the last position saved off the list.

Note: The last position pushed onto the list will always be the first one popped back later.

4.5 CONTROLLING FONTS

4.5.1 *Font selection*

The Star LaserPrinter 4III lets you define and select fonts three ways: as primary and secondary fonts, or by font identification number, or by description. We'll look at the first two ways now, and explain selecting a font by its attributes a little further on.

However you choose to refer to fonts, remember that a font must be available before you select it. So if you want to select a cartridge or downloaded font, you first have to put in the cartridge or download the font.

4.5.2 *Selecting primary or secondary fonts*

Of the three selection methods, you will save the most programming time by shifting back and forth between primary and secondary fonts. That's counterbalanced, though, by the fact that you often need more than two fonts.

Typically, you use primary and secondary fonts to flip back and forth between two different symbol sets — for example IBM symbol sets 1 and 2. You can designate any two fonts, whether internal, cartridge or downloaded, as primary and secondary.

The way you show you're talking about a primary font in an Escape sequence is to follow the <ESC> symbol with a left parenthesis. For example,

```
<ESC> (s 10 H
```

means you want your primary font pitched at ten characters to the inch. Typing a right parenthesis instead means you are referring to the secondary font:

```
<ESC> )s 10 H
```

You define a font as primary or secondary as you select it. To make a font your primary or secondary font, you use font-description Escape sequences such as those just above, specifying the attributes you want.

If you don't explicitly indicate what attributes you want for the primary or secondary font, the printer will use the same default font for both. This default font's attributes include the Roman-8 symbol set, 10-pitch spacing, 12-point height, upright style, medium weight, and Courier typeface.

After your primary font is selected, you can choose it for printing by sending this Shift In control code:

<SI>

All the text you send after that command will print in the primary font.

Your laser printer shifts to the secondary font when you send this Shift Out code:

<SO>

4.5.3 Assigning font ID numbers

The second way to define and select fonts is by using font ID numbers. You may prefer this method if you frequently use many fonts. While not as short as <SI> and <SO>, it's quicker than describing font attributes over and over again.

To give an ID number to an internal or cartridge font, you first make it the primary font. That is, you send a left-parenthesis Escape sequence (a font attribute command as described below) and the Shift In control code. Then, to assign an ID number to the font, you send this command:

<ESC> *c n D

For *n* you can enter any number between 0 and 32767 as the font's ID number. (Not that you can have more than 64 fonts in the printer at once, even with the optional memory board. A printer would need an elephantine memory to hold 32767 fonts!)

4.5.4 Selecting downloaded fonts

The easiest way to select among downloaded fonts is to use font ID numbers.

When you download a font you make the Assign Font ID command above the first command in your sequence (see “How to download your own fonts” later in this chapter). After you’ve assigned an ID number to a downloaded font, you can select it as your primary font with this Select Font ID command:

```
<ESC> ( n X
```

in which *n* is your desired font’s ID number.

If you use many fonts you’ll use that command to select among them. But what if you prefer to just use <SI> or <SO> to shift between primary and secondary fonts? You want to select a downloaded font ID as your secondary font. This is the command to send:

```
<ESC> ) n X
```

4.5.5 Font attributes

The third way to select a font is to simply describe what font attributes you want. (Remember, selecting a font does not modify a font. You can’t get bold or 14-point characters if you don’t have a bold or 14-point font in the printer.)

In listing the attributes you want, it will help you to prioritize them the same way your LaserPrinter 4III does. Your printer ranks the various attributes a font can have this way (from most to least important):

- orientation
- symbol set
- spacing (proportional or monospaced)
- pitch (characters per inch)
- font height (in points)
- style (italic or upright)
- stroke weight (light to bold)
- typeface

The laser printer just zips down this chain of attributes one by one, eliminating fonts that don't match what you want, until it gets down to one unique font that matches your request. If the printer matches down to, say, style or weight but can go no further, it will give you its closest font to your request.

And if you don't specify a particular value for some attribute, the printer assumes you want the value that attribute had in the *last* font you specified (or the default value if you've just turned on the printer). This can save you some effort: if the font you want has an attribute the same as the current font, you don't have to specify that attribute again.

Orientation

Portrait orientation prints text across the width of a page. Landscape orientation prints text sideways up the length of a page.

The Star LaserPrinter 4III is more flexible about orientation than most other laser printers; it lets you simply rotate any portrait font to the landscape orientation or vice versa. To start you off when you change orientation, the printer resets all its margins and its column and line definitions to their default settings.

When you want to select the opposite orientation, send this command:

`<ESC>&ℓn O`

in which for *n* you put

- 0 to get portrait orientation,
- 1 to get landscape orientation,
- 2 to get upside-down portrait orientation,
- or 3 to get upside-down landscape orientation.

(Notice: the ℓ character after the & is a lowercase L.)

To select the direction in which characters, raster graphics and fill patterns are printed, use the following command:

<ESC>&a *n* P

in which for *n* you put 0 to select the portrait direction,
90 to select the landscape direction,
180 to select the upside-down portrait direction,
and 270 to select the upside-down landscape direction.

Symbol sets: a review

Each font can have many symbol sets, each being a subset of all the possible characters of the font. These subgroups include different symbols for different nations or for lawyers or artists or mathematicians. Any two symbol sets, moreover, may store the same symbol at a different font position in the printer's memory.

The default symbol set is Roman-8, which includes all ASCII characters plus dozens of accented letters. But you can use any of the sets shown below. Technically you can pair any symbol set with any internal, cartridge or downloaded font; however it doesn't make much sense to print text with a math or line-drawing symbol set.

The Star LaserPrinter 4III provides two different symbol set commands. You put a code into one command to select a *particular* symbol set for your primary or secondary font. You use the other command to select the *current* or *default* symbol set for your primary or secondary font.

Selecting a symbol set

This first symbol set command lets you select a particular symbol set for the current font. To select a symbol set for your primary font, send this command:

<ESC> (*n*

For *n* enter one of the following symbol codes. The first character must be a digit and the second an uppercase letter.

Note: The symbol sets marked with * can select when the approval Font Cartridge is installed.

CODE <i>n</i>	SYMBOL SET
0A	Math-7 symbols*
0B	Line Draw characters*
0D	ISO 60: Norwegian
0E	Roman Extension*
0F	ISO 25: French
0G	HP German
0I	ISO 15: Italian
0K	ISO 14: JIS ASCII
0N	ECMA-94
0O	OCR-A*
0Q	Math-8A symbols*
0S	ISO 11: Swedish
0U	ISO 6: US ASCII
0Y	Bar Code 39*
1D	ISO 61: Norwegian
1E	ISO 4: UK
1F	ISO 69: French
1G	ISO 21: German
1O	OCR-B*
1Q	Math-8B symbols*
1S	HP Spanish
1U	Legal
2K	ISO 57: Chinese
2Q	Pi font-A symbols*
2S	ISO 17: Spanish
2U	ISO 2: IRV
3Q	OCR-B Extension*
3S	ISO 10: Swedish
4S	ISO 16: Portuguese
5M	PS Math
5S	ISO 84: Portuguese
6J	Microsoft Publishing
6M	Ventura Math
6S	ISO 85: Spanish
7J	Desk Top
8M	Math-8 symbols
8Q	IBM-PC Set*
8U	Roman-8
8Y	Bar Code EAN/UPC*
9Q	IBM-PC Extension*
9U	Windows

10J	PS Text
10U	IBM-PC (US)
11Q	ECMA-94 7Bit*
11U	IBM-PC (Denmark/Norway)
12U	PC-850
13J	Ventura International
14J	Ventura US
15U	Pi font symbols

To select a symbol set code for your secondary font, flip the parenthesis:

<ESC>) *n*

and for *n* substitute your choice from the codes above.

Selecting the current or default symbol set

Your printer can use either the primary or the secondary font as its current font. And that current font has its current symbol set. Your printer also remembers its default font and symbol set, which are Courier with Roman-8 (unless you've changed their initial parameter values through the control panel menu).

The following command lets you select one of those symbol sets for your primary font.

<ESC> (*n* @

For *n* enter one of the following selection values for your primary font:

<i>n</i> VALUE	SELECTION
0 (zero) or 1 (one)	Selects the default symbol set
2	Selects the current font's symbol set (this forces the printer to select its best matching font)
3	Selects <i>all</i> of the default font's attributes (not just symbol set)

Similarly, you can select either the default or the current symbol set for your secondary font. You also may want to use the same symbol set for both primary and secondary fonts.

To do these tasks, you can send the following command to select which symbol set you want for your secondary font:

<ESC>) n @

For *n* enter one of the values from this table:

<i>n</i> VALUE	SELECTION
0 (zero)	Selects the default symbol set
1 (one)	Selects same symbol set as primary font
2	Selects the current font's symbol set
3	Selects all the default font's attributes (not just symbol set)

Example: Symbol set commands

Let's take a short look at how you use these commands. Here's the scenario: You are already using the Line Printer typeface, but want to use the German symbol set as you are writing a report for your Berlin office and need umlaut characters for several names in the report.

Then in the report you decide to use a proprietary product name, so want to nip out to grab the ® symbol on a legal cartridge font you've already loaded, then return to your German set. When your report's all done, you want to return the printer to its Roman-8 default.

Here are the commands that will do the job for us:

<ESC> (0G

(you start your report here)

<ESC> (1U ®

<ESC> (0G

(you finish your report here)

<ESC> (0@

If you had finished with <ESC> (3@ the printer would return to its standard Courier font, not just its Roman-8 symbol set.

Spacing

If you specify monospaced for a font, each character prints with the same width. But if you specify proportional spacing the design of each character determines its width. To define how you want your primary font spaced, send this command:

```
<ESC> (s n P
```

in which for *n* you put 0 (zero) to get monospaced,
or 1 (one) to get proportional spacing.

If you specify proportional spacing it doesn't matter if you also specify pitch, because spacing is a higher priority font attribute. The printer will just ignore the pitch request.

To define spacing for your secondary font, use the same numbers and just flip the parenthesis:

```
<ESC> )s n P
```

Pitch

Pitch defines how many characters per inch you want for a monospaced-pitch font. Your Star LaserPrinter 4III's internal monospaced-pitch fonts have settings of 10, 12 or 16.66 characters per inch. Cartridge or downloaded fonts with monospaced pitches often have other settings for characters per inch.

To select the pitch you want for the primary font, send this command:

```
<ESC> (s n H
```

where for *n* you put in how many characters per inch you want. For example, <ESC> (s 12H will pack twelve characters into each inch.

The corresponding pitch command for the secondary font is:

```
<ESC> )s n H
```

You can use a different command instead of these for general character pitch setting. This command, since it doesn't have parentheses, covers both the primary and secondary fonts. It looks like this:

`<ESC> &k n S`

For n you enter a pitch code from the following table:

CHARACTERS PER INCH	PITCH CODE n
10 cpi (pica)	0 (zero)
16.66 cpi (condensed)	2

Font height

The height of the characters you print is measured in point sizes. The Star LaserPrinter 4III provides fonts in 6, 7, 8.5, 10, 12, 14, 16, 18, 24 and 36 point sizes. If the font height you specifically ask for is not available, the printer will select the font with the size closest to your request.

To select font height for the primary font use the following command. For n enter the font height in points that you want:

`<ESC> (s n V`

To select font height for the secondary font, send this command:

`<ESC>)s n V`

Style

Style defines whether your text is printed in italics or upright, the way these words are. Send this command to select the style you want for the primary font:

`<ESC> (s n S`

in which for n you enter

0 if you want normal upright text,
or 1 if you want italics.

To select style for the secondary font, just reverse the parenthesis and use the same *n* numbers:

<ESC>)s *n* S

Remember that style is a relatively low-priority attribute. If a particular font satisfies all higher priority attributes but doesn't come in the style you want, you'll get that font without your style.

Stroke weight

The weight of a font defines how lightly or boldly it prints.

You can be flexible about stroke weight. The following command gives you a range of 15 degrees of boldness, though not many fonts exploit that range.

Send this command to select a primary font with your desired stroke weight:

<ESC> (s *n* B

in which you replace *n* with a number from -7 (meaning light) to $+7$ (very bold). You need the negative sign to get the lighter weights. A weight of 0 (zero) produces medium print.

To select the stroke weight for the secondary font, use the same numbers with this command:

<ESC>)s *n* B

An incidental note: You will likely use optional fonts to give you boldface, so probably don't need to know this. But it's possible to print bold without even having a bold font in the printer. You just print the text you want in bold two times, with the overprint offset by 4 decipoints.

So you can use the command <ESC> &a *n* H to back up, you just need to know the width in decipoints of what you want to overprint. In a monospaced-pitch font like Courier that's easy: just keep track of how many characters you print. In a proportional font you'd keep track of the decipoints by using a character-width table. After backing up 4 decipoints less than the total text width you just print your text again.

Typeface

The last attribute you can give to characters is their typeface. The design of characters is what font designers often think of as the main determinant for a font. But when you select a laser printer font, typeface sits at the bottom of the list.

To assign the particular face you want for your primary font, send this command:

<ESC> (s n T

For *n* enter one of the font code numbers from this table:

TYPEFACE	<i>n</i>
Line printer	0 (zero)
Pica	1 (one)
Elite	2
Courier	3
H-Gothic	4
Roman	5
L-Gothic	6
Script	7
Prestige	8
Caslon	9
Orator	10
Presentation	11
Line Draw	12
PC Line	13
OCR	14
Bar Code	15

To assign a character face to the secondary font, just flip the parenthesis and use the same *n* numbers:

<ESC>)s n T

Example: Font attributes

Let's put the last half dozen font attributes together in an example. Say we want to select a nice font — a small Line Printer — for the footnotes in a report we've finished. Let's make it our secondary font, since the body of our report is done in the primary font.

We'll go with the defaults for orientation and symbol set. But let's be specific about the other attributes, and let's remember to put them in priority order.

We decide on a monospaced of 16.66 characters per inch and a height of just seven points (footnotes should look smaller than our regular text). To keep it readable, we opt for the ordinary upright style and medium weight in the Line Printer typeface. Our sequence of individual commands would look like this:

```
<ESC> )s 0P
<ESC> )s 16.66H
<ESC> )s 8.5V
<ESC> )s 0S
<ESC> )s 0B
<ESC> )s 0T
```

Since these font attributes all start with the same)s command-category prefix, let's put them all together in one command:

```
<ESC> )s 0p 16.66h 8.5v 0s 0b 0T
```

The BASIC statement we could send to select our desired font would look like this:

```
100 LPRINT CHR$(27);")s0p16.66h8.5v0s0b0T"
```

And assuming we have such a font in our printer, we'd get a font that looks like this sentence for our footnotes.

4.5.6 Underline

Underlining is printing feature, not a font attribute.

You can underline in two ways: as a print feature, or with the `_` underline character. If you backspace and use the underline character, however, you often find the underline doesn't come out the same length as your text.

The underline command works better. When you turn on the underline feature this way, the printer will underline all subsequent printable characters, including spaces.

Send this command to turn on the underlining mode:

```
<ESC> &d n D
```

in which for n you put 0 (zero) to get fixed underline,
or 3 to get floating underline.

And send this command to turn off the underline mode:

```
<ESC> &d @
```

4.5.7 How to print Escape sequences and control codes

You use both Escape sequences and control codes to print. So how do you print Escape sequences and control codes?

But you actually can print commands, and in two different ways. You would do this when you want to see everything exactly as it is sent to the printer — for example, to debug a string of text and commands that doesn't print the way you think it should.

The Transparent print command prints the string of data that follows it without paying attention to any embedded Escape sequences or control codes. Transparent print even prints Carriage Return codes without zapping the print position back to the left margin.

To use Transparent print, just put this command immediately in front of your print data:

<ESC> &p *n* X

For *n* you specify the number of bytes of data you want to print .

Display Functions, like the Transparent print command, prints Escape sequences and control codes without actually executing them. But Display Functions pays attention to Carriage Return codes, so text looks more like the way it normally prints. Display Functions also prints commands as blanks, not as symbols.

Display Functions actually involves two Escape sequences, one to turn it on and another to turn it off. To turn on Display Functions, send this command just before the data you want displayed:

<ESC> Y

And to turn off Display Functions, send this command at the end of the displayed print data:

<ESC> Z

That Escape Z sequence itself prints as a blank followed by a Z.

4.5.8 Font control

The Font Control command has two main functions: defining a font's status, and deleting fonts.

You can make a font either permanent or temporary with the Font Control command. This helps you control which fonts you delete, as permanent fonts do not get deleted when you reset the system. The permanent or temporary status you give to a font will apply only to the font you last specified, using one of the font ID commands described above.

When your printer's memory gets stuffed with fonts, you can also use this command to delete some of them. You can only delete fonts you've downloaded, as internal and cartridge fonts are never deleted. No text will get lost when you delete a font, even when that font is on an unprinted page in the printer's memory.

To control fonts you send this command:

<ESC> *c n F

For *n* enter one of the numbers from this table of functions:

<i>n</i>	FUNCTION
0 (zero)	Delete all temporary and permanent fonts
1 (one)	Delete all temporary fonts (another way to delete all temporary fonts is to send a reset command)
2	Delete just the font with the most recently specified ID
3	Delete just the last character of the font you have downloaded
4	Make the current font ID temporary
5	Make the current font ID permanent
6	Make a temporary copy of the current font

A bit of explanation about that last function 6: When you give a font ID to *any* font you first need a temporary copy of that font in memory. That copy is already there for downloaded fonts. But you will need function 6 to create a temporary copy of an internal or cartridge font.

Here's how to assign ID numbers to an internal or cartridge font. You first select the font, then send the Font ID command to give it an ID number, and finally copy the font into memory with Font Control function 6. If you want that copy to stay in RAM when you reset the printer, you conclude by sending Font Control function 5.

4.5.9 Example: Controlling fonts

Let's see how those last few commands work, translated into BASIC.

Pretend you want to make a short test with your current font (it doesn't matter what it is): you want to print what's in ASCII table positions 128 through 130. There's nothing there in your normal Roman-8 symbol set, but some other sets keep control codes or international characters there.

Assuming you like what you see printed from those ASCII positions, you then want to make that current font permanent. Finally, you also want to dump all the temporary fonts from printer memory to make room for some graphics you'll be printing.

Let's start with a reset and an underlined heading for your test print:

```
100 LPRINT CHR$(27);"E";
110 LPRINT CHR$(27);"&dOD";
120 LPRINT "Underlined heading for test print
      of ASCII 128 - 130";
130 LPRINT CHR$(27);"&d@"
140 LPRINT CHR$(27);"&p3X";
150 LPRINT CHR$(128);CHR$(129);CHR$(130);
160 LPRINT CHR$(12);
170 LPRINT CHR$(27);"*c5f1F";
```

Line 100 is just the <ESC> E reset command. Lines 110 and 130 turn on and off the underline feature.

Line 140 turns on transparent printing, which forces printing even for normally unprintable control codes. The three bytes you want to print are in line 150. To see what's there, you send a form feed command in line 160.

And finally, line 170 uses the font control command to make the current font permanent and then delete all temporary fonts.

4.5.10 Example: Assigning font numbers

Now let's do a program in BASIC. First we'll assign font numbers to the Courier and Line Printer resident fonts and to a cartridge font, IBM PC Courier. Then we'll print samples of each font.

```
100 LPRINT CHR$(27);"(8U";
110 LPRINT CHR$(27);"(s0p10h12v0s0b3T";
120 LPRINT CHR$(15);
130 LPRINT CHR$(27);"*c1D";
140 LPRINT CHR$(27);"*c6F";
150 LPRINT CHR$(27);"(8U";
160 LPRINT CHR$(27);"(s0p16.66h7v0s0b0T";
170 LPRINT CHR$(15);
180 LPRINT CHR$(27);"*c2D";
190 LPRINT CHR$(27);"*c6F";
200 LPRINT CHR$(27);"(10U";
210 LPRINT CHR$(27);"(s0p10h12v0s0b3T";
220 LPRINT CHR$(15);
230 LPRINT CHR$(27);"*c3D";
240 LPRINT CHR$(27);"*c6F";
250 LPRINT CHR$(27);"1X";
260 LPRINT "Font 1 - Resident Courier"
270 LPRINT CHR$(27);"(2X";
280 LPRINT "Font 2 - Resident Line Printer"
290 LPRINT CHR$(27);"(3X";
300 LPRINT "Font 3 - Cartridge PC Courier"
310 LPRINT CHR$(27);"(1X";
320 LPRINT CHR$(12)
```

Line 100 and 110 calls the internal Courier font and line 120 makes it the primary font. Line 130 gives it font ID number 1, and line 140 makes it temporary.

Lines 150 through 190 do the same thing for the Line Printer font, and lines 200 through 240 for the cartridge font. Notice that the cartridge font has the IBM symbol set code 10U.

Lines 250 through 300 print out samples of the three fonts. Finally, line 310 resets the default to our internal Courier font, and line 320 performs the final form feed to print the page.

4.6 USING YOUR OWN FONTS

4.6.1 *Font design is tedious*

A warning: font design is an art. Don't expect to turn out professional-looking fonts in a few hours.

Sometimes, though, you have to build your own typeface, even if you don't work with a company in the font-selling business. You may, for example, want to print your own customized company logo. It means building up characters within a cell or grid, perhaps 50 dots high and 35 wide — lots of dots.

Because defining your own typeface is so tedious, make sure you've checked out as many downloadable fonts as you can find from font development companies.

The next handiest way to do the job is to ask around, maybe where you bought your LaserPrinter 4III, to see if you can get one of the font-creating or font-editing utility programs now on the market. *FontGen IV+* is one. Keep an eye out, too, for new word processing tools that might save you the trouble of painstakingly figuring out details like kerning.

Even with aids like these, building a custom font is an intricate process. It calls for the creation of a family of up to 200 characters sharing a common design and proportional scheme, and that's just for one type size. No mean feat.

4.6.2 *How to download your own fonts*

Characters that you define and store yourself are called “user-defined” characters. Let's assume you already know what text is to be in your custom font, and have designed its typeface, weight, width and style. Once you've created your own characters, you'll need to download them to your laser printer.

The process of downloading a font you've designed yourself is somewhat detailed. To download your font, you follow the following steps:

- 1) assign a font ID number to your font,
- 2) download a font header,
- 3) identify the position of each character to be downloaded,
- 4) send a character descriptor and bit map for each character,
- 5) specify whether the file is to be permanent or temporary.

1) Assigning a font ID to your font

To assign an ID to your font, you send this command (described above under "Assigning font ID numbers") with an ID number for n between 0 and 32767:

`<ESC> *c n D`

Before sending that command though, check whether the ID number is already allocated to another font. If it is, that existing font will be deleted with the next command.

2) Downloading a header for your font

Even if the printer doesn't have enough memory to create your font, it will delete any existing font with the same ID number when you download the *header* for your font.

A font's header is the list of its attributes, which your printer uses to select that font. Each font header, 26 bytes long, is stored at the front of the font. You send a font header command to your printer just before you download the font's characters.

The header command looks like this:

`<ESC>)s n W`

and must be followed immediately by the data describing the font's attributes. The n value is the actual number of bytes of description data, almost always 26. Note: unlike other commands, you must enter the ASCII symbols 2 and 6 here, not the number 26.

Here's a typical font header command:

```
<ESC> )s26W 0<SUB>01000<RS>0<RS>02001<FF>0d0à0000<ETX>
```

Aside from the actual command at the front, the rest looks like gobbledygook? But there's 26 bytes there, each one an ASCII character, each one specifying a particular font attribute. (The enclosed items with brackets are single ASCII characters that happen to be control codes.)

Each byte in the header is a number, which you send as whatever symbol happens to be stored at that numeric position in the ASCII table. Coding some of these numbers is tricky, however, and we recommend you ask your Star Micronics dealer to help you build your font header. To get you started, the table below shows what each of those bytes means:

BYTE	MEANING
0-1	header length
2	blank
3	font size
4-5	blank
6-7	baseline position for characters
8	blank
9	cell width
10	blank
11	cell height
12	orientation
13	spacing
14-15	symbol set
16-17	pitch
18-19	line spacing
20-22	blank
23	style
24	stroke weight
25	typeface

3) Positioning each character in your font

Before you download each character you have to tell the printer where in its font table to put it. You indicate where by sending this command:

`<ESC> *c n E`

For *n* you put the decimal number, between 0 and 255, of the position in the font table where you want your character stored.

Your printer's font table is just like the ASCII table. Before you send each character, say *g*, you have to say where you want to put it. In the ASCII table, *g* is at decimal position 103. So you send this command:

`<ESC> *c 103 E`

And immediately after it you send the bits that make up the character *g*.

4) Describing each character in your font

The next step is to describe each of your characters, "mapping" where you want each dot to go. Send this command before each character:

`<ESC> (s n W`

For *n* you enter the number of bytes you'll be sending after this command, to describe and map your character. Sixteen bytes are needed for the description; the bit-map takes as many bytes as you've put into each character cell — perhaps two or three hundred bytes.

As with the font header, each byte in the character description is a number, sent as the symbol at that position in the ASCII table. Coding character descriptions is tricky too, so again we recommend you ask your Star Micronics dealer for help. The table below shows what the bytes in the character description mean:

BYTE	MEANING
0	description length
1	blank
2	always 14
3	always 1
4	orientation
5	blank
6-7	left offset (blank space to left of character)
8-9	top offset (blank space above character)
10-11	character width
12-13	character height
14-15	print position travel (proportional spacing only)

The bit map of the character is just the pattern of dots in the character, starting at the top left of its cell. You work your way across the cell and down to the bottom right, giving each dot a value of 0 if it's not to be printed and 1 if it is. Then you group those dots as 8-bit bytes.

5) Permanent or temporary?

The last step in downloading your own font is to make the font permanent or temporary, using the Font Control command described earlier. The command <ESC> *c 4 F will allow the font to be erased when you reset the printer. But the command <ESC>*c 5 F will keep your font available even after you reset the printer.

4.7 RASTER GRAPHICS

The Star LaserPrinter 4III offers *raster* graphics (sometimes called “bit-mapped graphics”), which specify each dot in a graphics pattern.

Be aware, though, that adding graphic elements always slows up printing with laser printers.

The following steps should be performed (in the order shown) when printing raster graphics:

- 1) Define the resolution
- 2) Set the orientation of the graphic image
- 3) Issue the command to start graphics
- 4) Issue the command to set the compression technique (if any) of the graphical data
- 5) Send the commands which transfer the graphics data
- 6) Send the command to end graphics.

1) Define the resolution

Before graphics are sent to the printer, the resolution must be set. This is achieved using the following command:

```
<ESC> *t n R
```

If the value of n is greater than 150, the resolution of the final graphics image will be 300 dots per inch (dpi); if n is from 101 to 150, the resolution will be 150 dpi; if n is from 76 to 100, the resolution will be 100 dpi; and if n is 75 or less, the resolution will be 75 dpi. The default resolution is 75 dots per inch. After graphics have started, the printer will ignore any resolution command until it receives the command to end graphics.

2) Set the orientation of the graphic image

To set the orientation of the graphic image, transmit the following command:

```
<ESC> *r n F
```

where n can take a value of either 0 or 3. When the value of n is 0, raster graphics printing will take place in the logical page orientation, and when the value of n is 3, raster graphics will be printed along the width of the physical page, regardless of the logical page orientation.

3) Issue the command to start graphics

The command to start graphics must be transmitted next. The command is:

`<ESC> *r n A`

where n can take a value of either 0 or 1. If you enter 0, the margin for graphics will be set at the left-most printable edge of the page (not the same as the left margin for text). But if you enter 1, the margin for graphics will be set at the column of the current print position, and your image will appear only to the right of that graphics margin.

4) Issue the command to set the compression technique (if any) of the graphical data

Three graphic data compression formats are available for data transfer. The data compression format to be used is selected using the following command:

`<ESC> *b n M`

where n can take the value 0, 1 or 2. Any other value is interpreted as 0. A full discussion of data compression technique is outside the scope of this manual, but a brief explanation of this command should be useful.

- Where $n = 0$, no encoding takes place, and a simple binary transfer takes place. Bit 7 of the first byte corresponds to the first dot in a raster row, bit 6 to the second, and so on.
- Where $n = 1$, run-length encoding takes place. This is a compression technique where the data is divided into pairs; the first byte of each pair serving as the repetition count for the data in the second pair. If the first byte of the pair is equal to zero, the data in the second byte is not repeated.
- Where $n = 2$, the data to follow is in Tagged Image File Format (TIFF) conforming to rev. 4.0 standards. The demands of space do not allow a detailed discussion of TIFF standards here, but briefly, TIFF files combine features of non-encoded and non-encoded files. Many proprietary graphics packages use TIFF encoding when storing and transmitting graphic data.

5) Send the commands which transfer the graphics data

When transferring raster graphics data, each line of raster data must be prefixed by the command:

`<ESC> *b n W`

where *n* gives the number of data bytes to follow (the maximum is 255 before another such command is sent). This data must follow the compression rules set in the previous command. For instance, a TIFF image interpreted in any way other than the TIFF format will produce very strange results! Repeat sending lines of graphics data, prefixed by the above command, until the whole image has been transmitted.

6) Send the command to end graphics

To signal the end of graphic data transmission, send the following command:

`<ESC> *r B`

There are no parameters. The LaserPrinter 4III is now in text mode.

A programming hint: move your print position in dot increments whenever you're dealing with graphics. It's easier than trying to calculate column-widths or decipoints.

The Raster Height command specifies the height in pixels of the next raster graphic (between the start graphics and stop graphics commands).

`<ESC> *r n T`

The value of *n* must be non-negative; if necessary, it is truncated to the value of (logical page length) - (y coordinate of cursor). This command causes all raster rows after the specified height to be clipped (disregarded), even if *n* = 0. It forced the cursor position to advance vertically by *n* rows, even if less than *n* rows are transferred. The area maps to either opaque or transparent depending on the source transparency mode.

The Raster Width command specifies the width in pixels of the next raster graphic.

<ESC> *r n S

The value of n must be non-negative; if necessary it is truncated to the value of (logical page width) - (x coordinate of cursor). It will clip all raster rows longer than the specified width, even if $n = 0$. It will pad any row shorter than the specified width with zeros. The area maps to either opaque or transparent depending on the source transparency mode.

The default value is the width or length of the logical page, depending on the orientation. The command is ignored when received between start and end raster graphics commands or if n is negative.

The Raster Y Offset command advances the vertical position and is ignored when not in the raster mode.

<ESC> *b n Y

If n is negative or if the new position would exceed the current raster height or the page limit, it is ignored.

4.8 PATTERN GRAPHICS

The Star LaserPrinter 4III also prints *pattern graphics*, which prints lines and patterned blocks.

Print shops call lines of any thickness *rules*. A printed line in fact is a rectangular area with one “skinny” dimension, from one to many dots thick. We will use the word “rules” too, to avoid confusion with the lines used to measure pages.

You follow these three steps when you use rule and pattern graphics:

- 1) Define the dimensions you need.
- 2) Choose the graphics pattern you want to fill in those dimensions.
- 3) Print the pattern.

Remember to send the following rule or pattern commands in that order.

4.8.1 Defining rule or pattern dimensions

Defining the dimensions of the area you want to fill just means indicating the horizontal and vertical size of the pattern, or the rule's length and thickness. You can indicate dimensions in either dots or decipoints (tenths of a point).

At 300 dots or 720 decipoints to the inch, decipoint measurements are more accurate. The printer converts decipoint values into dots, using 2.4 decipoints to the dot. It rounds up fractions to the next integer. So 1225 decipoints would work out to 510.4 dots, and the printer rounds this up to 511 dots.

Your dimension commands specify an area to the right and down from the current print position. If you define an area larger than the page, your printer will accept the command. It will, however, cut off your pattern or rule at the boundaries of the page's printable area.

When the printer finishes its print "map" of your rule or pattern, the print position automatically returns to the spot from which you started. That means, for instance, that you can make a lightly shaded rectangle and then start printing text right over it. This kind of box can be useful for setting off particular information from the main body of your text.

Horizontally, you can specify the rule length or horizontal pattern size in dots with this command:

```
<ESC> *c n A
```

in which for *n* you enter how many dots across the page you want the rule or pattern to be.

Alternatively, to specify the horizontal dimension for a rule or pattern in decipoints, you can print this command:

```
<ESC> *c n H
```

in which *n* is the horizontal rule or pattern size in decipoints.

Vertically, you can indicate the size of your rule or pattern in dots with this command:

```
<ESC> *c n B
```


in which n is the number of dots defining the thickness of the rule or the depth of the pattern.

Alternatively, to show the vertical dimension in decipoints, you send this command:

`<ESC> *c n V`

in which n is the number of decipoints in the rule's thickness or the pattern's vertical length.

4.8.2 Choosing and printing a rule or pattern

You need the next five commands to choose and print the particular pattern you want to fill your defined area. These commands work together.

With the Print Pattern command (which actually comes second) you specify whether you want to fill your rectangular area with a solid black rule, a finely dotted gray-scale pattern, or a predefined linear pattern. And with the Specify Pattern command you can indicate which *particular* dotted or linear pattern you want. You always send the Specify Pattern command before the Print Pattern command, even if you want a solid black rule.

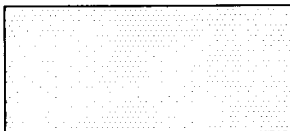
To indicate the particular pattern you want, send the following command. The general meaning of the n value you enter actually depends on the command you put after this:

`<ESC> *c n G`

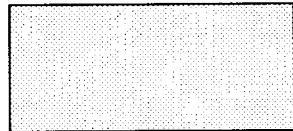
If you want a solid black rule it doesn't matter what you put in for n , as the printer ignores it.

If you want a 1-scale dotted pattern, for n you enter here a percentage number from 1 to 100 indicating the density with which you want the box filled, from light to solid. Your n percentage will correspond to one of the eight gray-scale densities in the chart below.

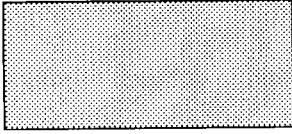
1 - 2 %



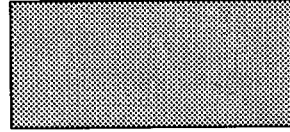
3 - 10 %



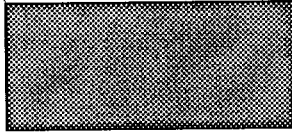
11 - 20 %



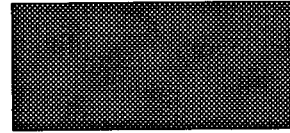
21 - 35 %



36 - 55 %



56 - 80 %



81 - 99 %



100 %

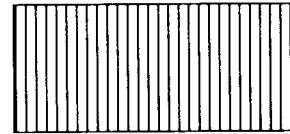


If you want a linear pattern, for n you enter here a pattern number between 1 and 6 inclusive, identifying one of the linear patterns below.

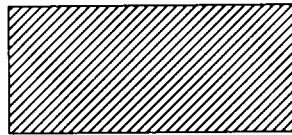
1



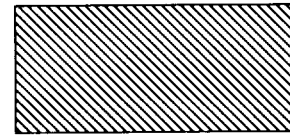
2



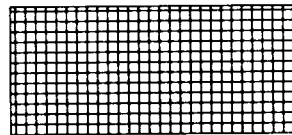
3



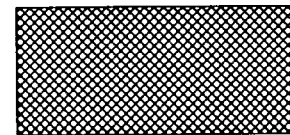
4



5



6



You always send the following Print Pattern command after a Specify Pattern command. This Print Pattern command identifies whether the area you have defined is to be filled with a rule, dotted gray-scale pattern, or linear pattern:

`<ESC> *c n P`

For n enter a value from the following table. (If you select a linear pattern here, but a dotted pattern in the previous Specify Pattern command, the printer will ignore this Print Pattern command.)

n Value	Pattern
0 (zero)	solid black
1	solid (opaque) white
2	shaded fill (as selected with <code><ESC> *c n G</code>)
3	cross-hatched fill (as selected with <code><ESC> *c n G</code>)
5	current pattern fill (as selected with <code><ESC> *v n T</code>)

If $n = 5$ has been selected, you will need the following command.

`<ESC> *v n T`

This command selects the current pattern type to be applied to source images (not rectangular areas) before printing.

n Value	Pattern
0 (zero)	Solid black
1	Solid white
2	Currently defined shading pattern
4	Currently defined cross-hatched pattern

For $n = 2$ or 3 , the pattern defined by the most recent `<ESC> *c n G` command is used. To change the pattern, a new `<ESC> *c n G` and a new `<ESC> *v n T` command are needed.

The following two commands control “transparency”, whether or not white sections of an image block out black pixels that are already in place.

```
<ESC> *v n N
```

This selects the source transparency mode, whether white areas of the source image should be treated as transparent (and do not “white-out” black pixels they cover) or opaque (in which case they white-out black pixels). Set *n* to 0 for the transparent mode and to 1 for the opaque mode.

```
<ESC> *v n O
```

This selects the pattern transparency mode, similarly to the above command, whether the current pattern should be treated as transparent or opaque. Set *n* to 0 for the transparent mode and to 1 for the opaque mode.

4.8.3 Examples: Pattern graphics

To specify a block five inches wide you could use a horizontal dimension of 1500 dots (5 inches times 300 dots). That command would look like this:

```
<ESC> *c 1500A
```

To print that area with a 25 percent gray-scale pattern, the commands you send would be:

```
<ESC> *c 25G  
<ESC> *c 2P
```

But to print an area filled with the horizontal bar pattern, the commands you send would be:

```
<ESC> *c 1G  
<ESC> *c 3P
```

(You could combine these commands as <ESC> *c 1g 3P.)

4.9 MACROS

4.9.1 Using macros

There's a great shortcut that simplifies the task of sending commands to your LaserPrinter 4III: use macros. A *macro* is a single control code, which you can define yourself, that does the work of a whole long series of printer commands. Any command can go into a macro.

Putting macros together to automatically repeat sequences of tasks is like using a real programming language. Your Star Micronics dealer may know of some pre-written macros already available for the Star LaserPrinter 4III. You'll find macros especially handy for creating letterheads and business forms, and also for setting tabs, subscripts and superscripts.

Your printer can store up to 32 macros without the optional RAM expansion. To manage printer memory you can make a macro either temporary (it disappears when you reset the printer) or permanent (it disappears only when you turn off the printer).

You assign each macro an ID number when you first define it. Use this Specify Macro ID command to specify (in place of *n*) the ID number of the macro to which you wish to refer:

<ESC> &f *n* Y

For example say you want to delete a macro numbered 80. You would first select that macro with the command <ESC> &f 80Y. Then you would delete it with the Macro Control command <ESC> &f 8X as described below.

4.9.2 Macro Control

The Macro Control command performs several jobs for you, such as defining, running and deleting macros. To manage macros you send the following command:

<ESC> &f *n* X

For *n* you enter a number from 0 (zero) to 10 to specify what macro control function you want to perform. These functions are described in the following table:

n FUNCTION

- 0 (zero) Start defining macro. Creates a new macro with the last specified macro number. This macro will be temporary; to make it permanent use <ESC> &f 10X after your definition. The printer will make a macro of the sequence of commands that follow this one, until it gets the command to stop defining the macro.
- 1 (one) Stop defining macro.
- 2 Execute macro. This option makes the printer run the last specified macro, changing printer parameters according to what its commands say. (The printer parameters are those you might also set from the control panel.) When the macro is done, the print position will be just where it was before you ran the macro.
- 3 Call macro. This option also makes the printer run the last specified macro. But before it runs the macro it saves the current parameters, and then restores them when the macro is finished. Again, when the macro is done the print position will be just where it was before you ran the macro.
- 4 Turn on automatic macro. This option automatically runs the last specified macro on every page you print. You can use this option to reproduce the same design on each page (a logo or form design perhaps). You can have more than one automatic macro. As with the “call macro” option, this one saves current parameters and print position, and restores them when the macro is finished. An automatic macro will terminate if you change orientation or page length.
- 5 Turn off automatic macro. Starting with the current page, this option terminates the last specified automatic macro.
- 6 Delete all macros. This option removes all macros and automatic macros from printer memory — *even* macros you have defined as permanent with option 10 below.

- 7 Delete temporary macros. This option also deletes temporary automatic macros.
- 8 Delete last specified macro.
- 9 Make last specified macro temporary.
- 10 Make last specified macro permanent.

4.9.3 Example: Macros

The following program loads and runs a macro. The macro moves an inch and a half right and down three inches from the top left corner of the page, where it prints a 25 percent gray-scale bar. It then ejects the paper.

```
100 LPRINT CHR$(27);"&f6X"  
110 LPRINT CHR$(27);"&f1Y"  
120 LPRINT CHR$(27);"&f0X"  
130 LPRINT CHR$(27);"*p450x1200Y";  
140 LPRINT CHR$(27);"*c180h7200V";  
150 LPRINT CHR$(27);"*c25G";  
160 LPRINT CHR$(27);"*c2P";  
170 LPRINT CHR$(12)  
180 LPRINT CHR$(27);"&f1X";  
190 LPRINT CHR$(27);"&f2X";  
200 END
```

Line 100 clears any existing macros, then line 110 specifies that this will be macro ID number 1. Line 120 starts downloading the macro.

Line 130 moves the print position to a spot 450 dots right and 1200 dots down from the top left corner of the page.

Lines 140 through 160 select the 180-dot deep and 7200-dot wide pattern and print it. Line 170 does the form feed that forces the actual printing. Line 180 ends the downloading process.

At the two line we select our macro and actually run it.

MEMO

The Star LaserPrinter 4III provides the ability to print vector graphics using the GL/2 graphics language.

Printing with GL/2 requires leaving the PCL mode and entering the GL/2 mode. Switching between modes involves only a few commands and software applications may easily switch between the two modes as needed — without affecting performance.

5.1 GL/2 COMMANDS AND SYNTAX

The GL/2 commands have four components: a mnemonic, parameter(s), separator(s), and a terminator.

- **Mnemonic** — The two-letter mnemonic is designed to remind you of the command's function. The mnemonic can be uppercase or lowercase.
- **Parameter(s)** — Some commands have no parameters; for those commands having them, parameters can be either required or optional. Optional parameters are enclosed in brackets [].
- **Separator(s)** — When you use parameters, you must separate them with a comma or space, or in the case of a numeric parameter, with a + or – sign. (Commas are recommended because some computers eliminate spaces, especially when sending variables.)
- **Terminator** — All commands require a terminator. GL/2 commands are terminated by a semicolon or the first letter of the next mnemonic. The last command prior to exiting GL/2 mode *must* be terminated with a semicolon.

5.1.1 Parameter formats

You must give parameters in the format (type of units) required by each GL/2 command. The required format is stated in the parameter table of each command's description, and is described as follows.

Integer — An integer from $-2,147,483,648$ to $+2,147,483,647$. The printer automatically rounds fractional parameters to the nearest integer. Using a number outside the specified range causes an error.

Clamped integer — An integer from $-32,768$ to $+32,767$. The printer automatically rounds fractional parameters to the nearest integer. Sending a number outside this range does not cause an error, but the number is "clamped" to the limits of the range.

Certain commands have parameters which are restricted to a smaller range. These ranges are listed in the parameter tables for each command. Sending a number outside the reduced parameter range may produce unexpected results.

Real — A number where the integer portion is from $-1,073,741,824$ to $+1,073,741,823$. You are assured of at least 6 significant digits (including integer and fractional portion). You may omit the decimal point when no decimal fraction is specified. If you do not specify a sign, the parameter is assumed to be positive. Using a number outside this range causes the command to be ignored.

Clamped real — A number where the integer portion is from $-32,768$ to $+32,767$; you are assured of at least 6 significant digits (including integer and fractional portion). You may omit the decimal point when no decimal fraction is specified. If you do not specify a sign, the parameter is assumed to be positive. Sending a number outside this range does not cause an error, but the number is "clamped" to the limits of the range.

Certain commands have parameters which are restricted to a smaller range. These ranges are listed in the parameter tables for each command. Sending a number outside the reduced parameter range causes the command to be ignored.

Label — Any sequence of characters. In the GL/2 language, text is described using the term "label". Refer to the Label (LB) command for a complete description.

5.1.2 Coordinate system

In GL/2, the coordinate system can be set by the user. The default coordinate system has its origin at the lower left of the picture frame (P1), with its x-axis horizontally to the right, and the y-axis vertically upwards.

Two types of units are available, plotter units (default) and user units. A plotter unit is 0.025 mm (0.00098 inch, 0.294 pixels at 300 dpi). User units can be set as required, different for the x and y axes, using the SC command.

5.2 CONTROLLING THE PRINTER

When importing an existing GL/2 file or creating an GL/2 image within an application, you use several Escape sequences to set up the picture frame size, choose the picture frame location, and enter and exit GL/2 mode.

5.2.1 Enter/Exit GL/2 mode

The following escape sequence is used to enter the GL/2 mode:

`<ESC> % n B`

If n is 0 or an even number, the cursor is set to its previous position when using GL/2. If n is 1 or an odd number, the cursor stays in its current position. When n is 0 and the printer is entering GL/2 for the first time, the default cursor position is P1, the lower left corner.

This command sets the cursor and causes subsequent GL/2 commands to be interpreted as commands, not text to the printed. The printer remains in the GL/2 mode until an exit or reset command (see below) is received, or until the printer is switched off.

To exit the GL/2 mode, use the following escape sequence.

`<ESC> % n A`

If n is 0 (or an even number), the cursor is reset to its position before entering GL/2; if n is 1 (or odd), the cursor remains at its current position. After this command, subsequent GL/2 commands are treated as text and will be printed.

5.2.2 Defining picture frame size

There are two escape sequences to define the area (or picture frame) that can be used for GL/2 graphics:

`<ESC> *c n X`

in which n is the horizontal size of the picture frame in decipoints, and

`<ESC> *c n Y`

in which n is the vertical size of the picture frame in decipoints.

These commands have the following side-effects: they set P1 to the lower left corner and P2 to the upper right corner of the picture frame, set the soft clipping window to coincide with the picture frame, clear the polygon buffer, and move the cursor to P1.

If n in either of these commands is zero, the picture frame is set to its default size.

5.2.3 Picture frame anchor point

This command sets the location of the Picture Frame anchor point, the position of the upper left corner of the picture frame.

`<ESC> *c n T`

When n is set to 0, the picture frame anchor point is set to the current point. When it is other than 0, the anchor point is set to the upper left corner of the current logical page.

Side-effects of this command are that it sets P1 to the lower left corner and P2 to the upper right corner of the picture frame, it sets the soft clipping window to coincide with the picture frame, it clears the polygon buffer, and it moves the cursor to P1.

5.2.4 Plot size

There are two escape sequences to define the plot size of the drawing:

`<ESC> *c n K`

in which n is the horizontal size of the GL/2 plot in inches.

`<ESC> *c n L`

in which n is the vertical size of the GL/2 plot in inches.

These commands fit the GL/2 plot into the picture frame, establishing scaling factors using the formula:

$(\text{plot size})/(\text{picture frame size divided by } 720)$

If n in either of these is zero, the default values (the size of the picture frame) are used.

5.3 CONFIGURATION AND STATUS

The configuration and status group commands help you with the following:

- Establishing default conditions and values for GL/2 features.
- Scaling images in the dimensional units you want to use.
- Enlarging or reducing images for different media sized.
- Establishing a window (soft-clip limits).
- Drawing equal-sized and mirror-imaged drawings.
- Rotating the GL/2 coordinate system.

Default command

DF [;]

This command returns the printer's GL/2 settings to the factory default settings. Use the Default (DF) command to return the printer to a known state while maintaining the current locations of P1 and P2 (unlike the IN command). When using DF at the beginning of a program, graphics parameters such as character size, slant, or scaling are not inherited from another program.

Initialize command

IN [;]

This command resets the parameters to their default values. It also sets the current position to the origin of the coordinate system (the lower left corner of the picture frame).

Input P1 and P2 command

IP [P1x, P1y [, P2x, P2y ;]]

This command sets control points P1 and P2. If P1 is defined but not P2, P2 tracks P1 to maintain the same relative position.

The default location of P1 is the lower-left corner of the picture frame; the default location of P2 is the upper-right corner.

This command affects scaling and all commands which define a size as a percentage of the distance between P1 and P2.

The results of the following commands depend on the positions of P1 and P2: DR, FT, IW, LB, LT, PW, RO, SC, SR, WU.

Input relative P1 and P2 command

IR [*P1rx*, *P1ry* [, *P2rx*, *P2ry* ;]]

This command establishes new or default locations for the scaling points P1 and P2 relative to the picture frame size. P1 and P2 are used by the Scale (SC) command to establish user-unit scaling. IR can also be used in advanced techniques such as printing mirror images, enlarging/reducing drawings, and enlarging/reducing relative character size, or changing label (text) direction. The coordinates of points P1 and P2 are expressed as percentage of the width (height) of the picture frame.

Input window command

IW [*xll*, *yll*, *xur*, *yur* ;]

This command sets the position and size of the soft-clip window and determines the effective clip window as the intersection of the printable area, the logical page, the picture frame and the soft-clip window.

The meanings of parameters are:

<i>xll</i>	x-coordinate of lower left corner of soft-clip window
<i>yll</i>	y-coordinate of lower left corner of soft-clip window
<i>xur</i>	x-coordinate of upper right corner of soft-clip window
<i>yur</i>	y-coordinate of upper right corner of soft-clip window

Page eject command

The following commands cause a conditional page eject, meaning that a page will be ejected if there is any printable data in the print buffer:

- Reset command, <ESC> E
- Page length command
- Page size command
- Orientation command
- Paper source command

When a page is ejected using one of the above commands, the cursor position is set to the top of form on the new page.

An alternate method of ejecting a page is the Form Feed command. A Form Feed causes an unconditional page eject and advances the current active cursor position to the top of form on the next page. The horizontal cursor position remains the same as before the page eject.

Rotate coordinate system command

· RO [*angle* ;]

This command rotates and translates the plotter coordinate system.

The *angle* parameter is a clamped integer, 0, 90, 180 or 270 (degrees), to obtain the following results (with respect to the picture frame):

- 0 Origin at lower left corner, x-axis horizontally to the right, y-axis vertically up.
- 90 Origin at lower right corner, x-axis vertically up, y-axis horizontally to the left.
- 180 Origin at upper right corner, x-axis horizontally to the left, y-axis vertically down.
- 270 Origin at upper left corner, x-axis vertically down, y-axis horizontally to the right.

The user coordinate system is not affected by this command.

This command does not change the current pen location, only its coordinates. The coordinates of P1 and P2 are not changed, so P2 will be outside the picture frame when *angle* is 90 or 270. The IP command should be used after rotation to correct the situation.

The coordinates of the points defining the soft-clip window are not changed, and the window is rotated.

Scale command

SC *xmin, xmax, ymin, ymax* [, *type* [, *left, bottom* ;]]

or

SC *xmin, xfact, ymin, yfact, type* [;]

where *xmin, ymin, xmax, ymax, xfact* and *yfact* parameters are the real.

The *type* parameter is the clamped integer which can be 0 to 2. The *left* and *bottom* parameters are the clamped real, 0 to 100.

The meanings of and relationships between the parameters are:

If *type* parameter is 0 (as specified or by default), SC defines anisotropic scaling; the first form of the command is assumed and the last two parameters, *left* and *bottom*, are ignored even if present; *xmin*, *ymin* become the user coordinates of P1, and *xmax*, *ymax*, the coordinates of P2.

If *type* parameter is 1, SC defines isotropic scaling; the first form of the command is assumed, and parameters *left* and *bottom* (or defaults) are used; *xmin*, *ymin* become the user coordinates of point Q1, and *xmax*, *ymax*, the user coordinates of point Q2, defined as follows:

- the rectangle whose diagonal is Q1 – Q2 is the largest which is contained in the rectangle whose diagonal is P1 – P2.
- if the plotter coordinates of Q1 and Q2 are $xq1, yq1$ and $xq2, yq2$, then:
$$(xq1 - xq2)/(xmin - xmax) = (yq1 - yq2)/(ymin - ymax)$$
- if the two rectangles do not coincide:
if $abs(xq1 - xq2) = abs(xp1 - xp2)$
then, $yq1 = yp1 + bottom/100 * abs(yq1 - yq2)$
and *left* is disregarded

if $abs(yq1 - yq2) = abs(yp1 - yp2)$
then, $xq1 = xp1 + left/100 * abs(xq1 - xq2)$
and *bottom* is disregarded

If *type* parameter is 2, SC defines point-factor scaling; the second form of the command is used (*left* and *bottom* are not used); *xmin*, *ymin* become the user coordinates of P1, and the user coordinates of P2 are set to:

$$xmin + (xp2 - xp1)/xfact, ymin + (yp2 - yp1)/yfact$$

Without parameters, this command eliminates scaling and sets the user coordinate system to the plotter coordinate system.

If there are less than 4, exactly 6, or more than 7 parameters, this command is ignored.

If *xmin* is the same as *xmax*, or if *ymin* is the same as *ymax*, or if *xfact* or *yfact* is 0, the command is ignored.

When appropriate, the scaling defined by SC has priority over that obtained from the ratio: $[size\ of\ picture\ frame]/[plot\ size]$

5.4 VECTOR GROUP

The information in this section enables you to achieve the following results in your programs:

- Use absolute and relative coordinates when plotting.
- Draw lines, arcs, and circles.
- Encode coordinates to greatly increase your printer's throughput.

Arc absolute command

AA *xc, yc, angle* [, *chord angle* ;]

where *xc* indicates the x-coordinate of center of arc, *yc* is the y-coordinate of center of arc, *angle* is the angular size of arc, from -360 to $+360$, and the *chord angle* is the angle subtended by chord, from 0.5 to 180.

This command draws an arc using absolute coordinates from the current pen position, as specified. After drawing the arc, the current pen position is at the end of the arc.

Arc relative command

AR *dxc, dyc, angle* [, *chord angle* ;]

where *dxc* indicates the x-coordinate of center of arc relative to the current location, *dyc* is the y-coordinate of center of arc relative to the current location, *angle* is the angular size of arc, from -360 to $+360$, and the *chord angle* is the angle subtended by chord, from 0.5 to 180.

This command draws an arc using relative coordinates from the current pen position, as specified. After drawing the arc, the current pen position is at the end of the arc.

Absolute arc three point command

AT *xi, yi, xe, ye* [, *chord angle* ;]

where *xi* indicates the x-coordinate of intermediate point I, *yi* is the y-coordinate of intermediate point I, *xe* is the x-coordinate of end point E, and *ye* is the y-coordinate of end point E. The *chord angle* is the angle subtended by chord, from 0.5 to 180

With the current position F, this command draws an arc containing points F, I and E.

Circle command

CI *radius* [, *chord angle* ;]

This command draws a circle *radius* with its center at the current location.

Plot absolute command

PA [*x1, y1, x2, y2, ... xn, yn* ;]

This command establishes absolute plotting and moves the pen to the specified absolute coordinates from the current pen position.

There is no limit to the number of arguments that can be specified. If this command is given with no arguments, it establishes that the coordinates in subsequent commands are absolute. If there are an odd number of arguments, the last argument is disregarded.

Pen down command

PD [*x1, y1, x2, y2, ... xn, yn* ;]

This command is the same as PA except that a “pen down” flag is set. When there are no arguments, that is the only effect of the command.

Polyline encoded command

PE,flag [value or coordinate pair ... flag]value or coordinate pair ;

With this command, there should be no separators between parameters, and the command terminator <> must be used.

The meanings of and relation between parameters are as given in the following table:

Flag (hex ASCII)	Meaning	Next parameter
3A or BA :	Select pen	pen number, encoded as base 64 or 32
3C or BC <	Pen up	coordinates of point to move to, encoded as base 64 or 32
3E or BE >	Fraction	number of fraction bits contained in coordinate, encoded as base 64 or 32
3D or BD =	Start PA	coordinates
37 or B7 7	Start base 32	encoding

Pen number specifies the pen to be used: 0 or 1 (see SP)

Number of fraction bits: from -26 to +26

When there are no parameters, this command 'updates' the carriage-return point.

When there are parameters, it draws lines by sending a shorter string of data than other commands, since all parameters other than flags are encoded. In the polygon mode, the coordinates are stored in the polygon buffer.

The encoding uses base 64 if not otherwise specified by flag = 7.

Plot relative command

PR [dx1, dy1, dx2, dy2, dxn, dyn ;]

This command establishes relative plotting and moves the pen to specified points, with each move relative to the current pen location.

Pen up command

PU [$x1, y1, x2, y2, \dots, xn, yn$;]

This command is the same as PA except that the “pen up” flag is set and no lines are drawn. If there is no argument, this is the only effect of the command.

The coordinates are interpreted as absolute if the command was not preceded by a PR command; otherwise the coordinates are treated as relative.

Relative arc three points command

RT dxi, dyi, dx, dy [, *chord angle* ;]

Same as AT except that the coordinates are relative.

5.5 POLYGON GROUP

There is a special mode of operation, the *polygon mode*, in which many commands are not executed but store the path they would otherwise draw in the polygon buffer. The path is stored by storing the coordinates of all point traversed, together with the pen up/down condition. When an appropriate command is given, the paths are drawn as if they formed a single path (which is not necessarily connected).

The Star LaserPrinter 4III has a buffer capable of storing 1500 points, with pen up and down commands stored as points.

The following commands clear the polygon buffer and then use it to draw:

EA, ER, EW, RA, RR, WG.

The following commands use the polygon buffer when in the polygon mode:

AA, AR, AT, CI, PA, PD, PE, PR, PU, RT.

Other commands, if given in the polygon mode, are ignored.

If the polygon buffer overflows while executing a drawing (or edging) command, EP is executed. If the polygon buffer overflows while executing a filling command, FP is executed. Points that cannot fit in the buffer are ignored.

Edge rectangle absolute command

EA *x, y* [:]

This command draws a rectangle with the current cursor position as one corner and the diagonally opposite corner at *x, y*.

This command clears the polygon buffer, then uses the buffer to draw.

Edge polygon command

EP [:]

This command draws the edge of the polygon stored in the polygon buffer (parts with the pen down). The contents of the buffer are not changed or deleted.

Edge rectangle relative command

ER *dx, dy* [:]

This command is similar to the EA command, except that the coordinates of the opposite corner relative to current cursor position are specified.

Edge wedge command

EW *radius, start angle, sweep angle* [, *chord angle* :]

This command draws the edge of a wedge of a circle with its center at current cursor position. A positive (negative) radius causes the positive (negative) x-axis to be the reference for the sweep angle.

Positive start and sweep angles are measured counterclockwise from the reference axis.

A wedge whose sweep angle is 360 degrees or greater is drawn as a circle with no line connected to the center. If the sweep angle is zero, it is a single straight line from the center to the starting point.

This command clears then draws to the polygon buffer.

Fill polygon command

FP [:]

This command uses the even-odd rule to fill the polygon currently in the polygon buffer. The fill type is the one currently selected. All points are used, whether stored with the pen up or down. The contents of the buffer are used but not changed or deleted.

This command is ignored if a previous PM, RA, RR, or WG command caused the polygon buffer to overflow and no other command cleared it.

Polygon mode command

PM mode [;]

Mode 0 clears the polygon buffer and enters the polygon mode, in which the following commands can be used:

AA, AR, AT, CI, DF, IN, PA, PD, PE, PM1, PM2, PR, PU, PR.

Reset command <ESC> E can also be given. The polygon stored using these commands can be edged (using EP) or filled (using FP) once the polygon mode has been left (PM2). The pen location at the time PM0 is issued becomes the first point in the buffer.

Mode 1 closes the current polygon (or subpolygon) and remains in polygon mode; all commands sent following PM1 but before a PM2 (or the next PM1) are stored as one subpolygon.

Mode 2 closes current polygon (or subpolygon) and exits polygon mode.

Fill rectangle absolute command

RA *x, y* [;]

This command fills the rectangle defined by current cursor position and (*x,y*) using the current fill. The pen up/down status is not affected by this command and the rectangle is drawn regardless of the pen status.

This command clears the polygon buffer, then uses the buffer to draw.

Fill rectangle relative command

RR *dx, dy* [;]

Same as RA except that the coordinates are relative.

This command clears the polygon buffer, then uses it to draw.

Fill wedge command

WG *radius, start angle, sweep angle* [, *chord angle* ;]

This command draws a filled wedge (see EW command).

This command clears the polygon buffer and uses the buffer to draw.

5.6 LINE AND FILL ATTRIBUTES GROUP

Anchor corner command

AC *xc, yc* [:]

The default is 0,0 and “anchors” the fill to the origin of the current coordinate system.

Fill type command

FT *type* [, *param1* [, *param2* ;]]

The relation between these three parameters and the meanings are given in the table below.

type	fill	param1	param2
1	solid (default)	ignored	ignored
2	solid	ignored	ignored
3	hatched	line spacing	line angle
4	cross-hatched	line spacing	line angle
10	gray	shading level	ignored
11	user-defined	fill index	ignored
21	LaserJet III pattern	pattern type	ignored

For types 3 and 4:

- The line spacing is given in current units and is measured along the x-axis. A zero value gives a solid fill and a negative value invalidates the command. The default value is 1% of the distance P1 to P2. If the current units are plotter units, turning scaling on or moving P1 and P2 has no effect on the spacing. If user units are used, the spacing varies as P1 and P2 are moved; turning scaling off fixes the spacing in the plotter unit equivalent to the current user unit.
- The line angle is measured counterclockwise from the positive x-axis. In cross-hatching, the two set of lines are at 90°.
- The lines are drawn using the current pen and line type.

For type 10, the shading level is expressed as a percentage of black; 0 is white, 100 is black.

For type 11, the fill index is as specified in command RF; if an RF command has not been given, solid fill is used.

For type 21, the pattern type is a number between 1 and 6, corresponding to the patterns defined in the standard mode.

If any parameter or combination is outside the values in the table, the command is ignored.

Line attributes command

LA *kind, value* [, *kind, value* [, *kind, value* ;]]

This command specifies how line ends and line joins are physically shaped. Use this command when drawing lines thicker than 0.35 mm.

The relation between and meaning of the parameters are given in the following table:

<i>kind</i>		<i>value</i>	
1	line end	1	butt (default)
		2	square
		3	triangular
		4	round
2	line join	1	mitered (default)
		2	mitered/beveled
		3	triangular
		4	round
		5	beveled
		6	none
3	miter limit	1 to 32,767 (default: 5)	

For a line end other than a butt end, add 1/2 line width to the length.

If the miter in a mitered line join exceeds the miter limit, it is truncated. If the miter in a mitered/beveled line join exceeds the miter limit, a beveled join is used.

The miter limit is the ratio (miter length)/(line width). Miter limits smaller than 1 are rounded up to 1.

For thin lines (line width ≤ 0.35 mm), the line end is always round, and line joins is also round.

Line type command

LT *type* [, *pattern length* [, *mode* ;]]

This command specifies the line pattern to be used when drawing lines.

When no parameters are specified, this command selects a solid line and saves the previous line type, pattern length and any unused portion of the pattern. If there are parameters, a pattern is selected as follows.

Patterns are described by the length of dashes and gaps, as a percentage of the pattern length, starting with a dash. 0% represents a dot. Patterns and their codes are:

code	pattern
0	0 (not a line, only one point)
1	0 100
2	50 50
3	70 30
4	80 10 0 10
5	70 10 10 10
6	50 10 10 10 10 10
7	70 10 0 10 0 10
8	50 10 0 10 10 10 0 10

If the pattern code is negative, from -8 to -1, the pattern corresponds to the absolute value of the code, but the pattern is “adaptive” and its length is adjusted (up or down) to fit one or more complete patterns.

After a solid line has been selected by specifying LT without parameters, pattern code 99 restores the previous line pattern and any residual pattern. LT99 is ignored when a non-solid line pattern is selected. While plotting with a solid line pattern, the following commands clear the previous line type and any residual pattern: AC, DF, IN, IP, IR, IW, LA, LT, PW, RF, RO, SC, SP, UL and WU.

The pattern length is measured as a percentage of the distance between P1 and P2 if mode = 0, or in millimeters of mode = 1.

If not specified, the current values of pattern length and mode are used.

Pen width command

PW width [, pen ;]

This command specifies a new width for the logical pen.

The default pen width is 0.35 mm or 1% of the distance P1 to P2. A width of 0 sets the thinnest line possible (one dot).

Metric widths are scaled by the ratio [size of picture frame]/[plot size].

If the pen number is not specified, the new width is applied to both. If neither pen 0 or 1 is specified, the command is ignored.

This command does not affect the character stroke width, with the exception of stick characters with stroke weight = 9999.

Raster fill definition command

RF index, width, height, pen [, pen, ... pen ;]

This command defines a rectangular pattern that may be used as area fill and for screened vectors (lines).

Without parameters, this command resets all fill patterns to solid fill. With only one parameter, it resets the indicated pattern to solid fill.

With all parameters specified, it defines a raster image consisting of 'height' rows, each containing 'width' dots.

Symbol mode command

SM character [;]

This command designates the character to be used as a marker or symbol. Symbols are used only in conjunction with PA, PD, PE, PR and PU commands (a symbol is drawn at the point(s) specified by these commands, regardless of the state of the pen).

The *character* parameter can be any character with decimal codes 33 - 58, 60 - 126, 161 and 254. If the *character* parameter is not in the specified range, the symbol mode is canceled; otherwise *character* symbol is drawn as if it was a character in a label, centered at the point.

Symbols are taken from the currently selected character set and are sized, slanted and rotated in the same way as characters.

Select pen command

SP pen number [;]

This command selects the printer's logical pen for subsequent plotting. This command must be set in order to output.

Pen 0 is white; it is used when no drawing is required or to draw white lines on a black fill, with transparency off.

Pen 1 is black; values greater than 1 are treated as 1.

Screened vector command

SV type [, opt1 [, opt2]]

This command selects the type of screening (area fill) to be applied to vectors (lines, hatching patterns (fill types 3 and 4), arcs, circles, and edges of polygons, rectangles, and wedges). This command does not affect solid fill types, labels, stroked characters, or edges of characters.

There are three types of screen fill: shaded fill, user-defined raster fill, and predefined cross-hatch patterns.

The meanings of and relation between parameters are as given in the following table:

Type	Meaning	Opt1	Opt2
0	no screening	ignored	ignored
1	shaded	shading percentage, between 0 (white) and 100 (black)	ignored
2	user defined raster (see RF)	index; the pen for the black pixels is selected as follows	0: black pen, 1: current pen
21	predefined	fill type	ignored

Without parameters, this command turns off screening.

If *opt1* and/or *opt2* is missing, the previous and appropriate default values are used.

With parameters, this command selects the screening (fill) to be used for all “vectors” (all lines except labels and ‘stroked’ characters).

Transparency mode command

TR [*n* ;]

The transparency mode defines how the white areas of the source graphics image affect the destination graphics image.

The parameter *n* specifies whether transparency mode is on (1) or off (0).

In the transparency mode, white source dots do not change the destination pixel; in the opaque mode (non-transparency mode), such dots white out the destination pixel.

Note the similarity to the standard <ESC> *v *n* N command, but also note that the opposite meanings of the parameter values. Also, there is no command corresponding to the standard <ESC> *v *n* O.

User-defined line type command

UL *index* [, *gap1*, ... *gap20* ;]

This command creates line types by specifying gap patterns, which define the length of spaces and lines comprising a line type.

The *index* parameter is a clamped integer which can be range 1 through 8. If the index is negative, its absolute value is used.

A maximum of 20 gaps are allowed for each user-defined line type. Gap values must be non-negative; a gap value of zero produces a dot if specified for an odd numbered gap that is preceded or followed by a non-zero even-numbered gap. The sum of the *gap* parameters must be greater than zero.

Pen width unit selection command

WU *type* [;]

This command selects the unit to be used by Pen Width (PW) command.

The *type* parameter specifies how the width parameter of the Pen Width (PW) command is interpreted; 0 interprets as Metric and 1 interprets as Relative.

5.7 CHARACTER GROUP

When you have created a vector graphic and want to add text, you can either enter normal mode to add text to your image or you can print text from within the GL/2 mode. If this is your first experience with GL/2, you should know that the term “label” is used throughout this section to indicate the printing of text.

The information in this section enables you to perform the following:

- Position and print labels using any font.
- Change label size, slant, and direction.
- Designate and select standard and alternate fonts.
- Print with proportional and monospaced fonts.
- Work with the character cell.

Alternate font definition command

AD kind, value [, kind, value, ... ;]

This command defines an alternate GL/2 font and its characteristics: font spacing, pitch, height, style, stroke weight, and typeface. It allows the font characteristics to be assigned to the secondary (alternate) font definition. Use this command to set up an alternate font that you can easily access when labeling.

The *kind* parameter specifies the characteristic for which you are setting a value (see the following table).

Kind	Characteristic	Default value	Description
1	Symbol set	277	Roman-8
2	Font spacing	0	Monospaced
3	Pitch	9	Characters per inch
4	Height	11.5	Font point size
5	Style	Upright	Upright
6	Stroke weight	0	Medium
7	Typeface	48	Stick (fixed vector)

The *value* parameter defines the characteristics of the characteristic specified by the *kind* parameter.

Character fill mode command

CF *fill mode* [, *edge pen* ;]

This command specifies the way scalable fonts are filled and edged; bitmap and Stick fonts cannot be edged and can be filled only with raster fill, shading, or cross-hatch patterns. Scalable characters may be filled with any of the fill patterns specified by the FT command (shading, hatching, cross-hatching, and user-defined raster fill patterns).

The *fill mode* parameter specifies how the printer will render filled characters to the following parameter values.

- 0 Specifies solid fill using the current pen and edging with the specified pen (or current pen if the *edge pen* parameter is not specified).
- 1 Specifies edging with the specified pen (or current pen if the *edge pen* parameter is not specified). Characters are filled only if they cannot be edged (bitmap or stick characters), using the edge pen.
- 2 Specifies filled characters using the current fill type (refer to the FT command). The currently selected pen is used. Characters are not edged. If the *edge pen* parameter is specified, it is ignored.
- 3 Specifies filled characters using the current fill type (refer to the FT command). The currently selected pen is used. Characters are edged with the specified pen (or current pen if the *edge pen* parameter is not specified).

For characters that are to be edged, the *edge pen* parameter indicates the pen that will be used to edge the character. If this parameter is 0, the characters are not edging. If this is 1, black edging is selected.

Character plot command

CP *spaces, lines* [;]

This command moves the current point horizontally by the value of “*spaces*” and vertically by the value of “*lines*”. Horizontal movement is to the right when “*spaces*” is positive and to the left when it is negative. Vertical movement is down when “*lines*” is positive and up when it is negative.

A CP command with no parameters is the same as <CR>, <LF> within a label.

Absolute direction command

DI *x, y* [:]

This command specifies the slope or direction at which characters are drawn, independent of P1 and P2 setting.

At least one parameter must be non-zero, otherwise the command is ignored.

Relative direction command

DR *run, rise* [:]

This command established the run and rise of the text path relative to the distance between points P1 and P2.

Define label terminator command

DT *label terminator* [, *mode* ;]

This command specifies the character to be used as the label terminator and whether it is printed.

The character defined with the *label terminator* parameter (not <null>, <LF>, <ESC> or <:>) is used as the terminator of strings in subsequent LB commands.

The *mode* parameter indicates what to do with *label terminator*, besides using it as a terminator.

When the *mode* is 0, the label terminator prints if it is a printable character and performs its function if it is a control code.

When the *mode* is 1, the label terminator does not print if it is a printing character and does not perform its function if it is a control code.

Define variable text path command

DV *path* [, *line* ;]

This command specifies the text path for subsequent labels and the direction of Line Feeds as either right, left, up, or down.

The *path* parameter specifies the location of each character with respect to the preceding character, relative to the labeling direction defined by the DI or DR commands. The text path set by DV is not affected by changes in P1 and P2.

- 0 Within a label, each character begins to the right of the previous character. This is a horizontal text path (unless altered by DI or DR).
- 1 Within a label, each character begins below the previous character. This is a vertical text path (unless altered by DI or DR).
- 2 Within a label, each character begins to the left of the previous character. This is a horizontal text path (unless altered by DI or DR).
- 3 Within a label, each character begins above the previous character. This is a vertical text path (unless altered by DI or DR).

The *line* parameter specifies the location of each character with respect to the preceding character, relative to the labeling direction defined by DI or DR commands. The *line* is 0, the normal line feed function with respect to text path direction is selected. The *line* is 1, the reverse line feed function with respect to text path direction is selected.

Extra space command

ES *width* [, *height* ;]

This command allows the character and line spacing to be changed. The values are added to or subtracted from the font parameters. This remains in effect until the next ES command or the printer is reset.

Select primary font command

FI *font id* [:]

This command allows the selection and use as the standard or primary font any font to which an ID has been assigned. For outline fonts, the SD command must also be used to specify the point size.

This command executes an SB command to insure compatibility of the font selected with the font types allowed.

Select secondary font command

FN *font id* [:]

This command does for the secondary font what FI does for the primary font.

Label instruction command

LB text ... text label terminator

This command prints (draws) printable characters in the string (up to 1024 characters), using the primary font selected and executes the functions of control characters in the string. Control characters SI and SO switch between the primary and secondary fonts.

Label origin command

LO position [:]

This command positions labels relative to the current pen location.

In order to use this command for centering, right justification, etc., it is necessary to store the label temporarily. The Star LaserPrinter 4III has a buffer capable of storing the longest possible label (see LB above).

Select alternate font command

SA [:]

This command selects the font currently designated as alternate.

This command has the same effect as a shift-out <SO> in the string of an LB command, except that the shift remains until the SS command is received.

Select font type command

SB n [:]

This command specifies which types of fonts will be used for labeling commands. When the value of *n* is 0, the scalable fonts are selected, and 1 selects the bitmap fonts.

Commands FI and FN imply an SB command and override any previous setting.

Standard font definition command

SD *kind, value* [, *kind, value, ...* ;]

This command defines (but does not select) the standard font by specifying its attributes. The meaning of *kind* parameter is as follows:

Kind	Attribute	Default
1	Symbol set	21 (ASCII)
2	Spacing	0 (monospaced)
3	Pitch	9 cpi
4	Height	11.5 point
5	Style	0 (upright)
6	Weight	0 (medium)
7	Typeface	48 (stick)

The *value* parameter defines the characteristics of the characteristic specified by the *kind* parameter.

Absolute character size command

SI *width, height* [;]

This command specifies the size of labeling characters in centimeters.

The default width and height depend on the pitch and size selected with the AD or SD command.

Once this command is given, the width and height of characters do not change when P1 and P2 move.

Without parameters, this command selects the size implied by AD or SD. Width specifies the width of characters; negative values imply mirror images about a vertical line.

Height specifies the height of capital M; negative values imply mirror images about a horizontal line.

When using stick fonts, a change of character size will affect the thickness of the line used to draw the characters. When appropriate, the parameters are multiplied by the ratio [size of picture frame]/[plot size]

When command SB1 is in effect, command SI cannot use negative parameters and, in general, can select only approximate values of positive parameters. In addition, only one parameters has effect, the width for monospaced fonts and the height for proportional fonts.

Character slant command

SL *tan(slant angle)* [;]

This command specifies the slant at which labels are drawn. The parameter is a tangent of the angle between the center line of a character and the vertical line.

Relative character size command

SR *width, height* [;]

This command specifies the size of characters as a percentage of the distance between P1 and P2.

Select standard font command

SS [;]

This command selects the font currently designated as standard. It has the same effect as the shift-in <SI> is the string of a label command except that the shift remains in effect until an SA command is received.

Transparent data command

TD *mode* [;]

mode: clamped integer
= 0: normal
= 1: transparent

This command defines how control characters are treated. In the normal mode, such characters perform their normal control functions and are not printed. In the transparent mode, all control characters are printed (non-printing characters print as spaces) and do not perform their normal functions. The normal mode is selected with 0 for the *mode* parameter, and the transparent mode is selected with 1.

5.8 ESCAPE SEQUENCES IN GL/2 MODE

When the following commands are given, they have the same results, whether the printer is in the standard mode or the GL/2 mode.

<ESC> E

- the initialization IN command is executed.
- the picture frame is set to its default size.
- the frame anchor is set to its default position.
- the plot size is set to its default size.
- the page orientation is reset.

A reset command from the control panel will have the same effect.

<ESC> &/n O

- the orientation of the picture frame is changed.
- the picture frame is set to its default size.
- the frame anchor is set to its default position.
- the plot size is set to its default size.

<ESC> &a n P

- The printing direction command does not effect the orientation or position of the GL/2 picture frame.

<ESC> &/n P

- the picture frame is set to its default size.
- the frame anchor is set to its default position.
- the plot size is set to its default size.
- P1 and P2 are set to their default positions.
- the cursor is set to P1.
- the soft clip window is set to its default size.
- the polygon buffer is cleared.

<ESC> A

- the picture frame is set to its default size.
- the frame anchor is set to its default position.
- the plot size is set to its default size.
- P1 and P2 are set to their default positions.
- the cursor is set to P1.
- the clip window is set to its default size.
- the polygon window is cleared.

MEMO

This final chapter in your Star LaserPrinter 4III Applications Manual holds two main sections. The first one will help you with your programming job, while the last provides the symbol set tables.

We've summarized all commands in ASCII order here. You'll find them organized by function in chapter 4 and 5.

The Star LaserPrinter's symbol sets have been included so that you can see exactly what characters are available to you. Roman-8 includes standard ASCII and is the default.

6.1 COMMAND SUMMARY

6.1.1 Printer Control Language (PCL) commands

Command	Function	Page
<BS>	Backspace	57
<HT>	Horizontal tab	55
<LF>	Line feed	57
<FF>	Form feed	58
<CR>	Carriage return	57
<SO>	Select secondary font	62
<SI>	Select primary font	62
<ESC> &a n C	Position horizontal cursor in columns	53
<ESC> &a n H	Position horizontal cursor in decipoints	54
<ESC> &a n L	Set left margin	48
<ESC> &a n M	Set right margin	48
<ESC> &a n P	Set print direction	65
<ESC> &a n R	Position vertical cursor in rows	55
<ESC> &a n V	Position vertical cursor in decipoints	56
<ESC> &d @	Cancel underlining	74
<ESC> &d n D	Select underlining	74
<ESC> &f n S	Save and recall cursor position	60

Command	Function	Page
<ESC> &f n X	Macro control	93
<ESC> &f n Y	Specify macro ID	93
<ESC> &k n G	Set line termination	58
<ESC> &k n H	Horizontal Motion Index	52
<ESC> &k n S	Select font pitch	70
<ESC> &l n C	Vertical Motion Index	53
<ESC> &l n D	Set line spacing	51
<ESC> &l n E	Set top margin	49
<ESC> &l n F	Set text length	49
<ESC> &l n H	Set feed selection	44
<ESC> &l n L	Perforation skip	49
<ESC> &l n O	Set page orientation	64
<ESC> &l n P	Select page length	46
<ESC> &l n X	Set number of copies	44
<ESC> &p n X	Transparent print data	75
<ESC> &s n C	End-of-line wrap	59
<ESC> (n	Select primary font symbol set	65
<ESC> (n @	Select default primary font	67
<ESC> (n X	Designate downloaded font as primary	63
<ESC> (s n B	Select primary font stroke weight	71
<ESC> (s n H	Select primary font pitch	69
<ESC> (s n P	Select primary font spacing	69
<ESC> (s n S	Select primary font style	70
<ESC> (s n T	Select primary font typeface	72
<ESC> (s n V	Select primary font height	70
<ESC> (s n W	Download character descriptor/data	82
<ESC>) n	Select secondary font symbol set	67
<ESC>) n @	Select default secondary font	68
<ESC>) n X	Designate downloaded font as secondary	63
<ESC>) s n B	Select secondary font stroke weight	71
<ESC>) s n H	Select secondary font pitch	69
<ESC>) s n P	Select secondary font spacing	69
<ESC>) s n S	Select secondary font style	71
<ESC>) s n T	Select secondary font typeface	72
<ESC>) s n V	Select secondary font height	70
<ESC>) s n W	Download font descriptor	80
<ESC> *b n M	Select downloading compression mode	85
<ESC> *b n W	Transfer raster graphics data	86

Command	Function	Page
<ESC> *b n Y	Advanced vertical raster position	87
<ESC> *c n A	Define horizontal rectangle size in dots	88
<ESC> *c n B	Define vertical rectangle size in dots	88
<ESC> *c n D	Specify font ID	62
<ESC> *c n E	Specify character code	82
<ESC> *c n F	Font control	76
<ESC> *c n G	Specify pattern ID	89
<ESC> *c n H	Define horizontal rectangle size in decipoints	88
<ESC> *c n P	Fill with specified pattern	91
<ESC> *c n V	Define vertical rectangle size in decipoints	89
<ESC> *p n X	Position horizontal cursor in dots	54
<ESC> *p n Y	Position vertical cursor in dots	56
<ESC> *r B	End raster graphics	86
<ESC> *r n A	Start raster graphics	85
<ESC> *r n F	Set graphic image orientation	84
<ESC> *r n S	Specifies pixel width of raster graphics	87
<ESC> *r n T	Specifies pixel height of raster graphics	86
<ESC> *t n R	Select raster graphics resolution	84
<ESC> *v n N	Select transparent/opaque mode for source images	92
<ESC> *v n O	Select transparent/opaque mode for patterns	92
<ESC> *v n T	Select fill pattern	91
<ESC> 9	Clear left and right margins	48
<ESC> =	Half line feed	58
<ESC> E	Reset the printer	45
<ESC> Y	Enable display function	75
<ESC> Z	Disable display function	75
<ESC> z	Self test	43

6.1.2 GL/2 commands

Command	Function	Page
<ESC> % n A	Exit GL/2 mode	99
<ESC> % n B	Enter GL/2 mode	99
<ESC> *c n K	Set horizontal plot size	101
<ESC> *c n L	Set vertical plot size	101
<ESC> *c n T	Set picture frame anchor point	100
<ESC> *c n X	Set picture frame horizontal size in decipoints	100
<ESC> *c n Y	Set picture frame vertical size in decipoints	100
AA	Arc absolute	106
AC	Anchor corner	113
AD	Alternate font definition	119
AR	Arc relative	106
AT	Absolute arc three point	107
CF	Character fill mode	120
CI	Circle	107
CP	Character plot	120
DF	Default	102
DI	Absolute direction	121
DR	Relative direction	121
DT	Define label terminator	121
DV	Define variable text path	121
EA	Edge rectangle absolute	110
EP	Edge polygon	110
ER	Edge rectangle relative	111
ES	Extra space	122
EW	Edge wedge	111
FI	Select primary font	122
FN	Select secondary font	122
FP	Fill polygon	111
FT	Fill type	113
IN	Initialize	102
IP	Input P1 and P2	102
IR	Input relative	103
IW	Input window	103
LA	Line attributes	114
LB	Label instruction	123
LO	Label origin	123

Command	Function	Page
LT	Line type	115
PA	Plot absolute	107
PD	Pen down	107
PE	Polyline encoded	108
PM	Polygon mode	112
PR	Plot relative	108
PÙ	Pen up	109
PW	Pen width	116
RA	Fill rectangle absolute	112
RF	Raster fill definition	116
RO	Rotate coordinate system	104
RR	Fill rectangle relative	112
RT	Relative arc three points	109
SA	Select alternate font	123
SB	Select font type	123
SC	Scale	104
SD	Standard font definition	124
SI	Absolute character size	124
SL	Character slant	125
SM	Symbol mode	116
SP	Select pen	117
SR	Relative character size	125
SS	Select standard font	125
SV	Screened vector	117
TD	Transparent data	125
TR	Transparency mode	118
UL	User-defined line type	118
WG	Fill wedge	112
WU	Pen width unit	118

6.2 SYMBOL SETS

This section gives tables of the symbol sets for the Star LaserPrinter 4III.

The decimal character code of each character is shown in an inset to the lower right of the character.

The hexadecimal code can be found by reading the entries at the top and left edges of the table. For example, the character "A" is in column 4 and row 1, so its hexadecimal character code is 41. This is equivalent ($4 \times 16 + 1 = 65$) to decimal 65, the number in the inset.

Control codes recognized by this printer are indicated by abbreviations inside pointed brackets $\langle \rangle$.

\langle Sample \rangle

ID Number	Symbol Name							
0D	ISO 60:							
	0	1	2	3	4	5	6	7
0	\langle NUL \rangle			0	@	P	,	p
1		\langle DC1 \rangle	!	1	A	Q	a	q
2		\langle DC2 \rangle	"	2	B	R	b	r
3		\langle DC3 \rangle	#	3	C	S	c	s

Hexadecimal value (high order) — points to the top edge of the table.
 Character — points to the character in the cell.
 Decimal value — points to the inset number in the bottom right of the cell.
 Control code — points to the character in the cell.
 Hexadecimal value (low order) — points to the left edge of the table.

ID Number

Symbol Name

0D

ISO 60: Norwegian

	0	1	2	3	4	5	6	7
0	<NUL> 0 16 32 48 @ 64 P 80 96 p 112							
1	<DC1> 1 17 ! 33 49 A 65 Q 81 97 q 113							
2	<DC2> 2 18 " 34 50 B 66 R 82 98 r 114							
3	<DC3> 3 19 # 35 51 C 67 S 83 99 s 115							
4	<DC4> 4 20 \$ 36 52 D 68 T 84 100 t 116							
5	5 21 % 37 53 E 69 U 85 101 u 117							
6	6 22 & 38 54 F 70 V 86 102 v 118							
7	<BEL> 7 23 ' 39 55 G 71 W 87 103 w 119							
8	<BS> <CAN> 8 24 (40 56 H 72 X 88 104 x 120							
9	<HT> 9 25) 41 57 I 73 Y 89 105 y 121							
A	<LF> <SUB> 10 26 * 42 : 58 J 74 Z 90 106 z 122							
B	<VT> <ESC> 11 27 + 43 ; 59 K 75 Æ 91 107 k 123 æ 123							
C	<FF> 12 28 ' 44 < 60 L 76 Ø 92 108 l 124 ø 124							
D	<CR> 13 29 - 45 = 61 M 77 Å 93 109 m 125 å 125							
E	<SO> <RS> 14 30 . 46 > 62 N 78 ^ 94 110 n 126 - 126							
F	<SI> <US> 15 31 / 47 ? 63 O 79 - 95 111 o 127 ¯ 127							

ID Number Symbol Name

0E Roman Extension

	0	1	2	3	4	5	6	7
0	<NUL> 0	16	32	48	â 64	À 80	Á 96	Ð 112
1	<DC1> 1	17	À 33	Ý 49	ê 65	î 81	Ă 97	þ 113
2	<DC2> 2	18	Â 34	ý 50	ô 66	ø 82	ã 98	· 114
3	<DC3> 3	19	È 35	° 51	û 67	Æ 83	Ð 99	µ 115
4	<DC4> 4	20	Ê 36	Ç 52	á 68	à 84	ø 100	¶ 116
5	5	21	È 37	Ç 53	é 69	í 85	í 101	‡ 117
6	6	22	Î 38	Ñ 54	ó 70	ø 86	Ï 102	- 118
7	<BEL> 7	23	Ï 39	ñ 55	ú 71	æ 87	Ó 103	‡ 119
8	<BS> 8	<CAN> 24	40	i 56	à 72	Ä 88	Ò 104	‡ 120
9	<HT> 9	 25	41	ç 57	è 73	ì 89	Ö 105	ª 121
A	<LF> 10	<SUB> 26	42	π 58	ò 74	Ö 90	ø 106	º 122
B	<VT> 11	<ESC> 27	43	£ 59	ù 75	Û 91	Š 107	« 123
C	<FF> 12	28	44	¥ 60	ä 76	É 92	š 108	■ 124
D	<CR> 13	29	45	Š 61	ë 77	ï 93	Ú 109	» 125
E	<SO> 14	<RS> 30	46	f 62	ö 78	ß 94	ÿ 110	± 126
F	<SI> 15	<US> 31	47	ç 63	ü 79	Ô 95	ÿ 111	127

ID Number

Symbol Name

0F

ISO 25: French

	0	1	2	3	4	5	6	7
0	<NUL> 0	16	32	0 48	à 64	P 80	` 96	p 112
1	1	<DC1> 17	!	1 49	A 65	Q 81	a 97	q 113
2	2	<DC2> 18	"	2 50	B 66	R 82	b 98	r 114
3	3	<DC3> 19	£	3 51	C 67	S 83	c 99	s 115
4	4	<DC4> 20	\$	4 52	D 68	T 84	d 100	t 116
5	5	21	%	5 53	E 69	U 85	e 101	u 117
6	6	22	&	6 54	F 70	V 86	f 102	v 118
7	<BEL> 7	23	'	7 55	G 71	W 87	g 103	w 119
8	<BS> 8	<CAN> 24	(	8 56	H 72	X 88	h 104	x 120
9	<HT> 9	 25)	9 57	I 73	Y 89	i 105	y 121
A	<LF> 10	<SUB> 26	*	: 58	J 74	Z 90	j 106	z 122
B	<VT> 11	<ESC> 27	+	; 59	K 75	° 91	k 107	é 123
C	<FF> 12	28	,	< 60	L 76	ç 92	l 108	ù 124
D	<CR> 13	29	-	= 61	M 77	§ 93	m 109	è 125
E	<SO> 14	<RS> 30	.	> 62	N 78	^ 94	n 110	.. 126
F	<SI> 15	<US> 31	/	? 63	O 79	- 95	o 111	* 127

ID Number

Symbol Name

0G

HP German

	0	1	2	3	4	5	6	7
0	<NUL> 0	16	32	0 48	§ 64	P 80	96	p 112
1	<DC1> 1	17	!	1 49	A 65	Q 81	a 97	q 113
2	<DC2> 2	18	"	2 50	B 66	R 82	b 98	r 114
3	<DC3> 3	19	£	3 51	C 67	S 83	c 99	s 115
4	<DC4> 4	20	\$	4 52	D 68	T 84	d 100	t 116
5	5	21	%	5 53	E 69	U 85	e 101	u 117
6	6	22	&	6 54	F 70	V 86	f 102	v 118
7	<BEL> 7	23	'	7 55	G 71	W 87	g 103	w 119
8	<BS> 8	<CAN> 24	(	8 56	H 72	X 88	h 104	x 120
9	<HT> 9	 25)	9 57	I 73	Y 89	i 105	y 121
A	<LF> 10	<SUB> 26	*	: 58	J 74	Z 90	j 106	z 122
B	<VT> 11	<ESC> 27	+	; 59	K 75	Ä 91	k 107	ä 123
C	<FF> 12	28	,	< 60	L 76	Ö 92	l 108	ö 124
D	<CR> 13	29	-	= 61	M 77	Ü 93	m 109	ü 125
E	<SO> 14	<RS> 30	.	> 62	N 78	^ 94	n 110	ß 126
F	<SI> 15	<US> 31	/	? 63	O 79	- 95	o 111	• 127

ID Number

Symbol Name

0I

ISO 15: Italian

	0	1	2	3	4	5	6	7
0	<NUL> 0 16 32 48 64 80 96 112			0 48 64 80 96 112	§ 64 80 96 112	P 80 96 112	ù 96 112	p 112
1		<DC1> 1 17 33 49 65 81 97 113	! 33 49 65 81 97 113	1 49 65 81 97 113	A 65 81 97 113	Q 81 97 113	a 97 113	q 113
2		<DC2> 2 18 34 50 66 82 98 114	" 34 50 66 82 98 114	2 50 66 82 98 114	B 66 82 98 114	R 82 98 114	b 98 114	r 114
3		<DC3> 3 19 35 51 67 83 99 115	£ 35 51 67 83 99 115	3 51 67 83 99 115	C 67 83 99 115	S 83 99 115	c 99 115	s 115
4		<DC4> 4 20 36 52 68 84 100 116	\$ 36 52 68 84 100 116	4 52 68 84 100 116	D 68 84 100 116	T 84 100 116	d 100 116	t 116
5			¥ 37 53 69 85 101 117	5 53 69 85 101 117	E 69 85 101 117	U 85 101 117	e 101 117	u 117
6			& 38 54 70 86 102 118	6 54 70 86 102 118	F 70 86 102 118	V 86 102 118	f 102 118	v 118
7	<BEL> 7 23 39 55 71 87 103 119		' 39 55 71 87 103 119	7 55 71 87 103 119	G 71 87 103 119	W 87 103 119	g 103 119	w 119
8	<BS> 8 24 40 56 72 88 104 120	<CAN> 8 24 40 56 72 88 104 120	(40 56 72 88 104 120	8 56 72 88 104 120	H 72 88 104 120	X 88 104 120	h 104 120	x 120
9	<HT> 9 25 41 57 73 89 105 121	 9 25 41 57 73 89 105 121) 41 57 73 89 105 121	9 57 73 89 105 121	I 73 89 105 121	Y 89 105 121	i 105 121	y 121
A	<LF> 10 26 42 58 74 90 106 122	<SUB> 10 26 42 58 74 90 106 122	* 42 58 74 90 106 122	: 58 74 90 106 122	J 74 90 106 122	Z 90 106 122	j 106 122	z 122
B	<VT> 11 27 43 59 75 91 107 123	<ESC> 11 27 43 59 75 91 107 123	+ 43 59 75 91 107 123	; 59 75 91 107 123	K 75 91 107 123	° 91 107 123	k 107 123	à 123
C	<FF> 12 28 44 60 76 92 108 124		‘ 44 60 76 92 108 124	< 60 76 92 108 124	L 76 92 108 124	ç 92 108 124	l 108 124	ò 124
D	<CR> 13 29 45 61 77 93 109 125		- 45 61 77 93 109 125	= 61 77 93 109 125	M 77 93 109 125	é 93 109 125	m 109 125	è 125
E	<SO> 14 30 46 62 78 94 110 126	<RS> 14 30 46 62 78 94 110 126	· 46 62 78 94 110 126	> 62 78 94 110 126	N 78 94 110 126	ˆ 94 110 126	n 110 126	ì 126
F	<SI> 15 31 47 63 79 95 111 127	<US> 15 31 47 63 79 95 111 127	/ 47 63 79 95 111 127	? 63 79 95 111 127	O 79 95 111 127	— 95 111 127	o 111 127	• 127

ID Number

Symbol Name

OK

JIS ASCII

	0	1	2	3	4	5	6	7
0	<NUL> 0 16 32 48			0 48	@ 64	P 80	` 96	p 112
1		<DC1> 1 17 33 49	!	1 49	A 65	Q 81	a 97	q 113
2		<DC2> 2 18 34 50	"	2 50	B 66	R 82	b 98	r 114
3		<DC3> 3 19 35 51	#	3 51	C 67	S 83	c 99	s 115
4		<DC4> 4 20 36 52	\$	4 52	D 68	T 84	d 100	t 116
5			%	5 53	E 69	U 85	e 101	u 117
6			&	6 54	F 70	V 86	f 102	v 118
7	<BEL> 7 23 39 55		'	7 55	G 71	W 87	g 103	w 119
8	<BS> 8 24 40 56	<CAN> (40	(	8 56	H 72	X 88	h 104	x 120
9	<HT> 9 25 41 57) 41)	9 57	I 73	Y 89	i 105	y 121
A	<LF> 10 26 42 58	<SUB> * 42	*	: 58	J 74	Z 90	j 106	z 122
B	<VT> 11 27 43 59	<ESC> + 43	+	; 59	K 75	[91	k 107	{ 123
C	<FF> 12 28 44 60		,	< 60	L 76	¥ 92	l 108	| 124
D	<CR> 13 29 45 61		-	= 61	M 77	] 93	m 109	} 125
E	<SO> 14 30 46 62	<RS> . 46	.	> 62	N 78	~ 94	n 110	~ 126
F	<SI> 15 31 47 63	<US> / 47	/	? 63	O 79	- 95	o 111	* 127

ID Number

Symbol Name

ON

ECMA-94 Latin 1

	0	1	2	3	4	5	6	7
0	<NUL> 0	16	32	48	@	P	`	p
1	1	<DC1> 17	!	33	49	A	Q	a
2	2	<DC2> 18	"	34	50	B	R	b
3	3	<DC3> 19	#	35	51	C	S	c
4	4	<DC4> 20	\$	36	52	D	T	d
5	5	21	%	37	53	E	U	e
6	6	22	&	38	54	F	V	f
7	<BEL> 7	23	'	39	55	G	W	g
8	<BS> 8	<CAN> 24	(	40	56	H	X	h
9	<HT> 9	 25)	41	57	I	Y	i
A	<LF> 10	<SUB> 26	*	42	58	J	Z	j
B	<VT> 11	<ESC> 27	+	43	59	K	[	k
C	<FF> 12	28	,	44	60	L	\	l
D	<CR> 13	29	-	45	61	M	]	m
E	<SO> 14	<RS> 30	.	46	62	N	^	n
F	<SI> 15	<US> 31	/	47	63	O	_	o
								

ID Number Symbol Name

0N

ECMA-94 Latin 1
(cont.)

	8	9	A	B	C	D	E	F
0	128	144	160	176	À 192	Ð 208	à 224	ð 240
1	129	145	ì 161	± 177	Á 193	Ñ 209	á 225	ñ 241
2	130	146	ç 162	² 178	Â 194	Ò 210	â 226	ò 242
3	131	147	é 163	³ 179	Ã 195	Ó 211	ã 227	ó 243
4	132	148	ñ 164	´ 180	Ä 196	Ô 212	ä 228	ô 244
5	133	149	¥ 165	µ 181	Å 197	Ö 213	å 229	ö 245
6	134	150	ı 166	¶ 182	Æ 198	Ï 214	æ 230	ï 246
7	135	151	š 167	· 183	Ç 199	× 215	ç 231	· 247
8	136	152	¨ 168	¸ 184	È 200	Ø 216	è 232	ø 248
9	137	153	© 169	¹ 185	É 201	Ù 217	é 233	ù 249
A	138	154	ª 170	º 186	Ê 202	Ú 218	ê 234	ú 250
B	139	155	« 171	» 187	Ë 203	Û 219	ë 235	û 251
C	140	156	¬ 172	¼ 188	Ì 204	Ü 220	ì 236	ü 252
D	141	157	­ 173	½ 189	Í 205	Ý 221	í 237	ý 253
E	142	158	® 174	¾ 190	Î 206	Þ 222	î 238	þ 254
F	143	159	¯ 175	¿ 191	Ï 207	ß 223	ï 239	ÿ 255

ID Number

Symbol Name

0S

ISO 11: Swedish

	0	1	2	3	4	5	6	7
0	<NUL> 0	16	32	0	É	P	é	p
1	<DC1> 1	17	!	1	A	Q	a	q
2	<DC2> 2	18	"	2	B	R	b	r
3	<DC3> 3	19	#	3	C	S	c	s
4	<DC4> 4	20	¤	4	D	T	d	t
5	5	21	%	5	E	U	e	u
6	6	22	&	6	F	V	f	v
7	<BEL> 7	23	'	7	G	W	g	w
8	<BS> 8	<CAN> 24	(	8	H	X	h	x
9	<HT> 9	 25)	9	I	Y	i	y
A	<LF> 10	<SUB> 26	*	:	J	Z	j	z
B	<VT> 11	<ESC> 27	+	;	K	Ä	k	ä
C	<FF> 12	28	^	<	L	Ö	l	ö
D	<CR> 13	29	-	=	M	Å	m	å
E	<SO> 14	<RS> 30	.	>	N	Ü	n	ü
F	<SI> 15	<US> 31	/	?	O	—	o	•
		32		63	79	95	111	127

ID Number

Symbol Name

0U

US-ASCII

	0	1	2	3	4	5	6	7
0	<NUL> 0	16	32	48	@ 64	P 80	' 96	p 112
1	<DC1> 1	!	33	49	A 65	Q 81	a 97	q 113
2	<DC2> 2	"	34	50	B 66	R 82	b 98	r 114
3	<DC3> 3	#	35	51	C 67	S 83	c 99	s 115
4	<DC4> 4	\$	36	52	D 68	T 84	d 100	t 116
5	5	%	37	53	E 69	U 85	e 101	u 117
6	6	&	38	54	F 70	V 86	f 102	v 118
7	<BEL> 7	'	39	55	G 71	W 87	g 103	w 119
8	<BS> 8	<CAN> 24	(40	8 56	H 72	X 88	h 104	x 120
9	<HT> 9	 25) 41	9 57	I 73	Y 89	i 105	y 121
A	<LF> 10	<SUB> 26	* 42	: 58	J 74	Z 90	j 106	z 122
B	<VT> 11	<ESC> 27	+ 43	; 59	K 75	[91	k 107	{ 123
C	<FF> 12	28	, 44	< 60	L 76	\ 92	l 108	| 124
D	<CR> 13	29	- 45	= 61	M 77	] 93	m 109	} 125
E	<SO> 14	<RS> 30	. 46	> 62	N 78	^ 94	n 110	~ 126
F	<SI> 15	<US> 31	/ 47	? 63	O 79	- 95	o 111	* 127

1D ISO 61: Norwegian

	0	1	2	3	4	5	6	7
0	<NUL> 0 16 32 48 64 80 96 112			0	@	P	`	p
1	<DC1> 1 17 33 49 65 81 97 113	!		1	A	Q	a	q
2	<DC2> 2 18 34 50 66 82 98 114	"		2	B	R	b	r
3	<DC3> 3 19 35 51 67 83 99 115	\$		3	C	S	c	s
4	<DC4> 4 20 36 52 68 84 100 116	\$		4	D	T	d	t
5		%		5	E	U	e	u
6		&		6	F	V	f	v
7	<BEL> 7 23 39 55 71 87 103 119	'		7	G	W	g	w
8	<BS> 8 24 40 56 72 88 104 120	<CAN> (		8	H	X	h	x
9	<HT> 9 25 41 57 73 89 105 121)		9	I	Y	i	y
A	<LF> 10 26 42 58 74 90 106 122	<SUB> *		:	J	Z	j	z
B	<VT> 11 27 43 59 75 91 107 123	<ESC> +		;	K	Æ	k	æ
C	<FF> 12 28 44 60 76 92 108 124	,		<	L	Ø	l	ø
D	<CR> 13 29 45 61 77 93 109 125	-		=	M	Å	m	å
E	<SO> 14 30 46 62 78 94 110 126	<RS> .		>	N	^	n	|
F	<SI> 15 31 47 63 79 95 111 127	<US> /		?	O		o	®

ID Number

Symbol Name

1E

ISO UK

	0	1	2	3	4	5	6	7
0	<NUL> 0 16 32		0 48	@ 64	P 80	` 96	p 112	
1		<DC1> 1 17	! 33	1 49	A 65	Q 81	a 97	q 113
2		<DC2> 2 18	" 34	2 50	B 66	R 82	b 98	r 114
3		<DC3> 3 19	£ 35	3 51	C 67	S 83	c 99	s 115
4		<DC4> 4 20	\$ 36	4 52	D 68	T 84	d 100	t 116
5			% 37	5 53	E 69	U 85	e 101	u 117
6			& 38	6 54	F 70	V 86	f 102	v 118
7	<BEL> 7 23		' 39	7 55	G 71	W 87	g 103	w 119
8	<BS> 8 24	<CAN> 24 40	(40	8 56	H 72	X 88	h 104	x 120
9	<HT> 9 25	 25 41) 41	9 57	I 73	Y 89	i 105	y 121
A	<LF> 10 26	<SUB> 26 42	* 42	: 58	J 74	Z 90	j 106	z 122
B	<VT> 11 27	<ESC> 27 43	+ 43	; 59	K 75	[91	k 107	{ 123
C	<FF> 12 28		, 44	< 60	L 76	\ 92	l 108	| 124
D	<CR> 13 29		- 45	= 61	M 77	] 93	m 109	} 125
E	<SO> 14 30	<RS> 30 46	. 46	> 62	N 78	~ 94	n 110	~ 126
F	<SI> 15 31	<US> 31 47	/ 47	? 63	O 79	- 95	o 111	* 127

ID Number

Symbol Name

1F

ISO 69: French

	0	1	2	3	4	5	6	7
0	<NUL> 0	16	32	0	à	P	μ	p
1	1	<DC1> 17	!	1	A	Q	a	q
2	2	<DC2> 18	"	2	B	R	b	r
3	3	<DC3> 19	£	3	C	S	c	s
4	4	<DC4> 20	\$	4	D	T	d	t
5	5	21	%	5	E	U	e	u
6	6	22	&	6	F	V	f	v
7	<BEL> 7	23	'	7	G	W	g	w
8	<BS> 8	<CAN> 24	(	8	H	X	h	x
9	<HT> 9	 25)	9	I	Y	i	y
A	<LF> 10	<SUB> 26	*	:	J	Z	j	z
B	<VT> 11	<ESC> 27	+	;	K	°	k	é
C	<FF> 12	28	,	<	L	ç	l	ù
D	<CR> 13	29	-	=	M	§	m	è
E	<SO> 14	<RS> 30	.	>	N	^	n	..
F	<SI> 15	<US> 31	/	?	O	-	o	⌘

ID Number

Symbol Name

1G

ISO 21: German

	0	1	2	3	4	5	6	7
0	<NUL> 0	16	32	0	§	P	`	p
1	1	<DC1> 17	!	1	A	Q	a	q
2	2	<DC2> 18	"	2	B	R	b	r
3	3	<DC3> 19	#	3	C	S	c	s
4	4	<DC4> 20	\$	4	D	T	d	t
5	5	21	%	5	E	U	e	u
6	6	22	&	6	F	V	f	v
7	<BEL> 7	23	'	7	G	W	g	w
8	<BS> 8	<CAN> 24	(	8	H	X	h	x
9	<HT> 9	 25)	9	I	Y	i	y
A	<LF> 10	<SUB> 26	*	:	J	Z	j	z
B	<VT> 11	<ESC> 27	+	;	K	Ä	k	ä
C	<FF> 12	28	,	<	L	Ö	l	ö
D	<CR> 13	29	-	=	M	Ü	m	ü
E	<SO> 14	<RS> 30	.	>	N	~	n	ß
F	<SI> 15	<US> 31	/	?	O	-	o	•

ID Number

Symbol Name

1S

HP Spanish

	0	1	2	3	4	5	6	7
0	<NUL> 0	16	32	0	@	P	`	p
1	<DC1> 1	17	!	1	A	Q	a	q
2	<DC2> 2	18	"	2	B	R	b	r
3	<DC3> 3	19	#	3	C	S	c	s
4	<DC4> 4	20	\$	4	D	T	d	t
5	5	21	%	5	E	U	e	u
6	6	22	&	6	F	V	f	v
7	<BEL> 7	23	'	7	G	W	g	w
8	<BS> 8	<CAN> 24	(	8	H	X	h	x
9	<HT> 9	 25)	9	I	Y	i	y
A	<LF> 10	<SUB> 26	*	:	J	Z	j	z
B	<VT> 11	<ESC> 27	+	;	K	ı	k	{
C	<FF> 12	28	,	<	L	Ñ	l	ñ
D	<CR> 13	29	-	=	M	¿	m	}
E	<SO> 14	<RS> 30	.	>	N	°	n	~
F	<SI> 15	<US> 31	/	?	O	-	o	*
		32		63	79	95	111	127

2K

ISO 57: Chinese

	0	1	2	3	4	5	6	7
0	<NUL> 0	16	32	0 48	@ 64	P 80	` 96	p 112
1	1	<DC1> 17	!	1 49	A 65	Q 81	a 97	q 113
2	2	<DC2> 18	"	2 50	B 66	R 82	b 98	r 114
3	3	<DC3> 19	#	3 51	C 67	S 83	c 99	s 115
4	4	<DC4> 20	¥	4 52	D 68	T 84	d 100	t 116
5	5	21	%	5 53	E 69	U 85	e 101	u 117
6	6	22	&	6 54	F 70	V 86	f 102	v 118
7	<BEL> 7	23	'	7 55	G 71	W 87	g 103	w 119
8	<BS> 8	<CAN> 24	(	8 56	H 72	X 88	h 104	x 120
9	<HT> 9	 25)	9 57	I 73	Y 89	i 105	y 121
A	<LF> 10	<SUB> 26	*	: 58	J 74	Z 90	j 106	z 122
B	<VT> 11	<ESC> 27	+	; 59	K 75	[91	k 107	{ 123
C	<FF> 12	28	,	< 60	L 76	\ 92	l 108	| 124
D	<CR> 13	29	-	= 61	M 77	] 93	m 109	} 125
E	<SO> 14	<RS> 30	.	> 62	N 78	~ 94	n 110	~ 126
F	<SI> 15	<US> 31	/	? 63	O 79	- 95	o 111	* 127

	0	1	2	3	4	5	6	7
0	<NUL> 0	16	32	0	§	P	`	p
1	1	<DC1> 17	!	1	A	Q	a	q
2	2	<DC2> 18	"	2	B	R	b	r
3	3	<DC3> 19	£	3	C	S	c	s
4	4	<DC4> 20	\$	4	D	T	d	t
5	5	21	%	5	E	U	e	u
6	6	22	&	6	F	V	f	v
7	<BEL> 7	23	'	7	G	W	g	w
8	<BS> 8	<CAN> 24	(	8	H	X	h	x
9	<HT> 9	 25)	9	I	Y	i	y
A	<LF> 10	<SUB> 26	*	:	J	Z	j	z
B	<VT> 11	<ESC> 27	+	;	K	i	k	°
C	<FF> 12	28	'	<	L	Ñ	l	ñ
D	<CR> 13	29	-	=	M	¿	m	ç
E	<SO> 14	<RS> 30	.	>	N	ˆ	n	˜
F	<SI> 15	<US> 31	/	?	O	—	o	•

ID Number

Symbol Name

2U

ISO IRV

	0	1	2	3	4	5	6	7
0	<NUL> 0 16 32 48			0 48	@ 64	P 80	` 96	p 112
1		<DC1> 1 17 33	!	1 49	A 65	Q 81	a 97	q 113
2		<DC2> 2 18 34	"	2 50	B 66	R 82	b 98	r 114
3		<DC3> 3 19 35	#	3 51	C 67	S 83	c 99	s 115
4		<DC4> 4 20 36	α	4 52	D 68	T 84	d 100	t 116
5			%	5 53	E 69	U 85	e 101	u 117
6			&	6 54	F 70	V 86	f 102	v 118
7	<BEL> 7 23 39		'	7 55	G 71	W 87	g 103	w 119
8	<BS> 8 24 40	<CAN> (		8 56	H 72	X 88	h 104	x 120
9	<HT> 9 25 41)		9 57	I 73	Y 89	i 105	y 121
A	<LF> 10 26 42	<SUB> *	:	58	J 74	Z 90	j 106	z 122
B	<VT> 11 27 43	<ESC> +	;	59	K 75	[91	k 107	{ 123
C	<FF> 12 28 44		<	60	L 76	\ 92	l 108	| 124
D	<CR> 13 29 45		=	61	M 77	] 93	m 109	} 125
E	<SO> 14 30 46	<RS> .	>	62	N 78	^ 94	n 110	~ 126
F	<SI> 15 31 47	<US> /	?	63	O 79	_ 95	o 111	* 127

ID Number Symbol Name

3S

ISO 10: Swedish

	0	1	2	3	4	5	6	7
0	<NUL> 0			0	@	P	`	p
1		<DC1> !	1	A	Q	a	q	
2		<DC2> "	2	B	R	b	r	
3		<DC3> #	3	C	S	c	s	
4		<DC4> α	4	D	T	d	t	
5			%	5	E	U	e	u
6			&	6	F	V	f	v
7	<BEL> '		7	G	W	g	w	
8	<BS> <CAN> (		8	H	X	h	x
9	<HT>)		9	I	Y	i	y	
A	<LF> <SUB> *		:	J	Z	j	z	
B	<VT> <ESC> +		;	K	Ä	k	ä	
C	<FF> ,		<	L	Ö	l	ö	
D	<CR> -		=	M	Å	m	å	
E	<SO> <RS> .		>	N	ˆ	n	ˆ	
F	<SI> <US> /		?	O	-	o	•	

4S

ISO 16: Portuguese

	0	1	2	3	4	5	6	7
0	<NUL> 0			0	Š	P	`	p
1		<DC1> 1	!	1	A	Q	a	q
2		<DC2> 2	"	2	B	R	b	r
3		<DC3> 3	#	3	C	S	c	s
4		<DC4> 4	\$	4	D	T	d	t
5			%	5	E	U	e	u
6			&	6	F	V	f	v
7	<BEL> 7		'	7	G	W	g	w
8	<BS> 8	<CAN> 24	(	8	H	X	h	x
9	<HT> 9	 25)	9	I	Y	i	y
A	<LF> 10	<SUB> 26	*	:	J	Z	j	z
B	<VT> 11	<ESC> 27	+	;	K	Ã	k	ã
C	<FF> 12		,	<	L	Ç	l	ç
D	<CR> 13		-	=	M	Ö	m	ö
E	<SO> 14	<RS> 30	.	>	N	ˆ	n	ˆ
F	<SI> 15	<US> 31	/	?	O	—	o	•

	0	1	2	3	4	5	6	7					
0	<NUL> 0	16	32	0	48	64	P	80	96	p	112		
1	1	<DC1> 17	!	33	1	49	A	65	81	a	97	q	113
2	2	<DC2> 18	"	34	2	50	B	66	82	R	98	b	114
3	3	<DC3> 19	#	35	3	51	C	67	83	S	99	c	115
4	4	<DC4> 20	\$	36	4	52	D	68	84	T	100	d	116
5	5	21	%	37	5	53	E	69	85	U	101	e	117
6	6	22	&	38	6	54	F	70	86	V	102	f	118
7	<BEL> 7	23	'	39	7	55	G	71	87	W	103	g	119
8	<BS> 8	<CAN> 24	(	40	8	56	H	72	88	X	104	h	120
9	<HT> 9	 25)	41	9	57	I	73	89	Y	105	i	121
A	<LF> 10	<SUB> 26	*	42	:	58	J	74	90	Z	106	j	122
B	<VT> 11	<ESC> 27	+	43	;	59	K	75	91	Ã	107	k	123
C	<FF> 12	28	,	44	<	60	L	76	92	Ç	108	l	124
D	<CR> 13	29	-	45	=	61	M	77	93	Ö	109	m	125
E	<SO> 14	<RS> 30	.	46	>	62	N	78	94	^	110	n	126
F	<SI> 15	<US> 31	/	47	?	63	O	79	95	o	111	õ	127

	0	1	2	3	4	5	6	7
0	<NUL> 0	16	32	0 48	· 64	P 80	´ 96	p 112
1	1	<DC1> 17	!	1 49	A 65	Q 81	a 97	q 113
2	2	<DC2> 18	"	2 50	B 66	R 82	b 98	r 114
3	3	<DC3> 19	#	3 51	C 67	S 83	c 99	s 115
4	4	<DC4> 20	\$	4 52	D 68	T 84	d 100	t 116
5	5	21	%	5 53	E 69	U 85	e 101	u 117
6	6	22	&	6 54	F 70	V 86	f 102	v 118
7	<BEL> 7	23	'	7 55	G 71	W 87	g 103	w 119
8	<BS> 8	<CAN> 24	(	8 56	H 72	X 88	h 104	x 120
9	<HT> 9	 25)	9 57	I 73	Y 89	i 105	y 121
A	<LF> 10	<SUB> 26	*	: 58	J 74	Z 90	j 106	z 122
B	<VT> 11	<ESC> 27	+	; 59	K 75	i 91	k 107	´ 123
C	<FF> 12	28	,	< 60	L 76	Ñ 92	l 108	ñ 124
D	<CR> 13	29	-	= 61	M 77	Ç 93	m 109	ç 125
E	<SO> 14	<RS> 30	·	> 62	N 78	¿ 94	n 110	¨ 126
F	<SI> 15	<US> 31	/	? 63	O 79	- 95	o 111	¸ 127

ID Number Symbol Name

8U

Roman-8

	0	1	2	3	4	5	6	7
0	<NUL> 0 16 32 48			0 48	@ 64	P 80	' 96	p 112
1		<DC1> 1 17	! 33	1 49	A 65	Q 81	a 97	q 113
2		<DC2> 2 18	" 34	2 50	B 66	R 82	b 98	r 114
3		<DC3> 3 19	# 35	3 51	C 67	S 83	c 99	s 115
4		<DC4> 4 20	\$ 36	4 52	D 68	T 84	d 100	t 116
5			% 37	5 53	E 69	U 85	e 101	u 117
6			& 38	6 54	F 70	V 86	f 102	v 118
7	<BEL> 7 23		' 39	7 55	G 71	W 87	g 103	w 119
8	<BS> 8 24	<CAN> 24	(40	8 56	H 72	X 88	h 104	x 120
9	<HT> 9 25	 25) 41	9 57	I 73	Y 89	i 105	y 121
A	<LF> 10 26	<SUB> 26	* 42	:	J 74	Z 90	j 106	z 122
B	<VT> 11 27	<ESC> 27	+ 43	;	K 75	[91	k 107	{ 123
C	<FF> 12 28		' 44	<	L 76	\ 92	l 108	| 124
D	<CR> 13 29		- 45	=	M 77	] 93	m 109	} 125
E	<SO> 14 30	<RS> 30	. 46	>	N 78	^ 94	n 110	~ 126
F	<SI> 15 31	<US> 31	/ 47	?	O 79	_ 95	o 111	* 127

ID Number

Symbol Name

8U

Roman-8


























































































































(cont.)

	8	9	A	B	C	D	E	F
0	128	144	160	176	192	208	224	240
1	129	145	161	177	193	209	225	241
2	130	146	162	178	194	210	226	242
3	131	147	163	179	195	211	227	243
4	132	148	164	180	196	212	228	244
5	133	149	165	181	197	213	229	245
6	134	150	166	182	198	214	230	246
7	135	151	167	183	199	215	231	247
8	136	152	168	184	200	216	232	248
9	137	153	169	185	201	217	233	249
A	138	154	170	186	202	218	234	250
B	139	155	171	187	203	219	235	251
C	140	156	172	188	204	220	236	252
D	141	157	173	189	205	221	237	253
E	142	158	174	190	206	222	238	254
F	143	159	175	191	207	223	239	255

ID Number Symbol Name

10U

IBM-PC (US)

	0	1	2	3	4	5	6	7
0	 0	 16	 32	0  48	@  64	P  80	 96	p  112
1	 1	 17	!  33	1  49	A  65	Q  81	a  97	q  113
2	 2	↑  18	"  34	2  50	B  66	R  82	b  98	r  114
3	 3	!!  19	#  35	3  51	C  67	S  83	c  99	s  115
4	 4	¶  20	\$  36	4  52	D  68	T  84	d  100	t  116
5	 5	§  21	%  37	5  53	E  69	U  85	e  101	u  117
6	 6	-  22	&  38	6  54	F  70	V  86	f  102	v  118
7	•  7	‡  23	'  39	7  55	G  71	W  87	g  103	w  119
8	■  8	†  24	( 40	8  56	H  72	X  88	h  104	x  120
9	○  9	↓  25	) 41	9  57	I  73	Y  89	i  105	y  121
A	●  10	→  26	*  42	:	J  74	Z  90	j  106	z  122
B	♂  11	←  27	+  43	;	K  75	[ 91	k  107	{  123
C	♀  12	↳  28	,	<  60	L  76	\  92	l  108	| 124
D	♪  13	↔  29	-	=  61	M  77	] 93	m  109	}  125
E	♫  14	▲  30	•	>  62	N  78	ˆ  94	n  110	˜  126
F	✳  15	▼  31	/	?  63	O  79	-	o  111	✳  127

ID Number Symbol Name

10U

IBM-PC (US)
(cont.)

	8	9	A	B	C	D	E	F
0	Ç 128	É 144	á 160	176	Ł 192	⌌ 208	α 224	≡ 240
1	ü 129	æ 145	í 161	177	⌋ 193	⌍ 209	β 225	± 241
2	é 130	Æ 146	ó 162	178	⌌ 194	π 210	Γ 226	≥ 242
3	â 131	ô 147	ú 163	| 179	⌋ 195	⌌ 211	π 227	≤ 243
4	ä 132	ö 148	ñ 164	⌋ 180	- 196	⌌ 212	Σ 228	∫ 244
5	à 133	ò 149	Ñ 165	⌋ 181	⌋ 197	⌌ 213	σ 229	∫ 245
6	á 134	û 150	ª 166	⌋ 182	⌋ 198	π 214	μ 230	÷ 246
7	ç 135	ù 151	º 167	π 183	⌋ 199	⌋ 215	τ 231	≈ 247
8	ê 136	ÿ 152	¿ 168	⌋ 184	⌌ 200	⌋ 216	Φ 232	° 248
9	ë 137	Ö 153	¬ 169	⌋ 185	⌌ 201	⌋ 217	Θ 233	• 249
A	è 138	Ü 154	¬ 170	⌋ 186	⌌ 202	⌋ 218	Ω 234	· 250
B	ï 139	Ç 155	‡ 171	⌋ 187	⌍ 203	■ 219	δ 235	√ 251
C	î 140	£ 156	‡ 172	⌋ 188	⌋ 204	■ 220	∞ 236	η 252
D	ì 141	¥ 157	¡ 173	⌋ 189	= 205	■ 221	φ 237	² 253
E	Ä 142	℞ 158	« 174	⌋ 190	⌋ 206	■ 222	ε 238	³ 254
F	Å 143	ƒ 159	» 175	⌋ 191	⌋ 207	■ 223	∩ 239	255

ID Number

Symbol Name

11U

IBM-PC (Denmark/Norway)

	0	1	2	3	4	5	6	7
0	◻ ₀	▶ ₁₆	◻ ₃₂	0 ₄₈	@ ₆₄	P ₈₀	◻ ₉₆	p ₁₁₂
1	☺ ₁	◀ ₁₇	! ₃₃	1 ₄₉	A ₆₅	Q ₈₁	a ₉₇	q ₁₁₃
2	● ₂	↓ ₁₈	" ₃₄	2 ₅₀	B ₆₆	R ₈₂	b ₉₈	r ₁₁₄
3	♥ ₃	!! ₁₉	# ₃₅	3 ₅₁	C ₆₇	S ₈₃	c ₉₉	s ₁₁₅
4	♦ ₄	⚡ ₂₀	\$ ₃₆	4 ₅₂	D ₆₈	T ₈₄	d ₁₀₀	t ₁₁₆
5	♣ ₅	§ ₂₁	% ₃₇	5 ₅₃	E ₆₉	U ₈₅	e ₁₀₁	u ₁₁₇
6	♠ ₆	- ₂₂	& ₃₈	6 ₅₄	F ₇₀	V ₈₆	f ₁₀₂	v ₁₁₈
7	• ₇	‡ ₂₃	' ₃₉	7 ₅₅	G ₇₁	W ₈₇	g ₁₀₃	w ₁₁₉
8	■ ₈	↑ ₂₄	(₄₀	8 ₅₆	H ₇₂	X ₈₈	h ₁₀₄	x ₁₂₀
9	○ ₉	↓ ₂₅	)₄₁	9 ₅₇	I ₇₃	Y ₈₉	i ₁₀₅	y ₁₂₁
A	⊗ ₁₀	→ ₂₆	* ₄₂	: ₅₈	J ₇₄	Z ₉₀	j ₁₀₆	z ₁₂₂
B	♂ ₁₁	← ₂₇	+ ₄₃	; ₅₉	K ₇₅	[₉₁	k ₁₀₇	{ ₁₂₃
C	♀ ₁₂	┌ ₂₈	˙ ₄₄	< ₆₀	L ₇₆	\ ₉₂	l ₁₀₈	|₁₂₄
D	♪ ₁₃	↔ ₂₉	- ₄₅	= ₆₁	M ₇₇	]₉₃	m ₁₀₉	} ₁₂₅
E	♫ ₁₄	▲ ₃₀	• ₄₆	> ₆₂	N ₇₈	˘ ₉₄	n ₁₁₀	~ ₁₂₆
F	⊛ ₁₅	▼ ₃₁	/ ₄₇	? ₆₃	O ₇₉	◊ ₉₅	o ₁₁₁	* ₁₂₇

ID Number

Symbol Name

11U

IBM-PC (Denmark/Norway)
(cont.)





























	8	9	A	B	C	D	E	F
0	Ç 128	É 144	á 160	176	Ł 192	⌌ 208	α 224	≡ 240
1	ü 129	æ 145	í 161	177	ł 193	⌍ 209	β 225	± 241
2	é 130	Æ 146	ó 162	178	Ṭ 194	π 210	Γ 226	≥ 242
3	â 131	ô 147	ú 163	| 179	ṭ 195	⌎ 211	π 227	≤ 243
4	ä 132	ö 148	ñ 164	† 180	- 196	Ł 212	Σ 228	∫ 244
5	à 133	ò 149	Ñ 165	‡ 181	† 197	ƒ 213	σ 229	∫ 245
6	á 134	û 150	õ 166	‡ 182	‡ 198	π 214	μ 230	÷ 246
7	ç 135	ù 151	Õ 167	π 183	‡ 199	‡ 215	τ 231	≈ 247
8	ê 136	ÿ 152	ı 168	ƒ 184	Ł 200	‡ 216	Φ 232	° 248
9	ë 137	Ö 153	ã 169	‡ 185	ƒ 201	∫ 217	Θ 233	• 249
A	è 138	Ü 154	Ä 170	‡ 186	⌌ 202	ƒ 218	Ω 234	• 250
B	ï 139	ø 155	ł 171	ƒ 187	⌍ 203	■ 219	δ 235	√ 251
C	î 140	Ɛ 156	ñ 172	⌌ 188	⌍ 204	■ 220	∞ 236	η 252
D	ì 141	Ø 157	ı 173	⌌ 189	= 205	■ 221	φ 237	² 253
E	Ä 142	Ł 158	³ 174	∫ 190	⌍ 206	■ 222	ε 238	• 254
F	Å 143	ł 159	α 175	∫ 191	ł 207	■ 223	∩ 239	255

ID Number

Symbol Name

12U

PC-850

	0	1	2	3	4	5	6	7
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
A								
B								
C								
D								
E								
F								

ID Number Symbol Name

12U

PC-850
(cont.)

	8	9	A	B	C	D	E	F
0	Ç 128	É 144	á 160		Ł 192	ø 208	Ó 224	- 240
1	ü 129	æ 145	í 161		⊥ 193	Ð 209	β 225	± 241
2	é 130	Æ 146	ó 162		⊥ 194	Ë 210	Ô 226	= 242
3	ã 131	ô 147	ú 163	| 179	† 195	Ë 211	Ò 227	‡ 243
4	ä 132	ö 148	ñ 164	† 180	- 196	È 212	ö 228	¶ 244
5	à 133	ò 149	Ñ 165	Á 181	† 197	ı 213	Õ 229	§ 245
6	á 134	û 150	ª 166	Ã 182	ä 198	í 214	μ 230	÷ 246
7	ç 135	ù 151	º 167	À 183	Ä 199	î 215	þ 231	· 247
8	ê 136	ÿ 152	¿ 168	© 184	Ł 200	ï 216	þ 232	° 248
9	ë 137	ÿ 153	® 169	¶ 185	ƒ 201	ĵ 217	Ú 233	“ 249
A	è 138	ÿ 154	¬ 170	∥ 186	⊥ 202	ƒ 218	Û 234	· 250
B	ï 139	ø 155	‡ 171	¶ 187	ƒ 203	■ 219	Ü 235	’ 251
C	î 140	£ 156	‡ 172	¶ 188	ƒ 204	■ 220	Ý 236	³ 252
D	ì 141	Ø 157	ı 173	Ç 189	= 205	ı 221	Ý 237	² 253
E	Ä 142	× 158	« 174	¥ 190	¶ 206	İ 222	- 238	· 254
F	Å 143	f 159	» 175	ƒ 191	α 207	■ 223	· 239	

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