Appendix A

LN01 Functional Specification

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1.0 CHANGES

1.1 LN01 Technical Negotiation Meetings - April 25, 26 & 27.

On April 25, 26 & 27 we (DEC) met with XEROX to discuss the technical details of the LN01 printer. During these meetings several changes to the LN01 Functional Specification came about. The following notes list those changes.

1. Before starting the negotiations XEROX agreed to accept the LN01 Functional Specification, dated 23-April-1982, in place of the LN01 specification that was sent in the RFQ package.

2. It was also agreed that any changes (those listed below) would not effect in anyway the schedule and/or price that was quoted in the XEROX responce to our LN01 RFQ package.

3. The String Introducers APC, OSC, PM have been moved to the serial version of the printer. The String Introducer DCS and the String Terminator ST will only be recognized as part of the DECLCS control sequence.

4. XEROX action item:

   "How does the XEROX parser handle control characters (CR,LF, etc) in escape sequences ?"

   XEROX will check on this and determine what their parser does when these characters are received.

   If no responce from XEROX, then ok. This means the XEROX parser will either accept the control characters or XEROX will change the parser to do so.

5. XEROX action item:

   XEROX will determine if the following statement is true:

   "...If a font assignment is received which uses a font number that currently has a font name assigned to it, the current assignment is discarded and the new font name is assigned to the font number."

6. The serial version of the printer will handle C1 control characters (includes CSI). All occurences of CSI have been deleted from the parallel section of this document.

7. In the section "SGR - Select Font", the following sentences:

   "...If a font select is received for a font which is of an orientation which is opposite to that currently being used, the font select is ignored. Printing continues in the currently selected font. A message is printed on the "Job Summary Sheet" indicating that the select font sequence was ignored."

have been changed to:

"...If a font select is received of an opposite orientation, then printing stops on the current page and starts on the next page in the new orientation."

8. The following changes were made by XEROX to the DECSHTS and DECSVTS escape sequences:

   1. The maximum number of numeric parameters for the escape sequence changes from 32 to 8.

   2. The maximum number of tabs stops that can be defined at one time remains at 32. (Verified via phone conversation with Jack Demcak on Friday, April 28, 1982).

   3. Numeric parameters may be transmitted to the printer in any order desired. The parameters are sorted in ascending order before the tab stops are actually set.

   4. All tab stops may be set independently of currently set tab stops.

9. The following details have been added to "DECSHTS - Set Horizontal Tabulation Stops" and "DECSVTS - Set Vertical Tabulation Stops":

   "...Starting with the lowest value new tab stop, each tab stop is added to the list of current tabs. Numerical order is maintained. If more than 32 tab stops exist, the first 32 tab stops are retained and those above 32 are discarded."

10. The escape sequence TBC - Tabulation Clear was added to clear the horizontal and vertical tabs set by DECSHTS and DECSVTS. TBC is defined as follows:

    ESC [2 g
    033 133 062 147

    Clear all horizontal tab stops

    ESC [4 g
    033 133 064 147

    Clear all vertical tab stops

11. DEC action item: If no parameter value for TBC or if zero, what should the printer do ?

    DEC responce: The printer should ignore the escape sequence as if it were never seen.

12. Margins were defined as "hard" margins. That is, the active position can not be placed outside the margins. Variable thickness lines can be drawn outside the margins via the DECVEC - Draw Vector sequence.

13. The following statements have been added to the sections "DECSLRM - Set Left and Right Margins" and "DECSTBM - Set Top and Bottom Margins".

    "...Margins will be set exactly where the user has specified them."

    "...Margin setting will take affect when the sequence is received."

14. DECSLPP - Set Lines Per Physical Page, will reset margins per description.

15. Any text refering to "lines" in this document will be changed to verbage using "decipoints" as the measurement of spacing.

16. The DECFIN escape sequence will only toggle the offset. The offset can not be set directly to the "normal" position through software. This is done by device power-up.

17. RIS - Reset to Initial State, Will not print a "Job Summary Sheet".

18. DECSHTS - Set Horizontal Tab Stops

    The default tab stops for the landscape orientation is 1 tab stop every 8 characters.

19. DECSVTS - Set Vertical Tab Stops

    The default tab stops for the landscape orientation is 1 tab stop every line.

20. DEC and XEROX action item:

    Discuss superscript and subscript functions using PLU and PLD escape sequences.

21. XEROX action item:

    Jack Demcak will send information concerning the subscript and superscript functions.

22. XEROX action item:

    XEROX will verify that their binary encoding procedure is working properly.

The following notes have been transcribed from the Master Copy of the LN01 Functional Specification dated 23 April 1982. These

notes were taken during the LN01 technical negotiations with XEROX on April 25, 26 & 27.

1. The page listing the additional control characters and escape sequences for the LN01 serial version has been moved to the section of the document describing the serial version of the LN01.

2. In the section "Control Characters", the sentence:

   "...The printer shall ignore all other ASCII control characters."

   has been changed to:

   "...The parallel printer shall ignore all other ASCII control characters."

3. In the section "Control Characters" under "Shift Out", the phrase:

   "...the shift in character"

   has been changed to:

   "...the shift out character".

4. The mnemonic:

   "DECLFNT - Load Font"

   has been changed to:

   "DECLCS - Load Character Set"

5. The phrase "...excluding ";" (073 octal)" under "Comment Record" in "DECLCS - Load Character Set" has been deleted.

6. The font numbers in "DECLCS - Assign Character Set" have been changed from 1 through 8 to 10 through 17.

7. In the section "DECLCS Assign Character Set", the phrase:

   "...the printer will print a message on the "Job Summary Sheet."

   has been changed to:

   "...the printer will report the error on the "Job Summary Sheet."

8. A font number of "0" was used incorrectly when describing various details about the default rom in "DECLCS - Assign Character Set".

   The correct font number is "10".

9. In "DECLCS - Assign Character Set" the following statement has been deleted:

   "...Thus more than 8 fonts can be used on a page."

10. In DECSLPP - Set Lines per Physical Page, the phrase:

    "...Pn must be a decimal number that is 1 <= Pn <= TBS."

    has been changed to:

    "...Pn must be a decimal number that is Ø <= Pn <= TBS."

11. In the section "Horizontal and Vertical Position Movement", the following sentence has been deleted:

    "...These escape sequences set the active position regardless of the margins."

12. In the section "SGR - Underline", the sentence:

    "...All printable characters are underlined, including spaces. Tabs are not underlined."

    has been changed to:

    "...All printable characters are underlined, including spaces and tabs."

13. The following statements have been added to DECVEC - Draw Vector:

    The range of legal values when drawing an X line are 2 to 16. The range of legal values when drawing a Y line are 2 to 1Ø23. If a value is received that is less than 2, a value of 2 is used for drawing the line. If a value is received that is greater than 16 for X lines, a value of 16 is used for drawing the line. If a value is received that is greater than 1Ø23 for Y lines, a value of 1Ø23 is used for drawing the line.

14. The following changes have been made to "DECVEC - Draw Vector":

    1. The character overhead for all lines 512 pixels or smaller in length has changed from 11 top 13.

    2. The character overhead has changed from 8 to 9.

15. The complete section describing the "DECMON - Data Monitor Mode" has been deleted.

16. The escape sequence "RI - Reverse Index" has been deleted from the serial section.

17. The following locations have been added to the Font File:

    Underline, Distance
    Underline, Thickness
    Strike-Through, Distance
    Strike-Through, Thickness
    Superscript, Distance
    Subscript, Distance
    Part Number

18. The following typographical errors were discovered and corrected.

    1. The octal codes listed in Appendix A "MULTINATIONAL CHARACTER SET" were incorrect. They were listed from Ø41 octal to 176 octal. The correct values are from 241 octal to 376 octal.

    2. The ID listed for the octal code 351 was "LE13". The correct ID is "LE11".

2.0 CHANGES FROM LN01/XEROX TRIP, JULY 2, 1982

1. Imaging Length

   The following sentences have been added:

   "The maximum imaging length of the LN01 is 13.6533 inches. Therefore, when printing on 14-inch paper in landscape orientation, 13.6533 inches are available for printing from the left edge of the paper, leaving a .3467 inch border from the right edge of the paper. When printing on 14-inch paper in portrait orientation, 13.6533 inches are available for printing from the bottom edge of the paper, leaving a .3467 inch border from the top edge of the paper."

2. VT - Vertical Tab

   The following sentence has been added:

   "If there are no such tab stops, the vertical tab character is treated as a line feed."

3. DECSHTS - Set Horizontal Tabulation Stops

   The following sentence(s) have been added:

   "The numeric parameter(s) are expressed in units of decipoints. See the section on "Size Unit" for more detailed information."

4. JFY - Justify

   The following statements have been added:

   The following control characters and escape sequences determine the end of the line to be justified when justification is turned on.

   CR - Carriage Return
   LF - Line Feed
   VT - Vertical Tab
   HPA - Horizontal Position Absolute
   VPA - Vertical Position Absolute
   FF - Form Feed

5. JFY - Justify

   The following sentence has been added:

   If justification has been turned on and then off for only a portion of a text line, those space characters outside the start and stop justify sequence use the width of the space character.

6. SGR - Underline

   The following sentences have been added:

   The underline mode stays in effect across line and page boundaries.

7. SGR - Select Font

   The SGR sequence was incorrectly defined as having a non-selective parameter list. The mnemonic "Pn" has been changed to "Ps", indicating a selective parameter list.

8. TBC - Tabulation Clear

   The mnemonic "Ps" has been added to indicate that this sequence has a selective numeric parameter list.

9. JFY - Justify

   The mnemonic "Ps" has been added to indicate that this sequence has a selective numeric parameter list.

10. LNM - Line Feed New Line Mode

    The mnemonic "Ps" has been added to indicate that this sequence has a selective numeric parameter list.

11. SGR - Underline

    The mnemonic "Ps" has been added to indicate that this sequence has a selective numeric parameter list.

12. DECASFC - Automatic Sheet Feeder Control

    The mnemonic "Ps" has been added to indicate that this sequence has a selective numeric parameter list.

13. DECASFC - Automatic Sheet Feeder Control

    The following sentence:

    "Select a sheet from the top tray and enable alternate tray selection method."

    has been changed to:

    "enable alternate tray selection method."

14. DECFIN - Document Finishing

    The following sentences have been added:

    The default numeric parameter value is 0.

    No action occurs if this parameter value is received.

15. DECVEC - Draw Vector

The following sentences have been substituted for those in the "DECVEC - Draw Vector" section.
P5

This numeric parameter defines the thickness or width of the line. The minumum legal value for P5 is 2.

16. Default Values and States

1. DECFIN - Document Finishing

The following sentences have been added:

"Upon receipt of the RIS sequence the output stacker is set to the no-offset position."

The word "normal" has been changed to "no-offset".

2. Print Summary Sheet

The following sentence:

"Printing of the Job Summary Sheet is enabled."

has been changed to:

"Printing of the Job Summary Sheet is disabled."

3. Led Display

The following sentence:

"The operators Led Display is set to the value 1."

has been changed to:

Upon power-up the operators Led Display is set to "Ø1" ."

17. Fonts

The following section has been added:

The font name is decoded in the following manner:

X = "Xerox"

c = "Computer"

p = "Printing"

14 Indicates the pitch of the font

B Indicates a BOLD Font.

- A delimiter

L/P L = Landscape / P = Portrait

18. Origins and Absolute Positions

Many of the escape and control sequences in this document indicate absolute or relative positions or movement in terms of decipoints. These positions are numbered 1,2,3.. and so on. The upper-left hand corner of the paper is the origin and is numbered 1,1. Position number 1 is the very edge of the paper. An absolute position of zero or one are the same position.

19. DECLCS - Font Configuration Request

The escape sequence syntax shown for "DECLCS - Font Configuration Request" contained an extra ";" (semi-colon) after "P2". The extra semi-colon has been removed.

20. DECLCS - Font Configuration Report

The escape sequence syntax shown for "DECLCS - Font Configuration Report" contained an extra ";" (cemi-colon) after "P2". The extra semi-colon has been removed.

21. Control Characters in escape sequences

The following statements have been moved to the serial section of the LNØ1 specification.

"If a control character, other than ESC (escape), CAN (cancel), or SUB (substitute) is ent within an escape or control sequence, the printer performs the control characters function as if it were received before the sequence. The printer then continues to process the sequence."

22. PLU - Partial Line Up

The a section titled "PLU - Partial Line Up" has been created. The following are the sentences for that section:

ESC L
Ø33 114

Printing superscript characters is performed with the PLU escape sequence. The PLU sequence causes the active position to move up in the vertical direction a predefined distance. The distance moved up in the vertical direction is determined by the currently selected character set. See

the appendix titled "Font File" for more information. The PLD - Partial Line Down" sequence causes the active position to return to the previous baseline. Only one level of superscripting is permitted.

23. PLD - Partial Line Down

The a section titled "PLD - Partial Line Down" has been created. The following are the sentences for that section:

ESC K
033 113

Printing subscript characters is performed with the PLD escape sequence. The PLD sequence causes the active position to move down in the vertical direction a predefined distance. The distance moved down in the vertical direction is determined by the currently selected character set. See the appendix titled "Font File" for more information. The PLU - Partial Line Up" sequence causes the active position to return to the previous baseline. Only one level of subscripting is permitted.

24. Default Portrait Values

The following statements have been added and/or changed in the section titled "Default Values and States".

DECSHTS - Set Horizontal Tab Stops

All currently set tabs are cleared. Default tabs are set to one every .80 inches (or every 8 characters). The first horizontal tab stop is 1.05 inches (8 characters) from the default left margin. There are default tabs 10 tabs stops.

DECSVTS - Set Vertical Tab Stops

All currently tab stops are cleared. Default vertical tab stops are located every inches (or 1 line). The first vertical tab stop is located inches (1 line) from the top margin.

DECSTBM - Set Top and Bottom Margins

Portrait Margins:

Top Margin:
Bottom Margin:

DECSLRM - Set Left and Right Margins

Portrait Margins:

Left Margins: 000.0 mm (.25 inch)
Right Margins: 000.0 mm (.25 inch)

25. Setting Top and Bottom Margins

The following sentence:

"When the form length is changed, vertical margins are cleared; the top margin is set to zero and the bottom margin is set to the form length."

Has been changed to:

"When the form length is changed, vertical margins are cleared; the top margin is set to one and the bottom margin is set to the form length."

The following sentence:

"Top margin must be greater than or equal to zero."

Has been changed to:

"Top margin must be greater than or equal to one."

26. Numeric parameters, Section 10.0

The following sentence:

"Numeric parameters are limited to 16 per string."

has been changed to:

"Numeric parameters are limited to 8 per string."

3.0 CHANGES/ADDITIONS/CORRECTIONS FROM XEROX 2700 DOCUMENTATION.

1. DECLCS - Load Character Set

Once fonts are loaded into memory they remain available for printing until one of the following occurs:

1. New fonts are loaded.
2. On-line tests are run.
3. System power is shut off.

2. Margins

Margins may be set anywhere on the page. For example, a top margin could be set at position 1, which is the very edge of the paper. Due to the Xeroxgraphic process involved in creating an image on paper, images placed near the edge of the paper may not actually be printed. Therefore, the following minumim margins values are suggested for ensuring the image can be printed.

Landscape Margins:

Top Margin: .235 inch

Bottom Margin: .235 inch (measured from the bottom edge of the paper)

Left Margin: .118 inch

Right Margin: .118 inch (measured from the right edge of the paper)

Portrait Margins:

Top Margin: .118 inch

Bottom Margin: .118 inch (measured from the bottom edge of the paper)

Left Margin: .235 inch

Right Margin: .235 inch (measured from the right edge of the paper)

3. Job Summary Sheets

The LN01 has the ability to print Job Summary Sheets. These sheets can be requested via the DECLCS sequence. The JOB Summary Sheet provides information about the LN01 printer and the current status of the printer.

A job summary sheet contains the following information:

1. The type of communications interface. The word "PARALLEL" is printed here.

2. The type of input expected. The possibilities are "ASCII/7" and "ASCII/8". The "7" indicates 7-bit ASCII data is expected and the "8" indicates 8-bit ASCII data.

3. A list of the currently available fonts are listed. This list includes the rom based fonts and those loaded through the "DECLCS - Load Character Set" sequence.

4. A comment line specified in the "DECLCS - Load Character Set" sequence.

5. A Job Status. If there were no errors, then "NO ERRORS" is printed. If any errors occured as many as 10 error codes and their corresponding page numbers are listed. Only the last 10 errors encountered will be printed. (See below for a list of error codes and messages.)

6. The revision level of the LN01 printer software.

Revision Level A03XM

The users comment line is printed here.

Interface: PARALLEL

Data Encoding: ASCII/7

Fonts Available: Job Status: No erro

Xcp14-L 8762 bytes
Titan10-P 12422 bytes
Titan10B-P 12474 bytes

Figure 1 Sample of a Job Summary Sheet

NOTE: The layout of the above example Job Summary Sheet is not an exact reproduction of an actual Job Summary Sheet. The spacing has been reduced to show the entire contents of the Summary Sheet.

Error Codes and Messages

The following codes are printed on the Job Summary Sheet when an error occurs.

Font Load Jobs

11 The Font Load Job contained unrecognizable font(s).

12 The font information in the Font Load Job exceeded 28,ØØØ bytes of dynamic memory. Performance degradation is possible.

13 Fonts exceeding 38,ØØØ bytes were not loaded.

14 Fonts exceeding the 768 character limit were not loaded.
Print Jobs

2Ø An unknown instruction was encountered and ignored.

21 The page requires too much processing time, and thus is too complex to print.

22 The line extends beyond the right margin. A loss of data is possible.

23 The limit of 1Ø,ØØØ printable and control characters per page has been exceeded. Data will be loast if the page is too complex. Otherwise, excess data is printed on the following page.

24 There is an error in an instruction for drawing a line.

25 There is a possible duplicate page.

26 The Absolute Placement Instruction has a missing field.

Font Usage

4Ø A Font ID Command referenced a nonexistant (font-name). The assignment of this Font ID was ignored.

41 A font of different orientation from that used in composing the page was specified. (This causes a new page to begin.)

42 An unassigned Font ID index number was called out in the document. It was ignored.

45 Font ID Command syntax error: The Font ID index number was greater than 7. The font assignment was ignored.

4. Data Monitor Mode

The following new section has been created to describe the Data Monitor Mode.

The LNØ1 printer will print data received from the host system in hexidecimal when in the "Data Monitor Mode". A dip switch located on the printer controller board enables the "Data Monitor Mode". The dip switch is #5 on the interface board. When the dip switch is in the "OFF" position, the "Data Monitor Mode" is enabled. When the dip switch is in the "ON" position, the "Data Monitor Mode" is disabled. The dip switches are read by the firmware only at power-up time. Therefore the user must power down the device, set the dip switch in the desired position and then power up the printer. All data received from the host system is printed in hexadecimal. Control characters and escape sequences are not interpreted. They are printed in hex and do not control the printing operation.

```
02 1B 41 06 20 4E 4F 4E 54 52 41 4E 53 50 41 52
45 4E 54 20 54 45 58 54 03 03 1B 2B 46 06 03 10
02 AA AA 02 04 B0 15 4B 6F 73 6D 6F 73 36 2D 50
20 20 20 20 20 20 20 20 20 20 20 00 00 00 00 00
00 06 00 1A 00 1E 00 20 BD 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
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00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 02 00 20 06 FF 3D FD 0B 0F 00 22 06 FF 3C 00
08 16 00 32 06 FF 3D 06 0D 3C 00 48 06 FF 3C FF
15 27 00 84 06 FF 3C FE 0F 3C 00 AC 06 FF 3C FF
16 39 00 E8 06 FF 3C FF 14 0C 00 22 07 FF 3D 06
08 18 00 2E 07 FF 3C FE 0A 18 00 46 07 DD 3C FE
0A 1A 00 5E 07 FF 3D 04 10 10 1A 00 78 07 FF 3D
02 0F 0A 00 92 07 FF 3D FE 08 18 00 9C 07 FF 3D
04 0F 0C 00 B4 07 FF 3D 00 08 24 00 C0 07 FF 3C
FF 0C 27 00 E4 07 FF 3C FF 0F 1B 00 0C 08 FF 3C
00 0F 27 00 28 08 FF 3C 00 0F 27 00 50 08 FF 3C
FF 0F 27 00 78 08 FF 3C 00 0F 27 00 A0 08 FF 3C
FF 0F 2A 00 C8 08 FF 3C FF 0F 27 00 F2 08 FF 3C
00 0F 27 00 1A 09 FF 3C FF 0F 27 00 42 09 FF 3C
FF 0F 10 17 10 02 0A 00 6A 09 FF 3D 00 08 0F 00
74 09 FF 3C FE 08 2C 00 84 09 FF 3D 01 1A 18 00
B0 09 FF 3D 03 0F 2E 00 C8 09 FF 3D 01 1A 21 00
```

5. Minumum's and Maximum's

The following is a list of minumum and maximum values for the LN01 printer. These values are based on the latest information available on the current firmware implementation.

NOTE: These values may increase or decrease if any changes are made to the firmware.

1. Functions per line

The LN01 printer has a maximum limit of 16 functions per line. These functions are comprised of "DECLCS - Select Character Set", PLU - Partial Line Up", and "PLD - Partial Line Down". When any of these functions are immediately adjacent, they are counted as one.

2. Maximum Line Length

The maximum line length is 185 characters.

The horizontal tab character consumes 3 characters.

3. Characters per Page

A page may contain up to 1Ø,ØØØ printable characters.

1. A line of text requires 7 characters.
2. A horizontal tab character consumes 3 characters.
3. A line drawn (using "DECVEC - Draw Vector") parallel to the X axis consumes 13 characters.
4. A line drawn (using "DECVEC - Draw Vector") parallel to the Y axis comsumes 13 characters for the first 512 pixels and 9 characters for each additional 512 pixels (or portion thereof).

4. Lines Per Page

A page may contain up to 2ØØ lines.

1. A subscript or superscript consumes 1 line.
2. A line drawn by "DECVEC - Draw Vector" consumes 1 line.

5. SGR - Underline

A maximum number of 16 underline segments can be used for a text line. An underline segment is defined from the start of underlining to the end of underlining. For example, if underlining is started and stopped such as to underline a single word, a maximum of 16 words could be underlined in a single text line.

4.0 CLARIFICATIONS, 7-SEP-82

The following describes several clarifications that have been made to the LN01 Functional Specification.

4.1 Clarifications Based On Bruno Vieri's Request

Please see Brian Manser's memo dated ??-AUG-82.

1. "SSU - Select Size Unit"

   The following escape sequence has been added to the LN01 Functional Specification.

   SSU - Select Size Unit

   ESC [Ps SP I
   033 133 *** 040 111

   SSU establishes the unit in which the numeric parameters of selected escape sequences in this functional specification are interpreted. The unit established remains effective until the occurrence of another SSU in the data stream.

   The parameter values are:

Ps	Size Unit
2	Decipoint (1/720 inch)
7	Pixel

   The default numeric parameter value is 0.

   Numeric parameter values other than 2 or 7 are illegal.

   The SSU sequences affects the numeric parameters in the following escape sequences:

   DECSHTS
   DECSVTS
   DECSLPP
   DECSTBM
   DECSLRM
   HPA
   HPR
   VPA

VPR
DECVEC

2. "VT - Vertical Tab"

A request was made by Xerox to have the Vertical Tab perform a form feed if no tab stops exist after the active position. The action performed by the Vertical Tab shall remain the same. That is, the Vertical Tab shall perform a line feed action if no tab stops exist after the active position.

4.2 Clarification On The Portrait Rom Font

1. Font Name

In "FONTS" the font name "Xcp10-P" for the portrait font

Has been changed to:

"Kosmos10-P"

4.3 Serial Interface

1. All references to escape sequences and character processing for the serial interface have been removed.

2. The title "APPENDIX B" has been changed to "APPENDIX A".

4.4 Typographical Corrections

1. PLU - Partial Line Up

The octal code for the final character in this escape sequence was incorrectly specified as 144. The correct value is 113 octal.

2. TBC - Tabulation Clear

The LNØ1 Functional Specification lists two numeric parameters for TBC as 2 and 4. The numeric parameter 2 should be 3. The function for numeric parameter 2 states: "Clear all Horizontal Tab Stops at the active line". This should read, "Clear all horizontal tab stops".

The corrected sequence is as follows:

TBC - Tabulation Clear

ESC [3 g
Ø33 133 Ø63 147

Clear all horizontal tab stops.

5.0 SELECTIVE/NON-SELECTIVE PARAMETER TABLE LISTING

Mnemonic	Selective/ Non-Selective
DECLCS	Non-Selective
SGR	Selective
DECSHTS	Non-Selective
DECSVTS	Non-Selective
TBC	Selective
DECSLPP	Non-Selective
DECSTBM	Non-Selective
DECSLRM	Non-Selective
HPA	Non-Selective
HPR	Non-Selective
VPA	Non-Selective
VPR	Non-Selective
JFY	Selective
SGR	Selective
DECASFC	Selective
LNM	Selective
DECFIN	Selective
DECVEC	Non-Selective
RIS	Not Applicable
PLU	Not-Applicable
PLD	Not-Applicable
IND	Not-Applicable
NEL	Not-Applicable
SPI	Non-Selective

6.0 INTRODUCTION

This document describes character processing and escape sequences for the LN01 printer.

6.1 LNØ1 Parallel Character Processing

The following is the set of control functions for the LNØ1 Parallel Interface.

CR - Carriage Return
FF - Form Feed
HT - Horizontal Tab
LF - Line Feed
VT - Vertical Tab
SI - Shift In
SO - Shift Out
NUL - Null
DEL - Delete
ESC - Escape
DECLCS - Load Character Set
DECLCS - Character Set Assignment
SGR - Select Font
DECSHTS - Horizontal Tabulation Set
DECSVTS - Set Vertical Tabulation Stops
DECSLPP - Set Lines Per Physical Page
DECSTBM - Set Top and Bottom Margins
DECSLRM - Set Left and Right Margins
HPA - Horizontal Position Absolute
HPR - Horizontal Position Relative
VPA - Vertical Position Absolute
VPR - Vertical Position Relative
JFY - Justify
SGR - Underline
DECASFC - Automatic Sheet Feeder Control
LNM - Line Feed New Line Mode
DECFIN - Document Finishing
DECVEC - Draw Vector
RIS - Reset to Initial State

7.0 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent referenced herein.

- ANSI X3.4-1977 - American National Standard Code for Information Interchange
- ANSI X3.41-1974 - Code extension techniques for use with the 7-bit coded character set of american national standard code for information interchange
- ANSI X3.64-1979 - Additional controls for use with american national standard code for information interchange
- DEC EK-VT100-UG-002 - VT100 User Guide
- ISO 6937 - Coded Character Sets for Text Communication (Draft International Standard)
- XP-12E LOW SPEED ELECTRONIC PRINTER SYSTEM PERFORMANCE SPECIFICATION

8.Ø EQUIVALENCE OF 7-BIT AND 8-BIT CHARACTERS

Character processing is described in this document in terms of 7-bit characters. The printer shall recognize the following equivalence of 7-bit and 8-bit characters:

1. In an 8-bit environment, received shift in and shift out control characters shall have no effect. The low order seven bits of the character shall determine whether the character is printable or is a control character. The eighth bit of printable characters shall specify the character set as follows:

Eighth Bit	Character Set
Ø	GL
1	GR

2. In an 8-bit environment, the eighth bit of characters after the escape character in an escape or control sequence shall be ignored. The remaining seven bits shall determine the interpretation of the character.

9.0 CHARACTER PROCESSING

The printer processes characters according to American National Standards Institute (ANSI) standards X3.64-1979, X3.4-1977 and X3.41-1977. The ANSI system of character processing is based on categories of characters in the American National Standard Code for Information Interchange (ASCII) chart. A character's category is determined by its position in the ASCII chart.

The charts' characters can be divided into two general categories, graphic characters and control characters. In the eight column ASCII chart, columns zero and one show the control characters. The rest of the chart contains printable characters (except for SP and DEL). SP (space) and DEL (delete) are always the same control characters regardless of the character set selected.

NOTE: SP can be considered either an information separator control character or a printable character. It can be considered a printable character because it takes up space both in the printer memory, and on the paper when printed.

9.1 Space Character

The space character's width is determined by the currently selected font.

10.0 CONTROL CHARACTERS

A control character is a single character control function used to control character processing. Control characters are not printed.

The printer responds to the control characters listed in Table 1. Table 1 also lists each control character's mnemonic, and function when operating in text mode. All other control characters received by the printer cause no action.

NOTE: Each control function listed in this functional specification has a mnemonic. The mnemonic is an abbreviation of the control function name.

Table 1

Printer Control Functions:

Octal Code	Mnemonic	Function
011	HT	Horizontal Tab
012	LF	Line Feed
013	VT	Vertical Tab
014	FF	Form Feed
015	CR	Carriage Return

Character Set Control Functions:

Octal Code	Mnemonic	Function
016	SO	Shift Out
017	SI	Shift In

Communication Control Functions:

Octal Code	Mnemonic	Function
000	NUL	Null
033	ESC	Escape
177	DEL	Delete

The parallel printer shall ignore all other ASCII control characters.

10.1 Backspace

The LNØ1 printer ignores the Backspace Space (Ø1Ø octal) character.

10.2 Carriage Return

The carriage return causes the active column to be moved to the left margin.

10.3 Form Feed

The form feed character advances the active line to the top margin of the next page and sets the active position to the first character position of the first line. This causes the current page buffer to be printed.

10.4 Horizontal Tab

The horizontal tab character advances the active position to the next horizontal tab stop greater than the current active position but no greater than the right margin. If there are no such tab stops, the horizontal tab character is treated as a space character.

See the section titled "Default Values and States" for a description of the default Horizontal Tab Stops.
Tab stops are defined by using the DECSHTS escape sequence.

10.5 Line Feed

The line feed character increments the active line, unless the active line is at the bottom margin, in which case it sets the active line to the top margin of the next page. If linefeed newline mode (LNM) is enabled, the active column is set to the left margin.

10.6 Vertical Tab

The vertical tab character advances the active line to the next vertical tab stop greater than the current active line but no greater than the bottom margin. The active column remains unchanged. If there are no such tab stops, the vertical tab character is treated as a line feed. Vertical tab stops are defined with the DECSVTS and VTS escape sequences.

See the section titled "Default Values and States" for a description of default Vertical Tab Stops.

10.7 Shift In (SI)

In a 7-bit environment, the shift in character when received shifts the printer to the GL character set.

10.8 Shift Out (SO)

In a 7-bit environment, the shift out character when received shifts the printer to the GR character set.

10.9 Null And Delete

The null and delete characters cause no operation in the printer. These characters must be stripped from the data stream upon reception without occupying space in the input buffer.

10.10 Escape

The escape character introduces an escape sequence.

11.0 ESCAPE AND CONTROL SEQUENCES

Escape and Control Sequences

Escape and control sequences are used to provide additional controls not provided by the control characters in the character set. These sequences are multiple character control functions used to control character printing and processing. They are not printed. Escape and control sequences are defined in ANSI standards X3.41 -- 1977 and X3.64 -- 1979.

The characters used in escape and control sequences throughout this functional specification are shown (but not defined) using the ASCII character set. The case of the characters used in a sequence is significant and must be sent to the printer exactly as shown. These characters are spaced apart for clarity only. The octal equivalent of each sequence is provided as the main reference in this document.

Escape Sequence Format

The format of an escape sequence is as follows.

```
ESC          I...I              F
033        040 -- 057       060 -- 176
 |           |                 |
Escape      Intermediate     Final
sequence     characters      character
introducer  (any number of   (one character)
            characters --
            zero or more)
```

The escape sequence introducer is the ESC control character (octal 033). When the ESC character is received, the next characters received are not printed, but stored, to be used as part of the sequence.

If the characters received after the ESC character are in the 040 -- 057 octal range they are intermediate characters. These characters are stored as part of the sequence.

If the character received after the ESC character is in the 060 -- 176 octal range, it is a final character. Final characters in the 100 -- 176 octal range are reserved for standard ANSI use. Final characters in the 060 -- 077 octal range are reserved for private use.

The final character indicates the end of the escape sequence. The intermediate and final characters together define the function of the sequence. The printer performs the action specified by the sequence, then continues to print data.

Example

The following sequence is used to designate the ASCII character set as GL.

```
Escape sequence introducer
 |   Intermediate character
 |   |   Final character
 |   |   |
ESC  (   B
033 050 102
```

Control Sequence Format

The format of a printer control sequence is as follows.

ESC	[	P.....P	F
033	133	060 -- 077	100 -- 176
Control sequence introducer		Parameter (zero or more characters)	Final (one character)

The control sequence introducer (CSI) consists of the ESC (octal 033) and [(octal 133) characters. It is used to gain the extended functionality of the 8-bit environment while using 7-bit characters. After the CSI character(s) are received, characters received are not printed, but stored for use as part of the sequence.

If the characters received after the CSI character(s) are in the 060 -- 077 octal range, the characters are parameter characters. A parameter character modifies the action or interpretation of the sequence.

Parameters are interpreted as unsigned decimal integers, with the most significant digit transmitted first. Leading zeros are allowed but not necessary. Each parameter in a group of numeric parameters is separated by the delimiter ";" (octal 073).

If no decimal value is specified for a parameter character in a sequence sent to the printer, a zero value is assumed for the parameter. The limit for a numeric parameter is TBS (decimal). Numeric parameters are limited to 8 per string.

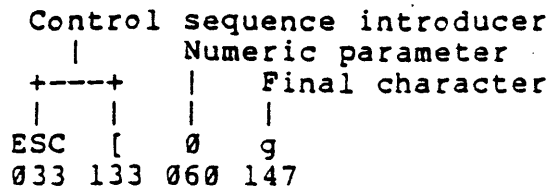
In this functional specification, parameters are shown as actual values or are designated as Pn, Pn1, Pn2, etc. In the octal representation of the sequences, parameter characters are shown as three asteriks (***).

NOTE: If the ? character (octal 077) occurs at the beginning of a string of parameters, the control sequence is processed as a DIGITAL private sequence.

If the character received after the CSI character(s) is in the 100 -- 176 octal range, it is a final character. Final characters in the 100 -- 157 octal range are reserved for standard ANSI use. Final characters in the 160 -- 176 octal octal range are reserved for private use. The final character indicates the end of a control sequence. The intermediate and final characters together define the function of the sequence. The printer performs the action specified by the sequence, then continues to print data.

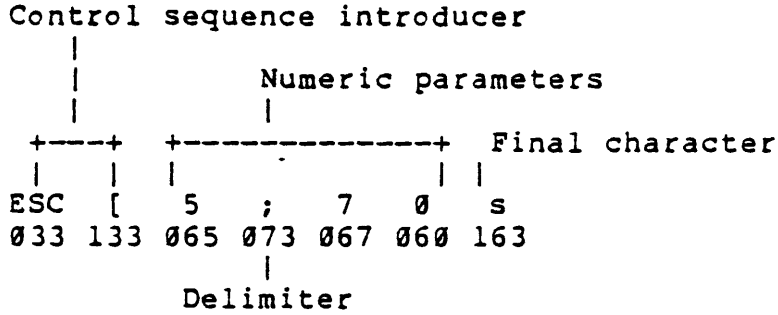
Example

The following sequence is used to clear the horizontal tab stop at the active position.



Example

The following sequence is used to set the left margin to column 5 and the right margin to column 70.



Error Recovery

The printer usually recovers from control function errors by performing as much of the function as possible. Errors include invalid control functions, control characters embedded in escape or control sequences, and parameters out of range. The following specific error recovery techniques are used by the printer.

- A control function not recognized by the printer is ignored.
- Unsupported control functions (valid control functions not listed in this functional specification) are ignored.

11.1 Fonts

DECLCS - Load Character Set

```
ESC  P  P1   ;  P2   ;  P3   y
Ø33 12Ø *** Ø73 *** Ø73 *** 171

          "Font Record"  ;  "Comment Record" ESC  \
          ************ Ø73 **************** Ø33 134
```

The DECLCS - Load Character Set escape sequence writes the new font information over the current contents of the font memory. All previous font information is lost. This includes all font bitmap data and all font assignments. The default landscape font is then assigned to font number 1Ø. The user must load all fonts required for a print job in one DECLCS.

The LNØ1 printer will allow the loading of a font with a name identical to the default fonts. During a font assignment, if a loaded font exists that has an identical name as one of the default fonts, the assignment is made to the loaded font.

P1 - Identification Number

This parameter is the LNØ1 identification number. The numeric value must be 1.

The whole escape sequence is ignored, if the numeric value is other than a 1.

P2 - Function Code

Parameter #2 indicates the function to be performed. A parameter value of 1 indicates a font load.

The entire escape sequence is ignored, if the numeric value is other than a 1 or 2.

P3 - Job Summary Sheet

Parameter #3 indicates whether a Job Summary Sheet should be printed or not.

P3	Action
Ø	Print Summary Sheet
1	Do not print Summary Sheet

When an error is detected by the device, a summary sheet is printed, whether printing of the sheet is enabled or disabled.

The entire escape sequence is ignored, if the numeric value is other than a 0 or 1.

Font Record

Font data is transmitted to the device by a font record. The DCS string introducer indicates the beginning of a font record and the DCS string terminator marks the end of the font record.

The font record essentially consists of binary data which has been converted to sixels. See appendix A for a complete description of how binary data is encoded into sixels.

Within the font record the device must be capable of accepting the carriage return and line feed characters (015 octal and 012 octal). These characters, upon being detected by the device, should be discarded with no error condition flagged.

Comment Record

The LN01 will print a "Job Summary Sheet", when the user has selected this option through parameter #3 or when an error occurs. On this "Job Summary Sheet" a comment record can be printed. The comment record is a line of user supplied text. This text may consist of ASCII characters from " " (040 octal) to "~" (176 octal). The maximum number of characters permitted in the comment record is 132 decimal.

The comment record follows the font record in the DECLCS - Load Character Set sequence and they are separated by the semi-colon character (";", 073 octal). The comment record is an optional parameter. When printing of the "Job Summary Sheet" is selected and no comment record is supplied, the "Job Summary Sheet" is printed with blanks where the comment record text would be. When the LN01 receives a DECLCS - Load Character Set sequence which selects no printing of the "Job Summary Sheet" and contains a comment record, The "Job Summary Sheet" is not printed (unless an error occurs) and the comment record is discarded.

Once fonts are loaded into memory they remain available for printing until one of the following occurs:

1. New fonts are loaded.

2. On-line tests are run.

3. System power is shut off.

11.2 Fonts

DECLCS - Assign Character Set

```
ESC  P  P1   ;  P2   ;  P3   y
033 120 *** 073 *** 073 *** 171

                "Font Name" ESC  \
                ********** 033 134
```

The DECLCS - Assign Character Set escape sequence assigns a number to a font name. Once this assignment is made, the SGR "Select Font" escape sequence can be used to invoke the font for printing.

P1 - Identification Number

This parameter is the LN01 identification number. The numeric value must be 1.

P2 - Function Code

Parameter #2 indicates the function to be performed. A parameter value of 2 indicates a font assignment.

The entire escape sequence is ignored, if the numeric value is other than a 1 or 2.

P3 - Font number

Parameter #3 is the font number to be assigned to the font name.

P3	Font concerned
10	primary (default) font
11	first alternative font
12	second alternative font
13	third alternative font
14	fourth alternative font
15	fifth alternative font
16	sixth alternative font
17	seventh alternative font

Font numbers range from 10 to 17.

Font Name

The font name to which the font number (parameter #2) should be assigned. Maximum of 20 ASCII characters is permitted.

Font Assignment

To select fonts for printing, the font name must be assigned to a font number. The font assignment sequence assigns or associates a font name to a font number. The user may then send a SGR - Select Font sequence to the printer to invoke the font for printing.

The font name for each font is loaded with the each font. See the section titled "Fonts" for the names of the rom resident fonts.

If a font assignment is received referencing a font name which does not exist in any fonts which are currently loaded in the printer, the font assignment sequence is ignored. When this happens, the printer will report the error on the "Job Summary Sheet".

If a font assignment is received which uses a font number that currently has a font name assigned to it, the current assignment is discarded and the new font name is assigned to the font number.

The LN01 will allow the loading of a font with a name identical to the rom resident fonts. When the user attempts to assign the font name to a font number with a name identical to one of the default fonts, the RAM or user loaded font takes precedence.

A font name may be assigned to multiple font numbers.

The user may assign the rom resident font to any font number. The user may also assign other font names to font number 10.

Up to 8 font assignments can be made at one time. Font assignments can occur any where in the data stream.

Upon device power-up and after the RIS sequence, the rom resident landscape font is assigned to font number 10, the primary or default font. If no font assignments are made, all pages are printed in the landscape orientation using the LN01's rom resident landscape font. The default font is located in the LN01's resident rom.

All font assignments are discarded during a font load sequence and when the RIS sequence is sent to the printer. The rom resident landscape font is then assigned to font number 10.

Syntax errors discovered in a font assignment sequence will cause the assignment to be ignored and a message will be printed on the "Job Summary Sheet".

11.3 Selecting Fonts

SGR - Select Font

```
ESC  [  Ps   m
033 133 *** 155
```

The SGR Select Font escape sequence invokes a font for printing. Font numbers are assigned to font names via the DECLCS - Assign Character Set escape sequence.

10	primary (default) font
11	first alternative font
12	second alternative font
13	third alternative font
14	fourth alternative font
15	fifth alternative font
16	sixth alternative font
17	seventh alternative font

SGR parameters in the range of 10 (061,060 octal) to 17 (061,067 octal) select logical fonts 1 through 8 for printing. See "Font assignment" for logical font assignment.

Fonts may be invoked anywhere in the data stream using the Select Font sequence. The selected font remains in effect until another SGR sequence or the RIS sequence is sent.

Upon power-up and after the RIS - Reset to Initial State sequence, the rom resident landscape font is assigned to font number 10. The rom resident landscape font is selected for printing if no other fonts have been invoked.

The SGR - Select Font sequence is ignored if no font name has been assigned to the font number. This occurrence will be printed on the "Job Summary Sheet".

Each page must be printed in either landscape or portrait orientation. Orientation can not be mixed within one page. If a font select is received for a font which is of an orientation which is opposite to that currently being used,

then printing stops on the current page, and starts on the next page in the new orientation.

Note: The default parameter value for this sequence is zero (Ø).

11.4 Setting Horizontal Tabulation Stops

A horizontal tab is a preselected point on a line to which the active position advances when a horizontal tab control character is received. The printer has 32 possible horizontal tab stops. Each stop may be set independently. Setting a stop already set has no effect; the same is true for clearing a stop already cleared. Tab stops may be set or cleared regardless of margins. See "Default Values and States" for a description of the default horizontal Tabulation Stops.

DECSHTS - Set Horizontal Tabulation Stops

ESC [Pn ; ... ; Pn u
Ø33 133 *** Ø73 ... Ø73 *** 165

This control sequence has a variable number of numeric parameters. The maximum number of numeric parameters is 8. Numeric parameters may appear in any order in the escape sequence.

Starting with the lowest value new tab stop, tab stop values are inserted into the current tab stop list. If more than 32 tab stops now exist, the first 32 tab stops are retained, while the highest value tab stops are discarded.

Horizontal tabs will be set at the positions indicated. Tabulation stops are set to the corresponding absolute position of all lines. The numeric parameter(s) are expressed in units of decipoints. See the section on "Size Unit" for more detailed information.

11.5 Setting Vertical Tabulation Stops

A vertical tab is a preselected line to which the active line advances when a vertical tab control character is received. The printer has 32 possible vertical tab positions. Vertical tabs may be set like horizontal tabs. Vertical tab stops may be set or cleared regardless of margins. See "Default Values and States" for a description of the default Vertical Tabulation Stops.

DECSVTS - Set Vertical Tabulation Stops

```
ESC  [  Pn   ;  ...  ;  Pn   v
033 133 *** 073 ... 073 *** 166
```

This control sequence has a variable number of numeric parameters. The maximum number of numeric parameter permitted is 8. Numeric parameters may appear in any order in the escape sequence.

Starting with the lowest value new tab stop, tab stop values are inserted into the current tab stop list. If more than 32 tab stops now exist, the first 32 tab stops are retained, while the highest value tab stops are discarded.

Vertical tab stops will be set at the positions indicated. The numeric parameter(s) are expressed in units of decipoints. See the section on "Size Unit" for more detailed information.

11.6 Clearing Tab Stops

TBC - Tabulation Clear

```
ESC  [  Ps   g
033 133 *** 147
```

Clear the tab stops as indicated by Ps.

```
ESC  [   3   g
033 133 063 147
```

```
CSI  3   g
233 063 147
```

Clear all horizontal tab stops.

```
ESC  [   4   g
033 133 064 147
```

```
CSI  4   g
233 064 147
```

Clear all vertical tab stops.

The default value is 0.

NOTE: If no numeric parameter is detected, or if the numeric parameter is other than 2 or 4, then the escape sequence is ignored.

11.7 Set Lines Per Physical Page

DECSLPP - Set Lines per Physical Page

```
ESC  [  Pn   t
Ø33 133 *** 164
```

Set form length to Pn decipoints. Pn must be a decimal number that is Ø <= Pn <= TBS. Set top margin to 1. Set bottom margin to Pn decipoints.

See "Default Values and States" for a description of the default values for the DECSLPP sequence.

The numeric parameter(s) are expressed in units of decipoints. See the section on "Size Unit" for a more detailed description.

11.8 Set Top And Bottom Margins

The top vertical margin specifies the first printable line; the bottom vertical margin specifies the last printable line. Printing is allowed only on the lines between the top and bottom margins inclusive.
Margins are defined as hard margins. That is, the active position may not be placed outside the margins. The escape sequence DECVEC - Draw Vector is permitted to draw lines outside the margins.

Margin setting will take effect when the sequence is received.

Margins will be set exactly where the user specifies them.

When the form length is changed, vertical margins are cleared; the top margin is set to one and the bottom margin is set to the form length. The following conditions must exist to set new vertical margins.

- Top margin must be greater than or equal to one

- Bottom margin must be greater than or equal to the top margin
- Form length must be greater than or equal to the bottom margin

Attempting to print above the top margin or below the bottom margin automatically advances the active line to the top margin of the next page. For example, a line feed (LF) received at the bottom margin causes the printer to perform a form feed.

The set vertical margins sequence, accompanied by two parameters, set the top and bottom margins. If both parameters are not zero and the first is the smaller of the two, the top margin is set to the first parameter and the bottom is set to the second. Then the active line may be repositioned to the new top margin depending on the current line position and printer activity.

The sequence is ignored if the first parameter is greater than or equal to the second parameter. The sequence is also ignored if one of the specified parameters would set the bottom margin past the assigned form length.

If the first parameter in the sequence is omitted, the remaining parameter sets the bottom margin to the specified line. If an attempt is made to set the bottom margin above the top margin, the sequence is ignored.

If the second parameter in the sequence is omitted, the first parameter sets the top margin to the specified line. If an attempt is made to set the top margin below the bottom margin, the sequence is ignored. If the active line is less than the new top margin, it is set to the new top margin.

If both parameters are set to zero or omitted the margins are unchanged. See the section titled "Default Values and States" for the default margin settings.

DECSTBM - Set Top and Bottom Margins

```
ESC  [  Pn   ;  Pm   r
033 133 *** 073 *** 162
```

The top margin is set to decipoint n, and the bottom margin is set to decipoint m. If the first parameter is greater than the second parameter, the command is ignored.

Whenever the active line is less than the new top margin or greater than the new bottom margin, the active line is set to the top margin. This is equivalent to performing a form feed. Note that this may not cause a page to be printed.

The numeric paramter(s) are expressed in units of decipoints. See the section on "Size Unit" for a more detailed description.

11.9 Set Left And Right Margins

The left horizontal margin specifies the first printable column on a line; the right horizontal margin specifies the last printable column on a line. Printing is permitted only within the left and right margins inclusive.
Margins are defined as hard margins. That is, the active position may not be placed outside the margins. The escape sequence DECVEC - Draw Vector is permitted to draw lines outside the margins.

Margin setting will take effect when the sequence is received.

Margins will be set exactly where the user specifies them to be.

The set horizontal margins sequence when accompanied by two parameters, sets the left and right margins. If both parameters are not zero, and the first is the smaller of the two, the left margin is set to the first specified parameter and the right margin is set to the second. The active column is then repositioned to the new left margin.

The sequence is ignored if the first parameter is greater than or equal to the second parameter. The sequence is also ignored if one of the specified parameters would set the right margin further right than TBS inches.

If the first parameter in the sequence is omitted, the remaining parameter sets the right margin to the specified value. If an attempt is made to set the right margin to the left of the left margin, the sequence is ignored.

If the second parameter in the sequence is omitted, the first parameter sets the left margin to the specified value. If an attempt is made to set the left margin to the right of the right margin, the sequence is ignored. If the active column is less than the new left margin, it is set to the new left margin and the active column is repositioned.

If both parameters are zero or omitted, the margins are unchanged. See the section titled "Default Values and States" for the default margin settings.

DECSLRM - Set Left and Right Margins

ESC	[	Pn	;	Pm	s
033	133	***	073	***	163

The left margin is set to n, and the right margin is set to m.

When the active column is less than the new left margin, the active column is advanced to the left margin.

The numeric parameter(s) are expressed in units of decipoints. See the section on "Size Unit" for a more detailed description.

11.10 Horizontal And Vertical Position Movement

The escape sequences, HPA, VPA, HPR and VPR allow the user to set the active position to an absolute location on the paper. If an attempt is made to move the active position via VPA or VPR past the bottom of the paper, the active position stops at the bottom.

11.11 Horizontal Position Movement

HPA - Horizontal Position Absolute

```
ESC  [  Pn   `
033 133 *** 140
```

HPA causes the active position to be moved to the n-th horizontal position of the active vertical position. If an attempt is made to move the active position past the last position on the line, the active position stops at the last position on the line.

The numeric parameter(s) are expressed in units of decipoints. See the section on "Size Unit" for a more detailed description.

The default value is 1.

HPR - Horizontal Position Relative

```
ESC  [  Pn   a
033 133 *** 141
```

HPR causes the active position to be moved to the n-th following horizontal position on the active vertical position. The new active horizontal position is computed by adding Pn to the active horizontal position

value. If an attempt is made to move the active horizontal position past the last position on the line, the active position stops at the last position on the line.

The numeric parameter(s) are expressed in units of decipoints. See the section on "Size Unit" for a more detailed description.

The default value is 1.

11.12 Vertical Position Movement

VPA - Vertical Position Absolute

ESC [Pn d
Ø33 133 *** 144

VPA causes the active position to be moved to the corresponding horizontal position at vertical position n. If an attempt is made to move the active position below the bottom vertical positon, the active position stops on the bottom.

The numeric parameter(s) are expressed in units of decipoints. See the section on "Size Unit" for a more detailed description.

The default value is 1.

VPR - Vertical Position Relative

ESC [Pn e
Ø33 133 *** 145

VPR causes the active position to be moved to the corresponding horizontal position at the n-th following vertical position. If an attempt is made to move the active position below the bottom line, the active position stops on the bottom. The new active vertical position is computed by adding Pn to the current active vertical position.

The numeric parameter(s) are expressed in units of decipoints. See the section on "Size Unit" for a more detailed description.

The default value is 1.

11.13 Justify

JFY - Justify

```
ESC  [   Ps  SP   F
033 133  *** 040 106
```

Perform the justification action as indicated by Ps.

```
ESC  [   0  SP   F
033 133 060 040 106
```

Indicates the end of the string to be justified.

```
ESC  [   2  SP   F
033 133 062 040 106
```

Indicates the beginning of a string of character positions, the contents of which are to be justified. Justification is performed on an interword basis.

The LN01 printer justifies text lines within the currently defined left and right margins by varying the spacing between words. The LN01 does not determine the end of line nor does it make hyphenation decisions. Interword spacing within a line of text is adjusted such that the first character of the first word starts on the left margin, the last character of the last word ends on the right margin. The space between words of the justified text line is evenly distributed.

The minimum and maximum distance between words will not be less than 60% nor greater than 200% of the width of the space character in the font from which the words' characters are derived. A line of text will not be justified if the maximum or minimum space size restrictions cannot be honored.

The justification operation will be performed on all text which occurs between a start of justification and end of justification sequence.

A start justify sequence detected within the line defines the left justification point for that line, and a stop justify sequence detected within a line defines the right justification point for that line. To justify a line of text according to the left and right margins, the start and stop justify sequences must encompass the line beginning and end points.

The following control characters and escape sequences determine the end of the line to be justified when justification is turned on.

CR - Carriage Return

LF - Line Feed

VT - Vertical Tab

HPA - Horizontal Position Absolute

VPA - Vertical Position Absolute

FF - Form Feed

If justification has been turned on then off for only a portion of a text line, those space characters outside the start and stop justify sequence use the width of the space character.

The default value is 0.

11.14 Underlining

SGR - Select Graphics Rendition, Underline

```
ESC  [  Ps   m
033 133 *** 155
```

A set of functions are selected/deselected according to the Ps numeric parameter list.

```
ESC  [   4   m
033 133 064 155
```

Causes underlining to begin. All printable characters are underlined, including spaces and tabs. Underlining remains in effect until one of the following escape sequences are seen.

```
ESC  [   0   m
033 133 060 155
```

Turns underlining off.

```
ESC  [   2   4   m
033 133 062 064 155
```

Turns underlining off.

The default is no underlining.

The underline mode stays in effect across line and page boundaries.

11.15 Paper Selection

DECASFC - Automatic Sheet Feeder Control

ESC	[	Ps	!	v
033	133	***	041	166

The LN01 printer contains two paper trays. These are called the top tray and the bottom tray. The user has the ability to select either tray, from which paper is used for printing. The LN01 printer defaults to alternate usage of the top and bottom trays, starting with the top tray. When one tray becomes empty, the other tray is automatically selected. The user can explicitly select a tray by sending the DECASFC escape sequence. Explicit selection disables the alternate tray selection method of operation. When an explicitly selected tray becomes empty, the LN01 printer waits indefinately for the operator to fill the tray before proceeding.

To re-enable cycling through the paper trays, a parameter value of 0 should be issued. Selection of paper begins at the top tray.

The last DECASFC escape sequence received prior to the completion of page composition determines the paper source for the printing of that page.

Pn	means
0	enable alternate tray selection method.
1	select a sheet from the top tray.
2	select a sheet from the bottom tray.

The default value is 0.

11.16 Line Feed New Line Mode

Line feed new line mode defines the line feed control character's function. When this mode is DISABLED, and the line feed control character (LF) is received, the printer increments the active line. If this mode is ENABLED, when the LF character is received it returns the active column to the left margin in addition to the usual functions.

LNM - New line mode

```
ESC  [  Ps   l
033 133 *** 154
```

This sequence disables several modes as indicated by Ps.

```
ESC  [   2   0   l          (DISABLED)
033 133 062 060 154
```

Causes only vertical movement of the active position when a line feed character is received.

```
ESC  [  Ps   l
033 133 *** 154
```

This sequence enables several modes as indicated by Ps.

```
ESC  [   2   0   h          (ENABLED)
033 133 062 060 150
```

When a line feed character is received causes the active position to be moved to the left margin of the next line.

The default is New Line Mode ENABLED.

11.17 Document Finishing

DECFIN - Document Finishing

```
ESC  [  Ps   !   }
033 133 *** 041 175
```

DECFIN is a document finishing specifier which defines one or more operations to be performed with sheets of paper as they are printed or with complete documents.

The LN01 has the ability to deliver documents to the output tray in a "no-offset" or "offset" position. Upon device power-up the printer will deliver printed sheets to the output tray in a single stack, i.e., the

"no-offset" position. The user may control the offset by sending the DECFIN escape sequence. DECFIN toggles the paper offset from the current position to the alternate position. The offset remains in effect until it is explicitly changed. The paper offset is reset to the default or "no-offset" position at device power-up.

Ps	Finishing operation
1	Toggle the offset of the paper.

The default numeric parameter value is 0. No action occurs if this parameter value is received.

11.18 Drawing Vectors

DECVEC - Draw Vector

```
ESC  [   Pl  ;  P2   ;  P3   ;  P4   ;  P5   !   |
033 133 *** 073 *** 073 *** 073 *** 073 *** 041 174
```

DECVEC draws a line of variable thickness. The X direction is parallel to physical page movement, the Y direction is parallel to the laser scan.

Pl - Line orientation

Defines the line orientation.

Pn	Line Orientation
0	X Line (Default)
1	Y Line

P2

This parameter defines the distance from the origin along the X axis where the line will start.

P3

This parameter defines the distance from the origin along the Y axis where the line will start.

P4

This numeric parameter defines the line's length. The line may be of any length.

P5

This numeric parameter defines the line thickness/width. The minumum legal value for P5 is 2.

Lines may be drawn regardless of margins.

The LN01 printer uses the coordinate system as depicted in Appendix D. The Y direction is parallel to the long edge of the paper and the X direction is parallel to the short edge. The origin for landscape oriented pages is the upper left hand corner, for portrait oriented pages, the lower left hand corner. All parameters are in 1/300 inch units. Note that this is different than other sequences where parameters are in decipoints.

The Draw Vector escape sequence generates overhead equivalent to one line and some number of input text characters depending upon its orientation (X or Y line) and its length. This overhead contributes to the maximum limit of 200 text lines and 10,000 characters per page.

All X (those parallel to the X axis) lines are equivalent to one line and 11 characters.

For Y lines (those parallel to the Y axis), the overhead depends on the length of the rule as shown:

All lines 512 pixels or smaller in length are equivalent to one line and 13 characters of overhead.

Any line greater than 512 pixels in length is equivalent to one line and 13 characters for the first 512 pixels. There is an additional 9 character overhead for each 512 pixel or partial 512 pixel length beyond the initial 512 pixel segment.

WARNING:

Because it is possible for a line to extend beyond the physical limits of a page, the user must ensure that the DECVEC sequence is coordinated with the proper paper size.

11.19 Reset To Initial State

RIS - Reset to Initial State

ESC c
033 143

Causes the device to reset all parameters to their default state.

See the section titled "Default Values and States" for a list of what parameters are reset.

11.20 Superscripting And Subscripting

PLU - Partial Line Up

ESC L
033 114

Printing superscript characters is performed with the PLU escape sequence. The PLU sequence causes the active position to move up in the vertical direction a predefined distance. The distance moved up in the vertical direction is determined by the currently selected character set. See the appendix titled "Font File" for more information. The PLD - Partial Line Down" sequence causes the active position to return to the previous baseline. Only one level of superscripting is permitted.

PLD - Partial Line Down

ESC K
033 113

Printing subscript characters is performed with the PLD escape sequence. The PLD sequence causes the active position to move down in the vertical direction a predefined distance. The distance moved down in the vertical direction is determined by the currently selected character set. See the appendix titled "Font File" for more information. The PLU - Partial Line Up" sequence causes the active position to return to the previous baseline. Only one level of subscripting is permitted.

11.21 Select Size Unit

SSU - Select Size Unit

ESC	[	Ps	SP	I
033	133	***	040	111

SSU establishes the unit in which the numeric parameters of selected escape sequences in this functional specification are interpreted. The unit established remains effective until the occurrence of another SSU in the data stream.

The parameter values are:

Ps	Size Unit
2	Decipoint (1/720 inch)
7	Pixel

The default numeric parameter value is 0.

Numeric parameter values other than 2 or 7 are illegal.

The SSU sequences affects the numeric parameters in the following escape sequences:

DECSHTS
DECSVTS
DECSLPP
DECSTBM
DECSLRM
HPA
HPR
VPA
VPR
DECVEC

12.Ø DEFAULT VALUES AND STATES

The printer will be set to the following values and states upon device power-up and when the RIS escape sequence is received.

Shift In and Shift Out

Upon device power-up the printer is shifted to the GL character set.

When the LNØ1 is configured for a 7-bit environment and the RIS escape sequence is received, the printer is shifted to the GL character set.

DECLCS - Load Character Set

Upon device power-up the rom landscape and portrait fonts are available for printing. When the RIS escape sequence is sent to the printer, any currently loaded fonts remain intact.

DECLCS - Assign Character Set

Upon device power-up and upon receipt of the RIS escape sequence, the default landscape font is assigned to font number 1Ø. When the RIS escape sequence is sent to the printer, all currently assigned fonts are deassigned.

SGR - Select Font

The default landscape font is selected for printing. This is font number 1Ø.

DECSHTS - Set Horizontal Tabulation Set

Landscape Orientation:

All currently set tabs are cleared. Default tabs are set to one every Ø.587 inches (or every 8 characters). The first horizontal tab stop is Ø.587 inches (8 characters) from the default left margin. There are 16 default tabs.

Portrait Orientation:

All currently set tabs are cleared. Default tabs are set to one every Ø.8Ø inches (or every 8 characters). The first horizontal tab stop is 1.Ø5 inches (8 characters) from the default left margin. There are 1Ø default tabs.

DECSVTS - Set Vertical Tabulation Stops

Landscape Orientation:

All currently set tabs are cleared. Default vertical tab stops are located every 0.117 inches (or 1 line). The first default vertical tab stop is located 0.117 inches (1 line) from the top margin.

Portrait Orientation:

All currently set tabs are cleared. Default vertical tab stops are located every ?.??? inches (or 1 line). The first default vertical tab stop is located ?.??? inches (1 line) from the top margin.

DECSLPP - Set Lines per Physical Page

Landscape:

Page Size: 8.50 inches

Portrait:

Page Size: 11.00 inches

DECSTBM - Set Top and Bottom Margins

Landscape Margins:

Top Margin:	10.2 mm	(.40 inch)
Bottom Margin:	205.7 mm	(8.10 inch)

Portrait Margins:

Top Margin:	16.8 mm	(.66 inch)
Bottom Margin:	262.6 mm	(10.34 inch)

NOTE: All measurements are from the top edge of the paper.

DECSLRM - Set Left and Right Margins

Landscape Margins:

Left Margin:	16.8 mm	(.66 inch)
Right Margin:	262.6 mm	(10.34 inch)

Portrait Margins:

Left Margin:	10.2 mm	(.25 inch)
Right Margin:	205.7 mm	(.25 inch)

NOTE: All measurements are from the left edge of the paper.

HPA - Horizontal Position Absolute
VPA - Vertical Position Absolute

The active position is set to the upper left-hand corner of the paper. This position is where the first line and character is to be printed.

JFY - Justify

Justification is disabled.

SGR - Underlining

Underlining is disabled.

DECASFC - Paper Selection

The top tray is selected, unless empty then the bottom tray is selected. The printer will automatically cycle through the paper trays.

LNM - Line Feed New Line

Line Feed New Line mode is enabled.

DECFIN - Document Finishing

Upon power-up documents are delivered to the output tray in the "no-offset" position.

Upon receipt of the RIS sequence the output stacker is set to the no-offset position.

Print Summary Sheet

Printing of the Job Summary Sheet is disabled.

Operators Led Display

Upon power-up the operators Led Display is set to "01".

13.0 SIZE UNIT

The LN01 has the ability to move the active position and address physical locations of the paper in 1/60 of an inch units. The escape sequences described in this document use decipoints (1/720 of an inch) as the unit of measurement. The LN01 must convert decipoints into 1/60 of inch units. This is done by dividing the binary value of the numeric parameter by 12 and discarding the remainder. The resulting value is now in 1/60 of an inch units.

The numeric parameters for the following escape sequences are expressed in units of decipoints.

DECSHTS
DECSVTS
DECSLPP
DECSTBM
DECSLRM
HPA
HPR
VPA
VPR

14.Ø FONTS

The LNØ1 Laser printer contains two default rom fonts.

The names of the fonts are as follows:

Font Name	Orientation
Xcp14-L	Landscape
Kosmos1Ø-P	Portrait

Note: The case of the characters in the name is significant.

The font name is decoded in the following manner:

X = "Xerox"

c = "Computer"

p = "Printing"

14 Indicates the pitch of the font

B Indicates a BOLD font.

\- A delimiter

L/P L = Landscape / P = Portrait

15.0 IMAGING LENGTH

The maximum imaging length of the LN01 is 13.6533 inches. Therefore, when printing on 14-inch paper in landscape orientation, 13.6533 inches are available for printing from the left edge of the paper, leaving a .3467 inch border from the right edge of the paper. When printing on 14-inch paper in portrait orientation, 13.6533 inches are available for printing from the bottom edge of the paper, leaving a .3467 inch border from the top edge of the paper.

16.0 SUGGESTED MINUMUM MARGINS

Margins may be set anywhere on the page. For example, a top margin could be set at position 1, which is the very edge of the paper. Due to the Xeroxgraphic process involved in creating an image on paper, images placed near the edge of the paper may not actually be printed. Therefore, the following minumim margins values are suggested for ensuring the image can be printed.

Landscape Margins:

Top Margin: .235 inch

Bottom Margin: .235 inch (measured from the bottom edge of the paper)

Left Margin: .118 inch

Right Margin: .118 inch (measured from the right edge of the paper)

Portrait Margins:

Top Margin: .118 inch

Bottom Margin: .118 inch (measured from the bottom edge of the paper)

Left Margin: .235 inch

Right Margin: .235 inch (measured from the right edge of the paper)

17.0 JOB SUMMARY SHEETS

The LN01 has the ability to print Job Summary Sheets. These sheets can be requested via the DECLCS sequence. The JOb Summary Sheet provides information about the LN01 printer and the current status of the printer.

A job summary sheet contains the following information:

1. The type of communications interface. The word "PARALLEL" is printed here.

2. The type of input expected. The possibilities are "ASCII/7" and "ASCII/8". The "7" indicates 7-bit ASCII data is expected and the "8" indicates 8-bit ASCII data.

3. A list of the currently available fonts are listed. This list includes the rom based fonts and those loaded through the "DECLCS - Load Character Set" sequence.

4. A comment line specified in the "DECLCS - Load Character Set" sequence.

5. A Job Status. If there were no errors, then "NO ERRORS" is printed. If any errors occured as many as 10 error codes and their corresponding page numbers are listed. Only the last 10 errors encountered will be printed. (See below for a list of error codes and messages.)

6. The revision level of the LN01 printer software.

```
                                Revision Level A03XM

The users comment line is printed here.

Interface:          PARALLEL

Data Encoding:      ASCII/7

Fonts Available:                                    Job Status: No err

Xcp14-L                  8762 bytes
Titan10-P       12422 bytes
Titan10B-P      12474 bytes
```

Figure 1 Sample of a Job Summary Sheet

NOTE: The layout of the above example Job Summary Sheet is not an exact reproduction of an actual Job Summary Sheet. The spacing has been reduced to show the entire contents of the Summary Sheet.

Error Codes and Messages

The following codes are printed on the Job Summary Sheet when an error occurs.

Font Load Jobs

11 The Font Load Job contained unrecognizable font(s).

12 The font information in the Font Load Job exceeded 28,000 bytes of dynamic memory. Performance degradation is possible.

13 Fonts exceeding 38,000 bytes were not loaded.

14 Fonts exceeding the 768 character limit were not loaded.

Print Jobs

20 An unknown instruction was encountered and ignored.

21 The page requires too much processing time, and thus is too complex to print.

22 The line extends beyond the right margin. A loss of data is possible.

23 The limit of 10,000 printable and control characters per page has been exceeded. Data will be loast if the page is too complex. Otherwise, excess data is printed on the following page.

24 There is an error in an instruction for drawing a line.

25 There is a possible duplicate page.

26 The Absolute Placement Instruction has a missing field.

Font Usage

40 A Font ID Command referenced a nonexistant (font-name). The assignment of this Font ID was ignored.

41 A font of different orientation from that used in composing the page was specified. (This causes a new page to begin.)

42 An unassigned Font ID index number was called out in the document. It was ignored.

45 Font ID Command syntax error: The Font ID index number was greater than 7. The font assignment was ignored.

18.0 DATA MONITOR MODE

The LN01 printer will print data received from the host system in hexidecimal when in the "Data Monitor Mode". A dip switch located on the printer controller board enables the "Data Monitor Mode". The dip switch is #5 on the interface board. When the dip switch is in the "OFF" position, the "Data Monitor Mode" is enabled. When the dip switch is in the "ON" position, the "Data Monitor Mode" is disabled. The dip switches are read by the firmware only at power-up time. Therefore the user must power down the device, set the dip switch in the desired position and then power up the printer. All data received from the host system is printed in hexadecimal. Control characters and escape sequences are not interpreted. They are printed in hex and do not control the printing operation.

```
02 1B 41 06 20 4E 4F 4E 54 52 41 4E 53 50 41 52
45 4E 54 20 54 45 58 54 03 03 1B 2B 46 06 03 10
02 AA AA 02 04 B0 15 4B 6F 73 6D 6F 73 36 2D 50
20 20 20 20 20 20 20 20 20 20 20 00 00 00 00 00
00 06 00 1A 00 1E 00 20 BD 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 02 00 20 06 FF 3D FD 0B 0F 00 22 06 FF 3C 00
08 16 00 32 06 FF 3D 06 0D 3C 00 48 06 FF 3C FF
15 27 00 84 06 FF 3C FE 0F 3C 00 AC 06 FF 3C FF
16 39 00 E8 06 FF 3C FF 14 0C 00 22 07 FF 3D 06
08 18 00 2E 07 FF 3C FE 0A 18 00 46 07 DD 3C FE
0A 1A 00 5E 07 FF 3D 04 10 10 1A 00 78 07 FF 3D
02 0F 0A 00 92 07 FF 3D FE 08 18 00 9C 07 FF 3D
04 0F 0C 00 B4 07 FF 3D 00 08 24 00 C0 07 FF 3C
FF 0C 27 00 E4 07 FF 3C FF 0F 1B 00 0C 08 FF 3C
00 0F 27 00 28 08 FF 3C 00 0F 27 00 50 08 FF 3C
FF 0F 27 00 78 08 FF 3C 00 0F 27 00 A0 08 FF 3C
FF 0F 2A 00 C8 08 FF 3C FF 0F 27 00 F2 08 FF 3C
00 0F 27 00 1A 09 FF 3C FF 0F 27 00 42 09 FF 3C
FF 0F 10 17 10 02 0A 00 6A 09 FF 3D 00 08 0F 00
74 09 FF 3C FE 08 2C 00 84 09 FF 3D 01 1A 18 00
B0 09 FF 3D 03 0F 2E 00 C8 09 FF 3D 01 1A 21 00
```

Data Monitor Mode Output
Figure 1

19.0 MINUMUM'S AND MAXIMUM'S

The following is a list of minumum and maximum values for the LN01 printer. These values are based on the latest information available on the current firmware implementation.

NOTE: These values may increase or decrease if any changes are made to the firmware.

1. Functions per line

   The LN01 printer has a maximum limit of 16 functions per line. These functions are comprised of "DECLCS - Select Character Set", PLU - Partial Line Up", and "PLD - Partial Line Down". When any of these functions are immediately adjacent, they are counted as one.

2. Maximum Line Length

   The maximum line length is 185 characters.

   The horizontal tab character consumes 3 characters.

3. Characters per Page

   A page may contain up to 10,000 printable characters.

   1. A line of text requires 7 characters.
   2. A horizontal tab character consumes 3 characters.
   3. A line drawn (using "DECVEC - Draw Vector") parallel to the X axis consumes 13 characters.
   4. A line drawn (using "DECVEC - Draw Vector") parallel to the Y axis comsumes 13 characters for the first 512 pixels and 9 characters for each additional 512 pixels (or portion thereof).

4. Lines Per Page

   A page may contain up to 200 lines.

   1. A subscript or superscript consumes 1 line.
   2. A line drawn by "DECVEC - Draw Vector" consumes 1 line.

5. SGR - Underline

   A maximum number of 16 underline segments can be used for a text line. An underline segment is defined from the start

of underlining to the end of underlining. For example, if underlining is started and stopped such as to underline a single word, a maximum of 16 words could be underlined in a single text line.

20.0 SELECTIVE/NON-SELECTIVE PARAMETER TABLE LISTING

The following table indicates which escape and control sequences contain selective parameter lists and which ones do not. A selective parameter list in this specification is denoted by "Ps" in the sequence.

Mnemonic	Selective/ Non-Selective
DECLCS	Non-Selective
SGR	Selective
DECSHTS	Non-Selective
DECSVTS	Non-Selective
TBC	Selective
DECSLPP	Non-Selective
DECSTBM	Non-Selective
DECSLRM	Non-Selective
HPA	Non-Selective
HPR	Non-Selective
VPA	Non-Selective
VPR	Non-Selective
JFY	Selective
SGR	Selective
DECASFC	Selective
LNM	Selective
DECFIN	Selective
DECVEC	Non-Selective
RIS	Not Applicable
PLU	Not-Applicable
PLD	Not-Applicable
IND	Not-Applicable
NEL	Not-Applicable
SPI	Non-Selective

21.0 ORIGINS AND ABSOLUTE POSITIONS

Many of the escape and control sequences in this document indicate absolute or relative positions or movement in terms of decipoints. These positions are numbered 1,2,3.. and so on. The upper-left hand corner of the paper is the origin and is numbered 1,1. Position number 1 is the very edge of the paper. An absolute position of zero or one are the same position.

APPENDIX A

MULTINATIONAL CHARACTER SET

This graphic character set consists of graphic alphabetic symbols not included in ASCII.

Because this document is produced using only the ASCII character set, it is not possible to reproduce here the graphic symbols of the multinational character set. Graphic symbols of this character set shall be as specified by ISO 6937. The ID given for each character is a reference to ISO 6937 for the character in that standard having the same graphic symbol. Erroneous characters, if received, shall be printed as the error character.

Octal Code	ID	Description of Character
241	SP03	inverted exclamation mark
242	SC04	cent sign
243	SC02	pound sign
244		error
245	SC05	yen sign
246		error
247	SM24	section sign
250	SC01	general currency sign
251	SM52	copyright sign
252	SM21	feminine ordinal indicator
253	SP17	angle quotation mark left
254		error
255		error
256		error
257		error
260	SM19	degree sign
261	SA02	plus/minus sign
262	NS02	superscript 2
263	NS03	superscript 3
264		error
265	SM17	micro sign
266	SM25	paragraph sign, pilcrow
267	SM26	middle dot
270		error
271	NS01	superscript 1
272	SM20	masculine ordinal indicator
273	SP18	angle quotation mark right
274	NF04	fraction one quarter
275	NF01	fraction one half

276		error
277	SP16	inverted question mark
300	LA14	capital A with grave accent
301	LA12	capital A with acute accent
302	LA16	capital A with circumflex accent
303	LA20	capital A with tilde
304	LA18	capital A with umlaut
305	LA28	capital A with ring
306	LA52	capital AE dipthong
307	LC42	capital C with cedilla
310	LE14	capital E with grave accent
311	LE12	capital E with acute accent
312	LE16	capital E with circumflex accent
313	LE18	capital E with umlaut
314	LI14	capital I with grave accent
315	LI12	capital I with acute accent
316	LI16	capital I with circumflex accent
317	LI18	capital I with umlaut
320		error
321	LN20	capital N with tilde
322	LO14	capital O with grave accent
323	LO12	capital O with acute accent
324	LO16	capital O with circumflex accent
325	LO20	capital O with tilde
326	LO18	capital O with umlaut
327		error
330	LO62	capital O with slash
331	LU14	capital U with grave accent
332	LU12	capital U with acute accent
333	LU16	capital U with circumflex accent
334	LU18	capital U with umlaut
335	LY18	capital Y with umlaut
336		error
337	LS61	sharp s
340	LA13	small a with grave accent
341	LA11	small a with acute accent
342	LA15	small a with circumflex accent
343	LA19	small a with tilde
344	LA17	small a with umlaut
345	LA27	small a with ring
346	LA51	small ae dipthong
347	LC41	small c with cedilla
350	LE13	small e with grave accent
351	LE11	small e with acute accent
352	LE15	small e with circumflex accent
353	LE17	small e with umlaut
354	LI13	small i with grave accent
355	LI11	small i with acute accent
356	LI15	small i with circumflex accent
357	LI17	small i with umlaut
360		error
361	LN19	small n with tilde
362	LO13	small o with grave accent
363	LO11	small o with acute accent
364	LO15	small o with circumflex accent
365	LO19	small o with tilde

366	LO17	small o with umlaut
367		error
370	LO61	small o with slash
371	LU13	small u with grave accent
372	LU11	small u with acute accent
373	LU15	small u with circumflex accent
374	LU17	small u with umlaut
375	LY17	small y with umlaut
376		error

APPENDIX B

FONT FILE DESCRIPTION

B.1 FONT RECORD

This section describes the format for transmitting a font to the LNØ1 printer.

B.2 FILE FORMAT

The font format consists of three main structures:

1. Font Description
2. Font Specification
3. Font Matrix

B.2.1 Font Description

The font description contains general dimensional data required by the LNØ1 printer software, as well as data identifying the font type, revision level and storage requirements.

The following is a list of the elements contained in the Font Description. Reference should be made to figures 1 and 2 to transform the word description of each element to the actual physical demensions on a portrait or landscape character. All locations are byte displacements from the beginning of the font file.

Elements of the Font Description which are type WORD must be stored least significant byte first, most significant byte second.

1. HEADER FLAG Type: WORD Location: ØØH-Ø1H

   The header flag contains an alternating one/zero bit pattern "AAAAH".

2. REV Type: BYTE Location: 02H

Revision level of font file (range 0 - 255)

3. Font Type Type: BYTE Location: 03H

Bit 0 = 0 for Portrait font
= 1 for Landscape font

Bit 1 = 0 for Fixed Pitch
= 1 for Proportional Spaced

Bits 2-7 not used and set to "0".

4. File Size Type: WORD Location: 04H-05H

Number of bytes in the font file.

5. Font Name Type: BYTE Location: 06H-19H

Font name with a maximum of 20 ASCII characters.

6. Underline Type: BYTE Location: 1AH

Distance

7. Underline Type: BYTE Location: 1BH

Thickness

8. Strike-Through Type: BYTE Location: 1CH

Distance

9. Strike-Through Type: BYTE Location: 1DH

Thickness

10. Superscript Type: BYTE Location: 1EH

Distance

11. Subscript Type: BYTE Location: 1FH

Distance

12. B Type: WORD Location: 20H-21H

Line Spacing value required below the baseline. (Number of bits for portrait, number of scan lines for landscape)

13. H Type: WORD Location: 22H-23H

Line spacing value required above the baseline. (Number of bits for portrait, number of scan lines for landscape)

14. LS Type: WORD Location: 24H-25H

Total line spacing in bits (portrait) or scan lines (landscape).

15. FC Type: BYTE Location: 26H

ASCII code for the first character in the font matrix.

16. LC Type: BYTE Location: 27H

ASCII code for the last character in the font matrix.

17. Part Number Type: BYTE Location: 28H-2CH

Part Number

18. Null Words Type: WORD Location: 2DH-2FH

Null words for future use.

B.2.2 Font Specifications

The Font specifications contain dimensional and alignment data for each character in the font and the address of the matrix (bit map) of each character relative to the beginning of the Font Format. The are four (4) words of parameter data for each character. Although printable character do not start with ASCII code 00H, space must be provided in the font specification for four words of data for each character starting at ASCII code 00H. In most cases, this will result in 256 (decimal) or more "dummy" locations in the beginning of the Font Specification.

In order to make the character code representation independent of the communications medium, no printable characters can be assigned an ASCII code less than 20H.

1. ByteCount Type: WORD Location: 30H-31H

   Total number of bytes in the font matrix for this character.

   Note:

   NO character can have a byte count of zero. Although the space character has no black bits in its matrix, it must be given a byte count parameter of two (2) bytes *, and the matrix address must point to two (2) bytes of all whites (0's).

   * see note on height parameter.

2. MatrixAddress Type: WORD Location: 32H-33H

   Address of the bit map for this character relative to the start of the Font File.

3. MatrixSegment Type: BYTE Location: 34H

   This byte is set to all 1's.

4. Height Type: BYTE Location: 35H

   The least significant six bits of this parameter indicate the number of bytes along the scan direction, containing bit map data for this character. The most significant two bits must be "0". The height range is 2 to 64 bytes (512 bits). The height must be given in 1's complement form.

   Notes:

   A height of 64 bytes is represented in 1's complement form as xx111111 in this format.

   Although the height may be given as an odd or even number of bytes, the minimum height is two (2) bytes. Characters with bit map data of height one byte or less must be padded with white space to force a height of two bytes.

5. Offset Type: BYTE Location: 36H

PORTRAIT ORIENTATION:

This byte represents the offset from the baseline (in number of bits/2) of the start of the bitmap data. Characters with descenders such as "y" will have a negative offset. Positive offsets occur for characters such as quote marks. The offset range is -128 to +127 (-256 to +254 bits).

LANDSCAPE ORIENTATION:

This byte represents the white space to the left of each character (number of pixels/2). If an odd number of pixels is required, the offset is specified as though the next lowest even offset were required, and the bit map is padded with one pixel of white.

6. Width Type: BYTE Location: 37H

This byte represents the width of the character in scanlines for portrait font and pixels for landscape fonts.

B.2.3 Font Matrix

The Font Matrix contains the bit maps of each character, with a logic one representing black and a logic zero representing white. The order of bit map storage is shown in figure 3 and figure 4 for a typical landscape and portrait character. Note that the first byte of each character must start on a word boundry. For portrait fonts, descenders or ascenders which would result in an offset of an odd number of bits must be padded with white space to force an offset of an even number of bits. The bit maps must be stored on a byte organization as shown in figures 3 and 4. The MSB is bit seven (7) and the LSB is bit zero (Ø).

B.2.4 End Of Font Flags

The end of font flags directly follow the last byte of bit map information for the last character in the font, and consist of eight bytes of "55H". These font flags are included in the File Size count.

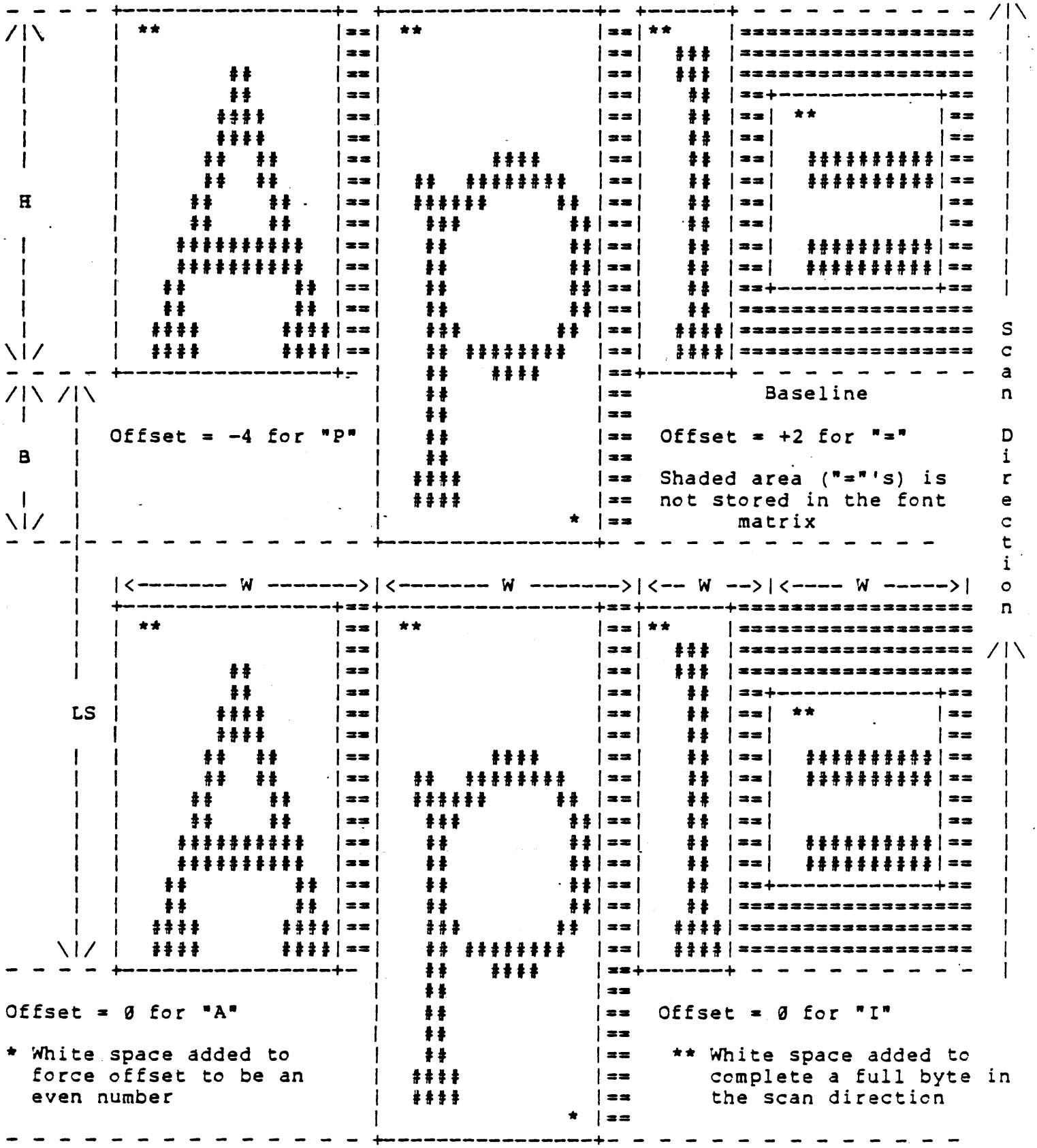
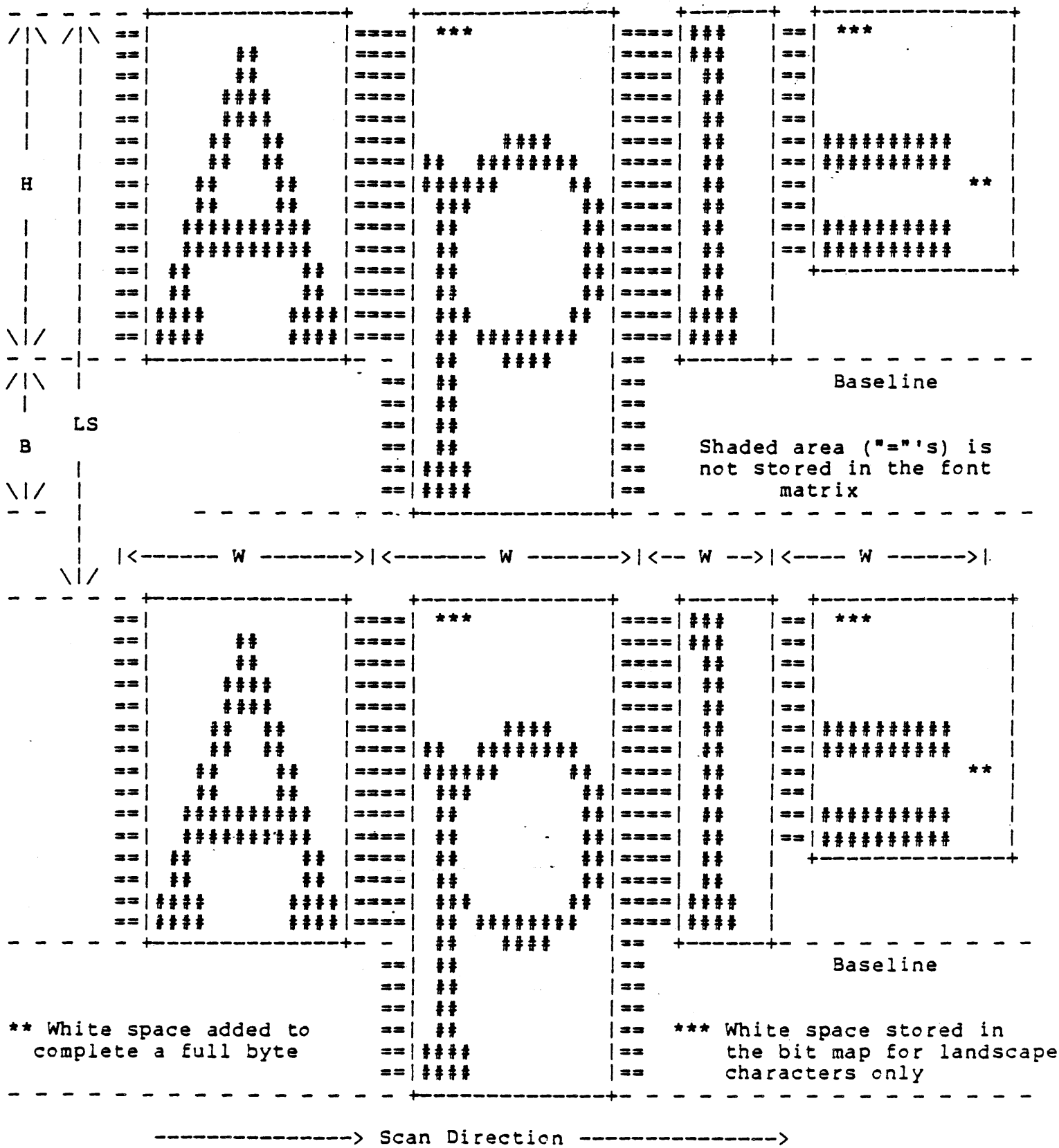


Figure #1 Portrait Font


H
LS
B
Baseline
Shaded area ("="'s) is not stored in the font matrix
|<------ W -------->|<------- W ------->|<-- W -->|<---- W ------>|
Baseline
** White space added to complete a full byte
*** White space stored in the bit map for landscape characters only
----------> Scan Direction ---------->
Figure #2 Landscape Font

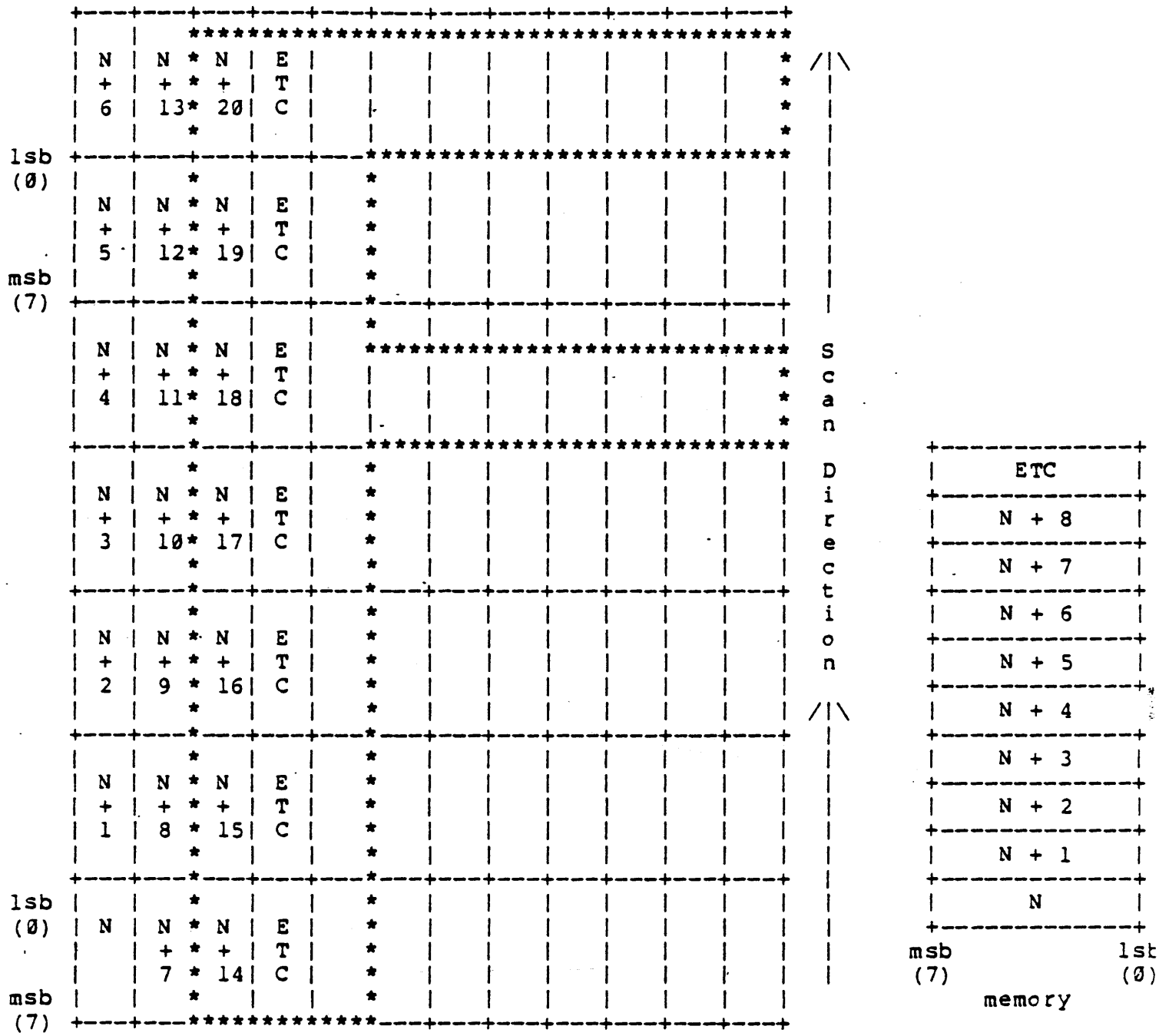


Figure #3 Font matrix organization for a portrait character.

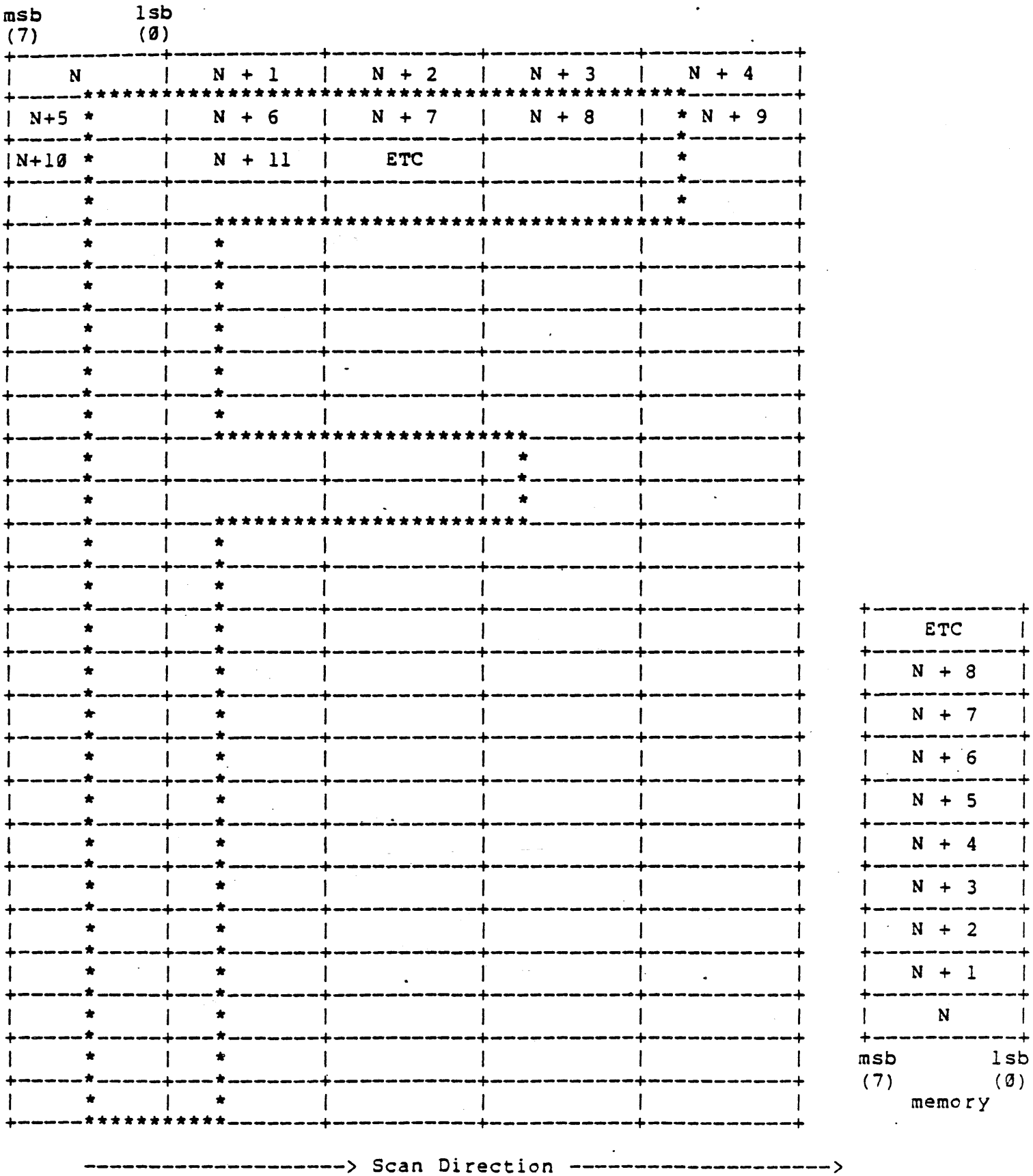

msb
(7)
lsb
(Ø)
N
N + 1
N + 2
N + 3
N + 4
N+5
N + 6
N + 7
N + 8
N + 9
N+1Ø
N + 11
ETC
ETC
N + 8
N + 7
N + 6
N + 5
N + 4
N + 3
N + 2
N + 1
N
msb
(7)
lsb
(Ø)
memory
----------> Scan Direction ---------->

Figure #4 Font matrix organization for a landscape character.

APPENDIX C

BINARY ENCODING PROCEDURE

The following paragraphs describe the procedure for encoding binary data into ASCII characters. Once encoded into ASCII the data can then be transmitted to the device. The receiving device will then decode the ASCII characters back into binary. The term "sixels" is used to denote the ASCII characters into which binary data has been converted.

Binary data is encoded into the set of ASCII characters from 077 octal to 176 octal. Any combination of 6 bits can be transmitted as an ASCII character. Binary data is converted into ASCII characters by removing six bits from the data stream and adding 077 octal. This ASCII character or sixel is now ready to be transmitted to the device.

The receiving device decodes the characters as follows. When a sixel is received, bit 7 is cleared (bits are numbered 0 through 7 with bit 0 the least significant and bit 7 the most significant) and 077 octal is subtracted. The resulting 6 bits can now be concatenated with other bits to reform the data stream.

Bits are disassembled from the data stream and reassembled in a specific order. Essentially the order is from the most significant bit to the least significant bit. Assume that a buffer of data needs to be transmitted and there is a pointer pointing to the very first byte in the buffer. The first bits sent will be bits 7-2 from byte 0. Next is bits 1 and 0 from byte 0 and bits 7-4 from byte 1. After that, bits 3-0 from byte 1 and bits 7 and 6 from byte 2 are transmitted.

Three bytes of data can be disassembled and transmitted as 4 characters. When the data buffer to be transmitted is such that it does not contain a multiple of 3 bytes, extra bits must be transmitted. For example, when 2 bytes of data need to be sent, 2 extra bits must also be transmitted. Two full groups of 6 bits can be removed from the 2 bytes, leaving 4 bits. Two extra bits, with undefined values are grouped with the 4 bits. These 6 bits are now encoded as per the above procedure. When the receiving device detects the end of record, the extra bits are discarded.

Example:

The following example and associated steps show the disassembly of bits from the data buffer and the encoding of the data into sixels.

Figure 1 shows a buffer of binary data which the host system wishes to transmit to a device.

	7	6	5	4	3	2	1	0
Byte 0	0	0	0	0	1	1	0	0
1	0	1	0	1	0	1	0	1
2	0	0	0	0	0	0	0	0

STEPS:

1.) Bits 7-2 from byte 0 are removed from the buffer.	000110(2)	006(8)
		+ 077(8)
2.) 077 octal is added.		105(8)
3.) The sixel is placed into a buffer which is to be transmitted.	E 105	
4.) Bits 1 and 0 from byte 0 and bits 7-4 from byte 1 are removed from the buffer.	000101(2)	005(8)
		+ 077(8)
5.) 077 octal is added.		104(8)
6.) The sixel is placed into a buffer which is to be transmitted.	E D 105 104	
7.) Bits 3-0 from byte 1 and bits 7 and 6 from byte 2 are removed from the buffer.	010100(2)	024(8)
		+ 077(8)
8.) 077 octal is added.		123(8)
9.) The sixel is placed into a buffer which is to be transmitted.	E D S 105 104 123	
10.) Bits 5-0 from byte 2 are removed from the buffer.	000000(2)	000(8)
		+ 077(8)
11.) 077 octal is added.		

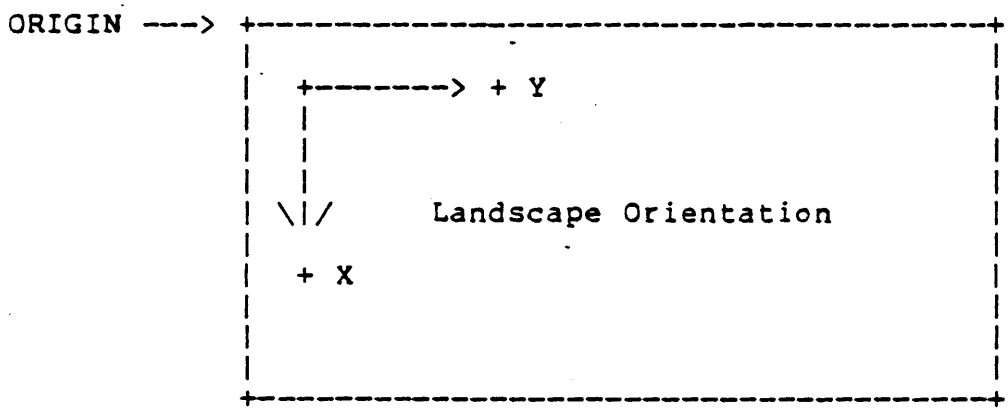
077(8)

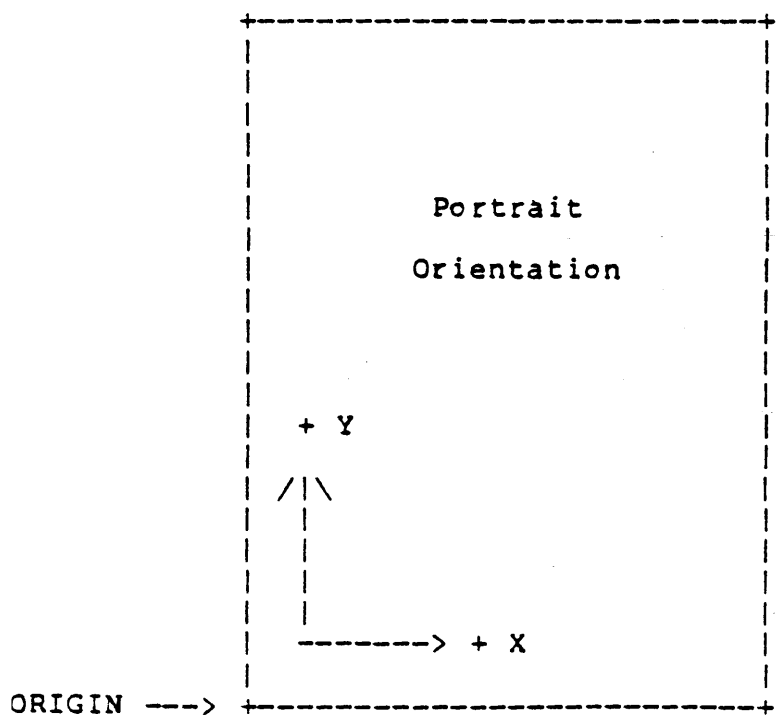
12.) The sixel is placed into a buffer which is to be transmitted.

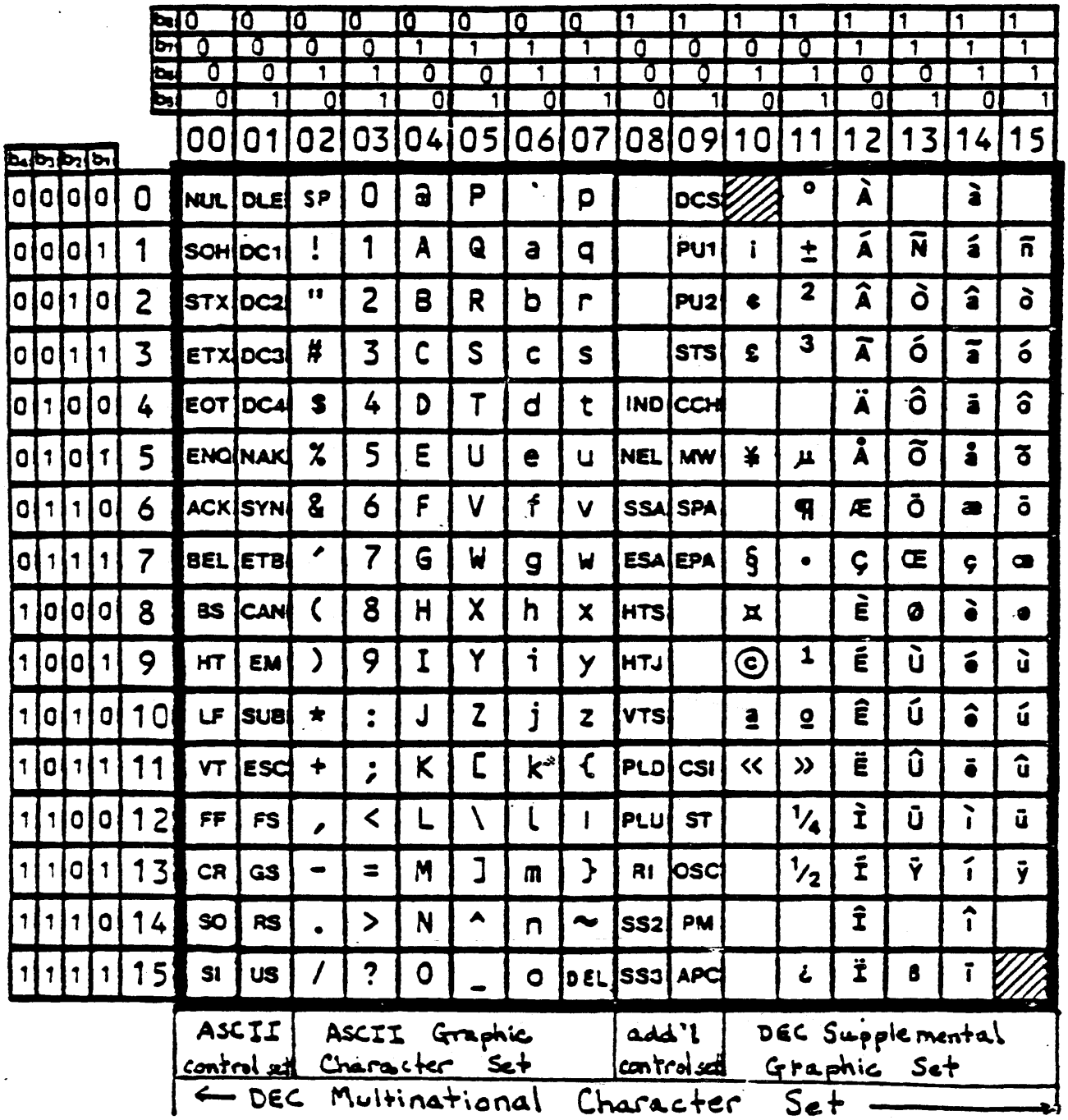
E	D	S	?
105	104	123	077

APPENDIX D

PAGE ORIENTATIONS AND ORIGINS







b4	b3	b2	b1		00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p		DCS		°	À		à	
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q		PU1	¡	±	Á	Ñ	á	ñ
0	0	1	0	2	STX	DC2	"	2	B	R	b	r		PU2	¢	²	Â	Ò	â	ò
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s		STS	£	³	Ã	Ó	ã	ó
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t	IND	CCH			Ä	Ô	ä	ô
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u	NEL	MW	¥	µ	Å	Õ	å	õ
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v	SSA	SPA		¶	Æ	Ö	æ	ö
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w	ESA	EPA	§	·	Ç	Œ	ç	œ
1	0	0	0	8	BS	CAN	(	8	H	X	h	x	HTS		¤		È	Ø	è	ø
1	0	0	1	9	HT	EM	)	9	I	Y	i	y	HTJ		©	¹	É	Ù	é	ù
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z	VTS		ª	º	Ê	Ú	ê	ú
1	0	1	1	11	VT	ESC	+	;	K	[	k	{	PLD	CSI	«	»	Ë	Û	ë	û
1	1	0	0	12	FF	FS	,	<	L	\	l	|	PLU	ST		¼	Ì	Ü	ì	ü
1	1	0	1	13	CR	GS	-	=	M	]	m	}	RI	OSC		½	Í	Ý	í	ý
1	1	1	0	14	SO	RS	.	>	N	^	n	~	SS2	PM			Î		î	
1	1	1	1	15	SI	US	/	?	O	_	o	DEL	SS3	APC		¿	Ï	ß	ï	

ASCII control set | ASCII Graphic Character Set | add'l control set | DEC Supplemental Graphic Set

← DEC Multinational Character Set →

Figure 1 Multinational Character Set

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