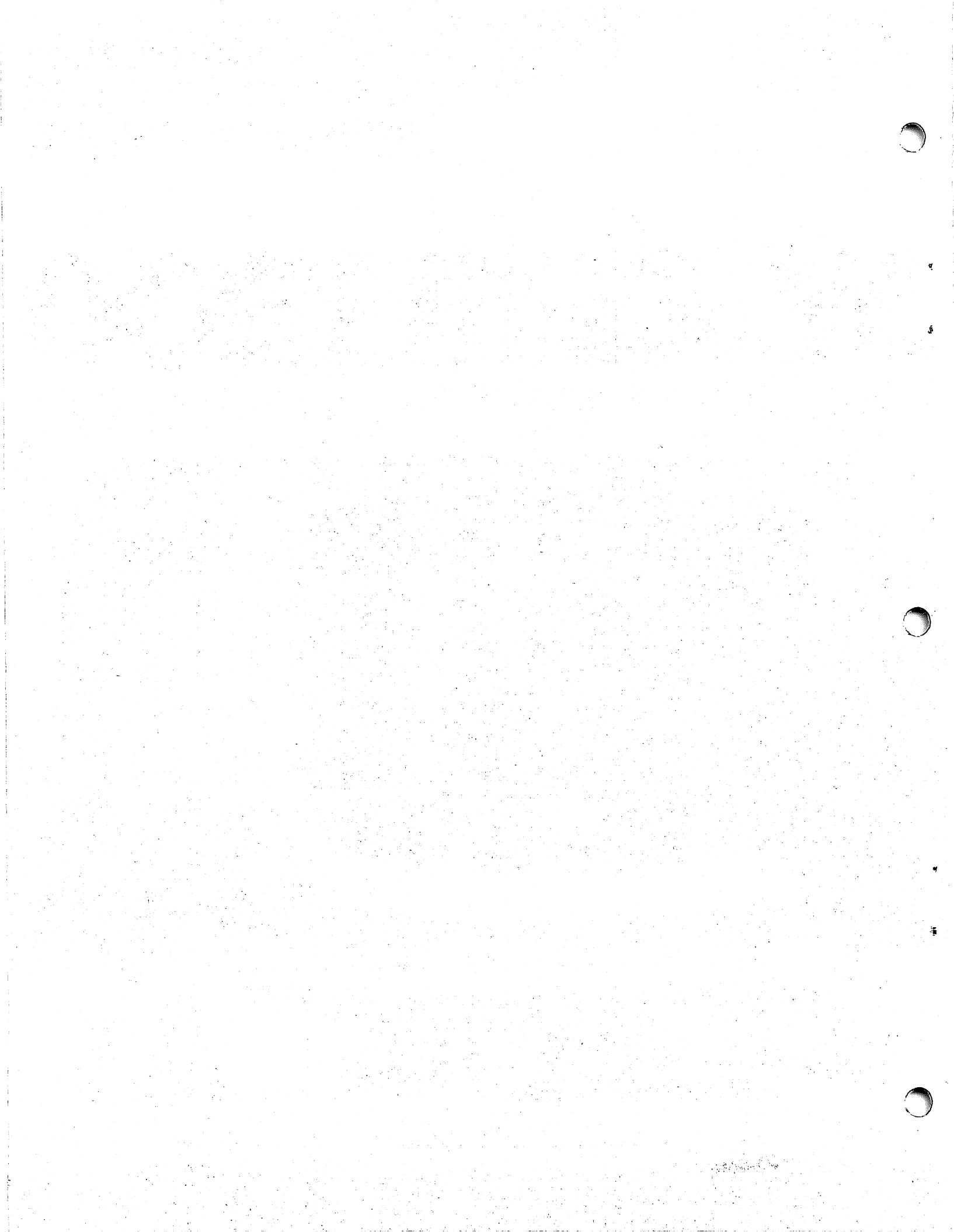


WANG

MODEL 2271P
PLOTting OUTPUT WRITER
REFERENCE MANUAL

SYSTEM 2200





MODEL 2271P PLOTING OUTPUT WRITER USER MANUAL

(INTERIM)

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HOW TO USE THIS MANUAL

This manual guides the user in the operation of the Model 2271P Plotting Output Writer. It is assumed that the user is generally familiar with the available Wang System and the BASIC language, or has access to additional Wang reference literature.

It is recommended that users who are not familiar with the operation of the Wang system read the Programming in BASIC and BASIC Language Reference Manual appropriate for the system's CPU before proceeding with this manual.

Chapter 1 contains general user and operator information. Chapter 2 describes device selection and the SELECT statement. Chapters 3 and 4 demonstrate how to generate and format output with the PRINT and PLOT statements. Chapter 5 describes the use of HEX control codes. The printer character set, hexadecimal codes, and specifications are collected in the Appendices.

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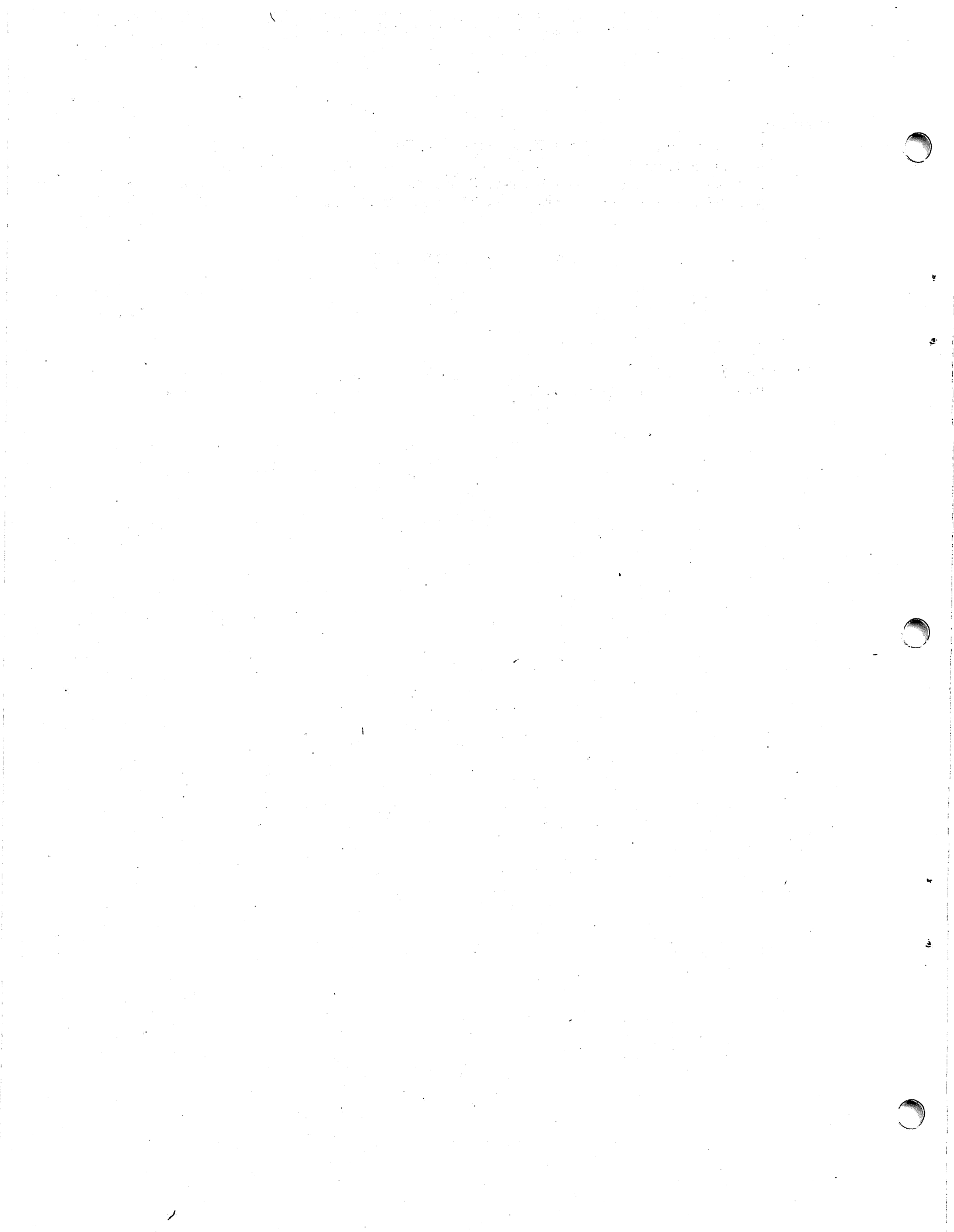
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CHAPTER 1: GENERAL INFORMATION

The Wang Model 2271P Plotting Output Writer is a modified Selectric[®] output writer designed for reliable, cost-effective preparation of presentation quality documents, plots, and forms. Since it is controlled with the Wang 36-pin printer/plotter interface, it can be attached to any 2200 Series CPU (except 2200VS), or other printer source such as the printer jacks for the WCS/15, PCS II, 2200 Work Station and 2236 Interactive Terminal.

Versatile printing, plotting and formatting capabilities are provided by the Model 2271P. Horizontal and vertical formatting and other features are fully programmable using standard Wang BASIC language output statements and special printer control codes.

Bidirectional platen and print element motion significantly decreases overall printing time by reducing carriage return and interfield spacing time. The Model 2271P can programmably move and print in the standard typewriter line feed spacing of 6 lines/inch, and character spacing for 10 or 12 pitch; or non-standard incremental spacing in multiples of 1/60 inch. The printer can move to specified positions on a form (measured in absolute positional coordinates relative to some user defined Home (X=0, Y=0) position) irrespective of the previous carriage and paper positions, or move in vectored incremental coordinates relative to the current platen and print positions. Additionally, the Model 2271P contains several switches and indicators. These controls provide for manual movement of the platen and print carriage to simplify form alignment, temporary deselection of the printer without losing the data currently in the printer buffer (while changing paper or ribbons, etc.), and signalling printer conditions such as "ribbon out". An audio alarm which can be programmed to alert the user to other conditions is also a feature of the Model 2271P.

A line buffer (either 126 or 151 characters, dependent upon the setting of the pitch selection control) receives data transmitted from the system CPU to the printer. The printer stores characters (data) until it is directed to print the line by the CPU. Use of a data buffer allows faster throughput (by overlapping CPU and printer operations) and data retention during temporary printer deselection.

The Model 2271P provides typewriter quality output using any Selectric[®] typeface. Printing occurs at about 15 characters per second over an area approximately 12.6 inches (31.8 cm) wide (151 column lines in 12-pitch format or 126 column lines in 10-pitch format). When not printing/plotting a character, the print carriage increments at up to 250 steps per second. Full

alphanumeric labelling of point plots is possible over an area approximately 13 inches wide by approximately 50 pages in length. The Model 2271P plots in increments of 1/60 inch in the X and Y directions to an accuracy of approximately $\pm 1/60$ inch plus 0.003 in./in. (± 0.042 cm plus 0.003 cm/cm).

Discrete or continuous-form paper from 3.5 to 13.5 inches wide (8.9 to 33.4 cm) can be used with the Model 2271P. The Model 2271P is optionally provided with a friction/pin-feed platen for maximum alignment accuracy when using multiple copy forms and for applications requiring extensive platen reversals.

1.1 ENVIRONMENTAL CONSIDERATIONS

Wang computer systems are designed to operate in normal office environments. However, consideration of certain factors affecting installation, maintenance, and operation will insure the optimal operation of the system. A rule of thumb is "an environment comfortable for the operator is acceptable for the system." Also see Appendix D, "Preventive Maintenance and Environmental Considerations."

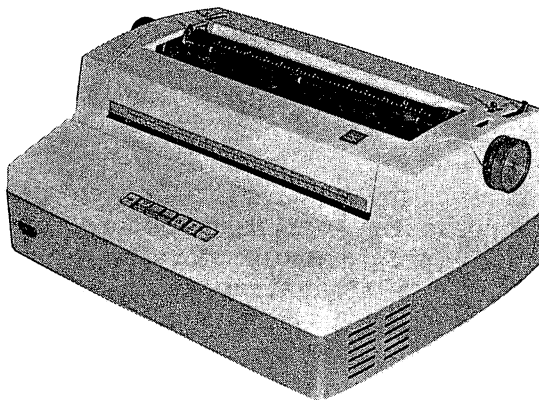


Figure 1-1. Model 2271P Plotting Output Writer

1.2 UNPACKING AND INSPECTION

The Model 2271P must be unpacked, inspected and installed by a qualified Wang Service Representative. Failure to follow this procedure will void the warranty.

1.3 INSTALLATION

The physical dimensions and site requirements for this unit are discussed in Appendix B, "Specifications." If possible, the system should be configured such that no more than eight (8) feet of cabling is required between printer and controller, since cable extension is not recommended.

A Wang Service Representative will verify the installation once the unit has been inspected for any foreign materials and shipping damage, connected in the system, powered "on", and tested to verify its proper operation.

1.4 PAPER INSERTION

Inserting paper in the Model 2271P is similar to inserting paper in a standard typewriter.

1. Pull the paper bail forward (hinged bar which holds paper against the platen). Insert the paper (with its rear side facing you) down behind the platen and turn the platen knob until the paper is around and up with the front of the paper now facing you.
2. Use the paper release lever (rightmost platen adjust lever) to squarely align the paper and create either a pin-feed or friction-feed situation. When the platen is in the release position, (forward), the paper will pin feed. When in the locked position, (rearward), the paper will friction feed.
3. After the paper is positioned, return the paper bail and paper release to their operating positions. Adjust the left-hand platen adjust lever for the thickness of the form. For a single sheet, the lever should be in the forward position. As paper thickness increases, move the lever rearward.

Never operate the printer without paper inserted to avoid damaging the platen.

(See Section 1.9 for Form Alignment Instructions and Considerations.)

1.5 CARTRIDGE RIBBON REPLACEMENT

1. Deselect the printer (depress select and release, the SELECT lamp extinguishes).
2. Move the print carriage (element and ribbon cartridge) to the center of the platen using the motion switches on the printer control panel.
3. Grasp the cover in front of the print carriage and raise it, exposing the carriage assembly.
4. Pull the cartridge release lever (bottom right side of the ribbon cartridge) forward 90° until it locks.
5. Remove the ribbon from the two ribbon guides (one on either side of the print element).
6. Remove the ribbon cartridge by grasping the sides and pulling it straight up.
7. Place the new ribbon cartridge on the print carriage and reinsert the ribbon into the guides.
8. Advance the ribbon to remove the slack by rotating the cartridge spindle knob on the right ribbon reel.

9. Return the cartridge release lever to its original position (push backward 90° until it locks).
10. Replace the cover and reselect (depress select, the SELECT lamp illuminates) to resume printer operation.

1.6 TYPING ELEMENT REPLACEMENT/INSERTION



The Model 2271P can utilize any Selectric type-style. Each typing element contains a set of 86 different ASCII characters which includes upper and lowercase alphabetic characters, numbers and symbols.

The standard type face available on the Model 2271P is the Prestige Elite 72 (IBM). There are certain characters that appear on the CRT viewing screen that are printed differently by the Model 2271P. For example, the three characters, <, >, † are not standard Selectric characters; they are replaced by the [,], and ! symbols on the printer. See Appendix A for the printer character set, and Appendix C for the typical CRT character set.

On top of each typing element is the number 10 or 12, indicating its pitch. Set the Pitch Selection Switch (located on the chassis inside the front cover slightly forward and under the print carriage) to the proper number for the element being used.

To replace the element:

1. Lift the lever on top of the element until it clicks to the open position.
2. Use the lever to lift the element straight up and off the post.

To insert a new element:

1. Pull the lever on top of the new element until it clicks open.
2. Holding the element by the lever, place the element on the post, pointing the triangle toward the platen.
3. Close the lever until it clicks in place.

NOTE:

The striking force of the element is adjusted with the impression control knob located on the print element carriage to the right of the element post. There are three positions on the control: 1, 3, and 5. Set the control to 5 for a greater striking force (multiple copies) and to 1 for less striking force. For most applications, the control should be set on 3.

1.7 FUSE REPLACEMENT

The need for fuse replacement normally represents a more serious electrical problem. Therefore it is recommended that in the event of a fuse failure, Wang Service Personnel be contacted at once.

The fuse is located in the rear of the printer. To access the fuse, the chassis cover must be removed. The fuse is changed by twisting the bad fuse out of the socket and replacing it with a new fuse. The printer should be turned OFF when changing a fuse.

1.8 CONTROLS AND INDICATORS

ON/OFF SWITCH

The ON/OFF rocker switch is located on the left side of the printer. To turn the printer ON, press the ON end of the switch. The Power lamp on the control panel illuminates. To turn OFF the printer, press the OFF end of the switch; the Power lamp extinguishes.

RESET

Although the RESET button is located on the keyboard of the CRT console, depressing this button returns the platen and print element to the currently specified Home position on the Model 2271P printer.

The Control Panel

The control panel on the top of the printer contains a number of switches and light indicators for manually controlling the operations of the printer (see Figure 1-2).



Figure 1-2. The Model 2271P Control Panel

The keys on the 2271P control panel are active only when the printer is ON and deselected (SELECT lamp extinguished). See the discussion of SELECT which follows. Several keys possess more than one function. The functions shown on the bottom portion of the buttons are "lower case". The functions shown on the top portion of the buttons are "uppercase". The control panel operates in the following manner:

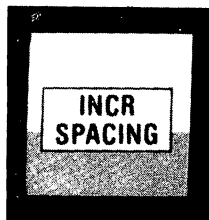
SELECT

After turning ON the printer, press the SELECT switch; the lamp beneath it illuminates. The printer is ready to receive data from the CPU however, it is not yet selected as the printing device. See the SELECT statement (Chapter 2). When the SELECT switch is depressed again, the SELECT lamp is extinguished and the printer is temporarily deactivated (deselected). The SELECT switch can be used to halt printing temporarily (as when changing paper or ribbon) without causing loss of data in the print buffer.

LOWERCASE FUNCTIONS:

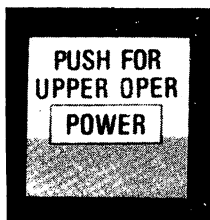
The lower case functions are active when the "PUSH FOR UPPER OPER." button is not held down while another function key is pressed. The \uparrow , \rightarrow , \downarrow , \leftarrow keys produce movement in increments of a character width (10 or 12 pitch) in the X-direction and a line feed in the Y-direction. Touching the keys produces a single step motion. When the keys are held down, a more rapid continuous motion is produced. For the uppercase functions of these keys, see their descriptions under UPPERCASE FUNCTIONS.

INCREMENTAL SPACING:



When this key is touched, a light beneath it illuminates. The \uparrow , \rightarrow , \downarrow , \leftarrow keys now produce incremental motion (1/60"). Touching the keys produces a single step motion. If the keys are held down, a more rapid continuous motion results. The INCREMENTAL SPACING key remains active until disabled by again pressing INCR. SPACING. This extinguishes the light beneath it and returns the Model 2271P to either 10 or 12 pitch standard character, and line feed spacing.

UPPERCASE FUNCTIONS:



If this key is held down while another function key is pressed, the uppercase functions are active. For example, the Home key, will now move the paper and carriage to the Home position of the form instead of causing \leftarrow print element motion. For the lowercase functions of these keys, see their descriptions under LOWERCASE FUNCTIONS.

CARRIAGE RETURN/LINE FEED

When this switch is depressed briefly while the "PUSH FOR UPPER OPER." switch is held down, the paper advances one line and the print carriage returns to the left margin currently specified. If the switch is held down, the paper advances (line feeds) continuously.

TOP-OF-FORM

When this button is depressed while the "PUSH FOR UPPER OPER." button is held down, continuous form paper is automatically advanced 11 inches or to the top of the next form.

The printer's Top-Of-Form indicator is automatically reset for eleven (11) inches whenever the printer power is turned on. When inserting new paper, it should be manually adjusted to the paper's Top-Of-Form position. To do this, adjust the paper to the physical beginning by manually rolling the platen to the top of the form. Then hold in the left platen knob (carriage clutch) while pressing the Top-Of-Form switch. When the platen ceases to move, the Top-Of-Form position has been set. Do not release the clutch knob until the paper feed motor has stopped. It is recommended that the Home position be reset whenever Top-Of-Form is reset.

SET HOME

When the "PUSH FOR UPPER OPER." button is held down while this switch is depressed, the Home position (X=0, Y=0) is set at the current form location. Whenever the Top-Of-Form is set, Home should be reset as well. Home can be specified at the physical top of the form or any desired location on the form.

RIBBON OUT LAMP-HOME

With the "PUSH FOR UPPER OPER." button held down while this key is pressed, the paper and print carriage move to the currently specified Home position. The lamp indicates that the ribbon cartridge should be changed. The printer should be deselected and a new ribbon cartridge installed (See Section 1.5). After the cartridge is changed, printing is resumed by pressing the SELECT switch.

Other Printer Controls

PITCH

This slide switch (located inside the front cover on the chassis, slightly forward and below the print carriage) is used to select the appropriate format for 10-pitch (126-column line) or 12-pitch (151-column line) printing. To select 10 characters per inch, set the switch to 10; to select 12 characters per inch, set the switch to 12. When plotting, the buffer capacity is 126 or 151 characters depending upon the setting of the pitch selection switch.

AUDIO ALARM

If the ribbon runs out while the printer is being used, the printer ceases operation and an audible one-half second tone is sounded. The printer should be deselected before attempting to correct any printer malfunctions. The audio alarm can also be programmed to sound using a HEX(07) code (see Section 5.2).

PLATEN RELEASE KNOB (PLATEN CLUTCH)

The left-hand platen knob disengages the platen mechanism to allow for setting the Top-Of-Form. Pushing this knob in disengages the platen from the motor which advances it.

PRINT IMPACT ADJUSTMENT LEVER

Located on the right of the print element post is a small lever which adjusts the element impact for multiple copy forms. The center adjustment is the standard position (3). Moving the lever forward to position (1) decreases the striking force. Moving the lever rearward to position (5) increases the striking force.

PAPER RELEASE LEVER

The rightmost platen adjustment lever allows the paper to move relative to the platen, to squarely align the paper and the platen and to select the printer for friction-feed or pin-feed operation. For friction-feed paper, this lever should be in the locked position (rearward); for pin-feed paper, it should be in the release position (forward).

PAPER THICKNESS LEVER

The leftmost platen adjustment lever allows multiple copy forms to be accepted in the platen. For a single sheet, the lever should be forward. The lever should be moved rearward as form thickness increases.

1.9 FORM ALIGNMENT

On a normal typewriter, horizontal carriage positioning is limited to multiples of single character widths (10 pitch or 12 pitch). Similarly, vertical positioning is limited to multiples of standard line feed increments, typically based on six lines per inch. This is often not sufficient to accurately align printed output on a form, especially if the form was not designed for use in a typewriter.

Form alignment can be performed manually or under immediate mode or program control in the Model 2271P. The user can specify Tabs, Line Feed Spacing and other parameters in an application program. Note, however, that all Tabs, Line Feed Spacing, Left Margin and Top-Of-Form are reset to their default (power on) values whenever the Model 2271P is turned on.

The programmable print and plot form formatting commands are discussed further in Chapters 3 and 4. The hexadecimal forms filling formatting commands are discussed further in Chapter 5.

Programmable Form Alignment

On the Model 2271P, printing is done on a standard line feed and 10 or 12-pitch character spacing basis. The character print position is moved with respect to the last character printed. Certain conventions govern formatting such as the left margin location and PRINT statement syntax (i.e. commas and semicolons). Plotting is done on a 1/60 inch incremental basis. The character print position moves relative to the last point plotted as specified by incremental vectors in the PLOT statement and depends on the lengths of previously printed fields. In form filling the output is printed and/or plotted on the form by moving to locations with respect to a user specified Home position which do not depend on the data typed in previous fields.

The Model 2271P form filling commands are specifically designed for positioning output on preprinted forms in non-standard typewriter spacing without respect to previously typed fields. These commands represent a much simplified means of obtaining a high degree of accuracy in forms positioning. These positioning commands may be divided into two groups:

1. Move to Fixed Position

Move commands allow the carriage to be positioned anywhere on the form to within an accuracy of 1/60 inch referenced with respect to a preset Home position, on the form. This feature makes current character positioning completely independent of previous positions, and substantially simplifies the effort necessary to both design and fill-out forms. Set Home identifies the absolute zero reference point on the form. Generally, the upper left-hand corner ($x=0$ $+x \rightarrow$, $y=0$ $+y \downarrow$) is defined as the Home position. This simplifies specification of the other points on the form since they will all be positive with respect to the upper left-hand corner. See Appendix C for a discussion of locating Home, and specifying other positions.

2. Set Left Margin/Line Feed Spacing

Commands are provided for setting the left margin to other than the default (power on) left margin and for setting the line feed size to other than 1/6 inch/line (6 lines/inch). These are useful when preprinted forms are used which do not have standard line feed and carriage return spacing.

Most forms can be divided into three general classes:

1. Those designed for typewriter output, with standard 10 or 12 pitch character spacing and line feed size (6 lines per inch).
2. Those conforming for the most part to typewriter spacing, but with some non-standard sections.
3. Those not designed for typewriter output, consisting mainly of non-standard character and line feed spacing.

Forms in the first classification require none of the special form filling or plotting commands. These can be handled using only the standard format features found in the BASIC language (PRINT, PRINT TAB(), PRINTUSING, etc.)

Forms in the second classification can, in general, be handled using some of the special HEX form filling commands to execute the non-standard platen and print carriage motions, followed by standard BASIC language statements to create the printed output. For example, the non-standard portion of such a form might consist of a double column of figures starting 4 1/2 from the left margin, with the columns being 25 characters apart. The line feed spacing for each column might be 12 lines per inch. The standard portions of the form could be filled out using standard BASIC print statements, while the left margin and line feed size could be set to non-standard values to print the column data using the special HEX form filling commands.

Forms in the third classification are best handled completely by the special HEX form filling commands to execute the nonstandard platen and print carriage motions, followed by standard BASIC statements to create the printed output. With this method, the location of every field to be printed is specified in absolute coordinates with respect to the form's Home position by a HEX(E7XXXXYYY) command followed by a semicolon. The HEX(E7) command changes the printer's mode of operation. When a print argument is preceded by an incremental move command (HEX(E7)), the printer prints the first character of the print argument prior to spacing to the next character's print position instead of spacing prior to printing the character. This way the print position of the element printed is the exact location specified in the move command. If an entire form is to be printed using HEX(E7) commands these spacing, printing sequence and formatting differences are transparent to the user. If, however, the program intermixes PRINT HEX(E7) and other PRINT or PRINTUSING statements, the user must take into account the effects of trailing punctuation (i.e. suppression of carriage returns). Also see Chapters 4 and 5.

Manual Form Alignment

The Model 2271P Plotting Output Writer also offers an extensive complement of control buttons specifically designed to simplify the task of manually aligning the print element with a preprinted form. The control panel switches are operational when the printer is deselected (SELECT lamp is extinguished). When deselected, the printer does not accept or print data from the 2200 CPU.

Some common manual procedures for initializing a form are:

1. Set Home - Using the \uparrow , \downarrow , \leftarrow , \rightarrow switches, align the platen and carriage at the desired Home position on the form. Press the Set Home switch to set Home at this position.
2. Set Top-Of-Form - Using the \uparrow , \downarrow switches, move the platen to the top of the form. Hold in the left platen knob (carriage clutch) while pressing the Top-Of-Form button on control panel. When the platen stops moving, the Top-Of-Form has been reset.

Continuous Form Alignment

When processing continuous forms, the Top-Of-Form and Home positions on the first form must be manually defined as described above. The Top-Of-form and Home for all subsequent forms can be set programmably by initiating the following procedures. Note the importance of trailing punctuation.

1. If the forms are 11 inches:

Programmably reset Top-Of-Form and Home for each subsequent form with a statement such as:

```
100 PRINT HEX(OCE4);
```

2. If the forms are other than 11 inches:

Programmably move the form a distance equal to the length of the form in the Y direction, then reset Top-Of-Form and Home for each subsequent form with statements such as:

- (a) 100 PRINT HEX(E70000YYYYE4);

Subsequent output will begin at the Home position.

- (b) 100 PRINT HEX(E70000YYYYE4)

Subsequent output will begin one character right of the Home position

- (c) 100 PRINT HEX(E70000YYYY)

```
100 PRINT HEX(E4)
```

Subsequent output will begin one line below and one character right of the Home position.

CHAPTER 2: DEVICE SELECTION

In order for a peripheral device to be utilized by the CPU it must be connected in the system with a special cable and controller (the peripheral controller board for the device is inserted in an I/O port of the CPU) and addressed with a three-digit address code which is specified in the SELECT statement. See the 2200 BASIC language manual applicable to the system's CPU for the other uses of SELECT.

Once the Model 2271P has been properly SELECTed, it can be programmed to generate hardcopy output with the appropriate BASIC statements. The Model 2271P responds to all statements in the Wang BASIC and BASIC-2 instruction sets for PLOT, PRINT, LIST and CO.

In print mode, (when a PRINT, LIST or CO statement is executed), the buffer capacity represents the maximum number of characters that can occur in a line of text. Depending upon the device type specified, the line currently in the buffer is usually printed (and a carriage return/line feed executed) whenever the line width specified in the SELECT PRINT statement is exceeded, the 10 pitch (126 characters) or 12 pitch (151 characters) buffer capacity is exceeded, or a HEX(OD) carriage return/line feed is executed. When plot mode is selected, (when a PLOT statement is executed), the data in the buffer are printed when the buffer capacity is exceeded (either 126 or 151 characters, depending upon the setting of the pitch control). The platen and print carriage move only as explicitly commanded in the PLOT statement incremental vector motions, or HEX control codes (such as HEX(OD) or HEX(OA) carriage return/line feed, etc).

This chapter discusses the general forms of the SELECT statement used for generating output with this unit. For more detailed information concerning the syntax and programming of these and the other output statements for the Model 2271P, consult the Wang BASIC Language Reference Manual applicable to your CPU. Additionally, Wang Laboratories supports an extensive set of printer and plotter utilities. These utilities require only a minimum of programming knowledge and experience, and their use is recommended.

2.1 THE SELECT STATEMENT

Whenever "Master Initialization" occurs at the system CPU, the default address for all PRINT, LIST and CO output is set to 005, the primary CRT. All PLOT output defaults to address 413, the primary plotter. If the Model 2271P is to be used for printed output (PRINT, LIST, CO), the SELECT statement must be used to select the printer as the output device for the desired class of output operation. The printer SELECT switch must also be depressed and the SELECT lamp illuminated. A SELECT statement can be executed either in the Immediate Mode or as a statement within a program.

Example:

```
:100 SELECT PRINT 215 (126)
```

Where:

```
I/O Class = PRINT  
Device Address = 215  
Line Width = (126)
```

If a line width is not specified in a SELECT PRINT, SELECT LIST or SELECT CO statement, the line width defaults to the width of the primary CRT. In a system with an 80-column CRT, the standard line length is 80 characters. The standard line width is 64 characters in a system with a 64-column CRT.

Device Addressing

The device address (XYY) has two components. They are the device type and the unit device address. The unit device address (YY) is used by the CPU to electronically select a specified device. It is the address set in the devices controller in the CPU, and is therefore unique for each device. The device address of the Model 2271P controller is preset to 15 by Wang Laboratories before the unit is shipped. If a second Wang printer is used on the same CPU, it is usually assigned device address 16 by the Wang Service Representative who installs the system.

The device type (X) determines which of the system I/O routines are used to control the device. A device may be addressed using more than one device type and several devices may be addressed using the same device type. For example, the device type determines whether or not carriage return commands are sent by the CPU whenever the buffer capacity is exceeded. When a PRINT statement is executed, the Model 2271P printer automatically executes a carriage return at the end of a specified character line length, and/or when the buffer capacity is exceeded. The Model 2271P automatically executes a line feed/carriage return (i.e. returns print carriage to left margin and advances the paper to a new line) following the reception of a carriage return HEX(OD) code from the CPU. The plotter does not carriage return when the PLOT statement is executed unless the carriage return code is included in the PLOT statement in a HEX literal.

Type 0 This device type is usually used to address devices that do not automatically execute a line feed after a carriage return. When this device type is used, the CPU issues a line feed code (HEX(OA)) after each carriage return code (HEX(OD)). Because the Model 2271P printer automatically executes a line feed after each carriage return for PRINT, LIST and CO operations, use of device type 0 causes output to be double spaced (a line feed is issued by the CPU in addition to the automatic line feed at the end of each line).

Example:

```
:SELECT PRINT 015 (80)
:10 FOR I=1 TO 5
:20 PRINT "AABCCDDEEFFGGHHIIJJKLLMMNNOOPPQRRSSTTUUVVWW"
:30 NEXT I
:RUN (EXECUTE)
```

Output:

```
AABCCDDEEFFGGHHIIJJKLLMMNNOOPPQRRSSTTUUVVWW
AABCCDDEEFFGGHHIIJJKLLMMNNOOPPQRRSSTTUUVVWW
AABCCDDEEFFGGHHIIJJKLLMMNNOOPPQRRSSTTUUVVWW
AABCCDDEEFFGGHHIIJJKLLMMNNOOPPQRRSSTTUUVVWW
```

Type 2 When this device type is selected, the CPU issues a null character (HEX(00)) following each carriage return. Device type 2 is generally used with devices that automatically execute a line feed after a carriage return and is the device type normally used with the Model 2271P for PRINT, LIST and CO operations. With this device type, output is single spaced since no additional line feed is issued by the CPU.

Example:

```
:SELECT PRINT 215
:10 FOR I=1 TO 5
:20 PRINT "AABCCDDEEFFGGHHIIJJKLLMMNNOOPPQRRSSTT"
:30 NEXT I
:RUN (EXECUTE)
```

Output:

```
AABCCDDEEFFGGHHIIJJKLLMMNNOOPPQRRSSTT
AABCCDDEEFFGGHHIIJJKLLMMNNOOPPQRRSSTT
AABCCDDEEFFGGHHIIJJKLLMMNNOOPPQRRSSTT
AABCCDDEEFFGGHHIIJJKLLMMNNOOPPQRRSSTT
AABCCDDEEFFGGHHIIJJKLLMMNNOOPPQRRSSTT
```

Type 4 Device type 4 is usually used in the PLOT mode. Line length is not specified. When used with PRINT, LIST and CO operations the automatic carriage return/line feed normally issued by the CPU at the end of these statements is suppressed. In this case, the Model 2271P initiates a carriage return/line feed, only when a carriage return code HEX(OD) is issued by the program, or the CPU (by depressing the keyboard RETURN key).

Example 1: (10 pitch)

```
:10 SELECT PRINT 415
:20 FOR I=1 TO 15
:30 PRINT "AABBCCDDEE"
:40 NEXT I
:50 PRINT HEX(OD)
:RUN (EXECUTE)
```

Output: (Reduced)

```
AABBCCDDEEAABBCCDDEEAABBCCDDEEAABBCCDDEEAABBCCDDEEAABBCCDDEEAABBCCDDEEAABBCCDDEEAABBCCDDEEAABBCC
DDEEAABBCCDDEEAABBCCDDEE
```

Example 2: (10 pitch)

```
:10 SELECT PRINT 415
:20 FOR I=1 TO 3
:30 PRINT "AABBCCDDEEFFGGHHIIJJKLLMM
NNOOPPQQRRSSTTAAABBCCDDEEFFGGHHIIJ
KKLLMMNNOOPPQQRRSSTTAAABBCCDDEEFFGG
HHIIJJKLLMMNNOOPPQQRRSSTTAAABBCC
DDEEFFGGHHIIJJKLLMMNNOOPPQQRRSS
TT"
:40 NEXT I
:50 PRINT HEX(OD)
:RUN (EXECUTE)
```

Output: (Reduced)

```
AABBCCDDEEFFGGHHIIJJKLLMMNNOOPPQQRRSSTTAAABBCCDDEEFFGGHHIIJJKLLMMNNOOPPQQRRSSTTAAABBCC
DDEEFFGGHHIIJJKLLMMNNOOPPQQRRSSTT
AABBCCDDEEFFGGHHIIJJKLLMMNNOOPPQQRRSSTTAAABBCCDDEEFFGGHHIIJJKLLMMNNOOPPQQRRSSTTAAABBCC
DDEEFFGGHHIIJJKLLMMNNOOPPQQRRSSTT
AABBCCDDEEFFGGHHIIJJKLLMMNNOOPPQQRRSSTTAAABBCCDDEEFFGGHHIIJJKLLMMNNOOPPQQRRSSTTAAABBCC
DDEEFFGGHHIIJJKLLMMNNOOPPQQRRSSTT
```

Example 3:

```
:10 SELECT PLOT 415
:20 FOR I=1 TO 5
:30 PLOT 10 <10, , "*" >
:40 PRINT HEX(ODOA)
:50 NEXT I
:RUN (EXECUTE)
```

Output:

```
*****
*****
*****
*****
*****
```

Type C Device type C provides the identical features of device type 4 with increased speed. It is available only with the 2200VP/MVP CPU and can be used for plotting only. Instead of serially defining the plotter increments in a code stream, the CPU generates a five-byte binary vector which locates the plot elements allowing considerably more efficient throughput than device type 4.

Example:

```
10 SELECT PLOT C15
20 PLOT 10 <10, , "*" >
```

Output:

```
*****
```

Line Width

Line width is an optional parameter in a SELECT PRINT, SELECT LIST, or SELECT CO statement which specifies the number of characters to be sent out to the printer before the system sends out a carriage return code and resets the internal character (column) count. Line width is normally varied to accommodate paper of different widths. As a line of output is printed on the Model 2271P, the CPU keeps a count of the number of characters sent (column count). If this column count equals the current value of the line width before the output line is complete, a carriage return is transmitted to the printer, the column count is reset to zero, and the unfinished output is continued on the next line. If the output is completed and a carriage return is transmitted before the column count equals the line width, the system automatically resets the column count to zero for the start of a new line. (A PRINT statement with no trailing comma or semicolon causes a carriage return to be executed at the end of the output.) The column count is reset to zero under any one of the following conditions:

1. The column count equals the line width.
2. A PRINT, PRINTUSING, or HEXPRINT statement with no trailing punctuation (;,) is executed.
3. The system is RESET.
4. A CLEAR command is executed.
5. The system is Master Initialized.
6. A SELECT PRINT statement is executed.

The maximum number of characters per line that can be printed in the Model 2271P is either 126 or 151 characters depending on pitch selection. In the SELECT statement, line width can be indicated in parentheses following the device address. A line width cannot be specified in the SELECT PLOT statement. For example:

SELECT PRINT 215 (80)	(Selects the Model 2271P for PRINT output and sets line width to 80).
SELECT CO 215 (64)	(Selects the Model 2271P for Console Output and sets line width to 64).
SELECT LIST 215 (140)	(Selects the Model 2271P for listing a program or disk catalogue and sets line width to 140).

If a line width is not specified for PRINT, LIST or CO, either the default or the last line widths selected for these operations are used. Note: The default line width set during Master Initialization is equal to the line width of the primary CRT (80 characters with an 80 column CRT). The maximum line width which can be specified in a SELECT statement is 255. However, the use of a line length greater than 126 or 151 characters is not recommended. A line width specified greater than 126 (10 pitch) or 151 (12 pitch) columns typically produces two carriage returns; one done automatically by the printer when a full line of characters (126 or 151) have been printed, another sent out by the system when the line count specified in the SELECT PRINT statement is exceeded. Specifying a line width shorter than the maximum allowable causes a carriage return to be sent out when the line count is exceeded.

Example 1:

```
:5  REM EXAMPLE OF USING A LINE LENGTH LESS THAN THE MAXIMUM NUMBER
    OF CHARACTERS IN THE PRINT LINE
:10 SELECT PRINT 215 (5)
:20 PRINT "THE MODEL 2271P PRINTS UP TO 151 CHARACTERS PER LINE"
:RUN (EXECUTE)
```

Output:

```
THE M
ODEL
2271P
PRINT
S UP
TO 15
1 CHA
RACTE
RS PE
R LIN
E
```

Note that embedded spaces in the line are included in the column count.

Example 2:

```
:10 REM EXAMPLE OF USING A LINE LENGTH GREATER THAN 126 (10 pitch)
:20 SELECT PRINT 215 (151)
:30 PRINT "THIS LINE INCLUDING SPACES CONTAINS 180 CHARACTERS;
        SINCE THAT IS LONGER THAN THE MAXIMUM LINE WIDTH OF 126
        AND THE LINE WIDTH SPECIFIED IN LINE 20 IT WILL PRINT
        OUT IN THREE LINES."
:RUN (EXECUTE)
```

Output: (Reduced)

```
THIS LINE INCLUDING SPACES CONTAINS 180 CHARACTERS; SINCE THAT IS LONGER THAN THE MAXIMUM LINE WIDTH OF 126 AND THE LINE WIDTH
SPECIFIED IN LINE 20 IT
WILL PRINT OUT IN THREE LINES
```

If a value does not fit at the end of a print line, it is output on the next line, unless it is generated by a HEX code. For example, executing the following program line with a line length of seven characters

```
:SELECT PRINT 005(7)
:10 FOR I=1 to 4:PRINT "AAB";:NEXT I
:RUN(EXEC)
```

produces

```
AABAAB
AABAAB
```

If a value is output with a HEX code, it is split at the end of a line and continued on the next line. For example, this program line

```
:SELECT PRINT 005(7)
:10 FOR I = 1 to 4:PRINT HEX (414142);:NEXT I
:RUN(EXEC)
```

produces

```
AABAABA
ABAAB
```

2.2 SELECT PLOT

```
:SELECT PLOT 415 (or SELECT PLOT C15-2200VP/MVP only)
```

This statement selects the Model 2271P for PLOT operations. Plotting can occur in immediate or program modes.

Example:

```
Program Mode
:10 SELECT PLOT 415
:20 PLOT 50 < 5, , "*" >
:RUN(EXEC)
```

When this program is executed, the plotter output is:

```
*****
```

2.3 SELECT PRINT

```
:SELECT PRINT 215 (126)
```

This statement selects the printer with device address 215 for all program output resulting from the execution of PRINT, PRINTUSING or HEXPRINT statements. Printout resulting from PRINT and HEXPRINT statements entered in the Immediate Mode appears on the CRT unless the printer is also selected for CO (see SELECT CO 215).

Example:

```
Program Mode
:10 SELECT PRINT 215 (126)
:20 PRINT "N", "2 to the Nth"
:25 PRINT
:30 FOR X=0 TO 8
:40 PRINT X, 2 X
:50 NEXT X
:RUN(EXEC)
```

When this program is executed, the printed output is:

N	2 to the Nth
0	1
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	256

Example:

```
:10 SELECT PRINT 215 (151)
:20 X=7:Y=2.0:Z=5
:30 PRINT USING 40, X;Y;Z
:40 % ##.##
:RUN (EXEC)
```

Output:

7.0 2.0 5.0

Example:

```
:05 DIM A$25
:10 SELECT PRINT 215 (40)
:20 A$ = "THE 2271P PRINTER/PLOTTER"
:30 HEXPRINT A$
:RUN (EXEC)
```

Output:

544845203232373150205052494E5445522F504C4F54544552

2.4 SELECT LIST

:SELECT LIST 215

This statement selects the printer with device address 215 for LIST operations.

2.5 SELECT CO (CONSOLE OUTPUT)

:SELECT CO 215 (40)

This statement selects the printer with device address 215 for all Console Output and sets the line width at 40 characters. Console Output includes all system displays, such as the READY message, output from STOP and END statements, any data keyed in from the keyboard in console input mode or response to INPUT (?) requests and all output from Immediate Mode operations, TRACE statements, and error messages.

2.6 COMBINING SELECT PARAMETERS

It is possible to combine parameters in a SELECT statement. However, it is not possible to select two output devices for the same I/O operation class concurrently. Only the last address specified will be selected.

Example:

SELECT PRINT 215 (100), LIST 215(80), CO 215 (112)

2.7 DESELECTING THE MODEL 2271P

The printer must be SELECTed for all PRINT, LIST, PLOT and CO operations.

To deselect the printer, use one of the following methods:

1. Select another device for PLOT, PRINT, LIST or CO by using the SELECT statement.
2. Master Initialize the system (turn Power OFF, then ON). Master Initialization selects the CRT for all LIST, PRINT and CO operations.
3. Key CLEAR and touch RETURN/EXECUTE. PRINT and LIST operations are returned to the default device (same as the address for Console Output (CO)). If the printer is currently the CO device, either method 1 or 2 must be used to deselect it.
4. Depress the SELECT lamp (it extinguishes). This is the only method of deselection which does not lose the data in the printer buffer. This method should be used when temporary deselection is required as when changing the paper or ribbon cartridge.

CHAPTER 3: PLOT MODE

3.1 THE PLOT STATEMENT

When a PLOT statement is executed the print element is always moved relative to the last plotted point rather than relative to a fixed origin. The PLOT statement's maximum move vector is about 17 inches. However, using the hexadecimal MOVE commands, the effective plotting area can be increased in the vertical direction (Y) to + 32,767 increments (i.e. approximately + 546 inches or + 49 pages @ 11 inches per page). The width is limited to 13 inches. When a PLOT statement exceeds the platen width, the overrun characters will not be printed. Therefore, when plotting always place the longer of the axis lengthwise along the paper. The PLOT statement is very versatile. It can be used to plot single functions, multiple functions and added or concatenated functions. Plots can also be measured (manually scaled) to draw conclusions about the sizes of and relationships between the arguments and/or functions.

The PLOT statement has the following general form:

```
PLOT [expression 0]<[expression 1],[expression 2],[literal]>[  
expression 0]< ...,...,...> [, .....
```

Where:

expression 0: Represents the "replication factor" or the number of times the values inside the plot enclosures, < , , > are plotted. If omitted, expression 0 is assumed to be 1.

(1 ≤ expression 0 < 1000)

expression 1: Represents X increments of 1/60 in. (0.0423 cm.).

(-1000 < expression 1 < 1000)

When positive (+) move to the right, when negative (-) move to the left. If omitted, expression 1 is assumed to be 0.

expression 2: Represents Y increments of 1/60 in.(0.0423 cm).

(-1000 <expression 2 <1000)

When positive (+) move up, when negative (-) move down. If omitted, expression 2 is assumed to be 0.

literal: Represents the argument (character(s)) to be plotted. The character or characters to be printed can be specified as a literal-string in quotes or a HEX literal or the value of an alpha variable. The PLOT interval can also be any programmable function specified with HEX control codes. "Null" (a blank space) implies move the typing element the X and Y distance specified in expressions 1 and 2, without plotting.

Expressions 0, 1 and 2 are truncated to integers.

EXAMPLES OF PLOT STATEMENTS

Example 1: Hex String

```
SELECT PLOT 415
:10 PLOT<10,20, HEX(414243E4)>
:RUN(EXEC)
```

Result 1:

Advances X=10 increments (of 1/60") and Y=20 increments and plots ABC, then sets the Home position at this location.

Example 2: Null

```
SELECT PLOT 415
:20 C=40 : D=50
:30 PLOT<C-10, D+20,>
:RUN(EXEC)
```

Result 2:

Advances X=30 increments and Y=70 increments without plotting any characters.

Example 3: Alpha Variable

```
SELECT PLOT 415
:20 A$="PRINT THIS"
:30 X = 10
:40 PLOT 2 <X, 10, A$>
:RUN(EXEC)
```

Result 3:

Advances X=10 increments and Y=10 increments, then prints PRINT THIS. Advances X=10 increments and Y=10 increments, from S in PRINT THIS then prints PRINT THIS (again).

Example 4: Literal String

```
SELECT PLOT 415
:20 N=10
:30 PLOT N <20, ,"ABC">
:RUN(EXEC)
```

Result 4:

Advances X=20 increments and Y=0 increments. Prints ABC; repeats this 10 times, starting at C of the last ABC.

Example 5: Multiple Arguments

```
SELECT PLOT 415
:20 PLOT <10,20,"*">,<20,,"ABC">
:RUN(EXEC)
```

Result 5:

Advances X=10 increments and Y=20 increments and prints a star (*), then advances X=20 increments and Y=0 increments from the star (*) and prints ABC.

Example 6: Adding Functions

```
SELECT PLOT 415
10 Y1 = SIN(Y)*(1+Y)
20 Y2 = SQR(4*(#PI ↑ 2)-Y ↑ 2)
30 X = Y1 + Y2
40 FOR Y = -2*#PI TO 2*#PI STEP #PI/32
50 PLOT <X,Y," ">
60 NEXT Y
RUN(EXEC)
```

Result 6:

Plots the sum of the functions Y1 and Y2 over the range specified.

Example 7: Family of Functions

```
SELECT PLOT 415
10 FOR A = 1 TO 4
20 FOR X = -20 TO 20 STEP .5
30 Y = A*X
40 PLOT <X,Y,"* ">
50 NEXT X
60 NEXT A
```

Result 7:

Plots a family of curves relative to the same set of axis.

PRINTING ON GRAPHS

Documenting graphs (i.e., drawing coordinate axes, labeling points, etc.) on the Model 2271P can be accomplished using either the PRINT or PLOT statements. When printed or plotted, the pitch of characters in literal strings in quotes is dependent upon the setting of the pitch control, so proper character spacing will automatically occur.

Example:

```
10 PLOT 25 < 5,,"* ">
20 PLOT 12 <,-5,"* ">
30 PLOT 25 <,-5,,"* ">
40 PLOT 12 <,5,"* ">
50 PLOT <18, 36, "REPORT
HEADING">
```

Result:

Plots a rectangle 25 stars (*) wide by 12 stars (*) high with REPORT HEADING in the center.

CHAPTER 4: PRINT MODE

4.1 THE PRINT STATEMENT

The PRINT statement has the following general form:

```
PRINT [t] [print element] [t] [t print element] .... [t]...
```

where:

t = a comma or a semicolon
print element = an expression, TAB (expression), an alpha
or numeric variable, an array element, or
a literal string.

The PRINT statement outputs the values of its print arguments on the selected output device according to certain conventions of format and syntax. Numeric values and the results of evaluated numeric expressions are output by the PRINT statement in either fixed or floating point format depending on their absolute value. Negative numbers are printed with a leading minus (-) sign and trailing blank. Non-negative numbers are printed with a leading and trailing blank. Alpha values (literal strings in quotes, HEX literals and values from STR functions) are output character-by-character (byte-by-byte). See the section on the PRINT statement in the BASIC Language Reference Manual applicable to the available CPU for a comprehensive discussion of how numeric and alphanumeric values are output, and examples of the PRINT statement.

Successive print elements in a single PRINT statement must be separated either by commas or semicolons. Commas produce output differently than semicolons. The ability to format printed output in a PRINT statement using commas, semicolons and other methods is discussed in this chapter.

When execution of the PRINT statement terminates, a carriage return (CR) is issued. Normally this is the desired result. This CR may be suppressed by adding a comma or semicolon to the end of the PRINT statement.

Normally, all data sent to the 2271P is printed with respect to the currently specified left margin and line feed values using a "space-before-print" sequence to create the proper character spacing. The printer executes a space prior to printing each character of the print argument.

However, line feed and left margin values are disregarded and printer output is handled with respect to a preset Home position using a "print-before-space" sequence when the print argument is preceded by an incremental move command (HEX(E7)). In this case, the printer prints the first character prior to spacing to the next character's print position instead of spacing prior to printing the first character. This means that the print position of the element printed is the exact location specified in the move command. If an entire form is to be printed using HEX(E7) commands these spacing, printing sequence and formatting differences are transparent to the user. If, however, the program intermixes PRINT HEX(E7) and other PRINT or PRINTUSING statements, the user must take into account the effects of trailing punctuation (i.e. suppression of carriage returns).

The trailing semicolon causes the first carriage return following a HEX(E7) command to return the printer to left margin oriented mode, and suppresses the line feed. Subsequent carriage returns do not suppress the line feed. Also see Chapter 5 Section 2.

4.2 FORMATTING PRINTED OUTPUT

Formatting of printed output can occur in several ways. The user can:

1. Specify comma and semicolon element separators in the PRINT statement.
2. Specify the exact format in the PRINTUSING statement.
3. Specify the format locations with the PRINT TAB() function.
4. Specify the format locations using Hex codes in the PRINT HEX() literal.

The PRINT Statement (Comma and Semicolon Element Separators)

Specifying commas as the element separators in PRINT statements causes printing of successive arguments to occur at the beginning of every sixteen columns. The PRINT, PRINTUSING and HEXPRINT statements are used with the Model 2271P printer in the same manner as they are used with the CRT, although more print zones of 16 characters each are available on the printer than on the CRT.

When 10-pitch is selected, the Model 2271P has a line length of 126 characters, divided into seven zones of 16 characters each and one zone of 14 characters. The zones constitute columns 0-15, 16-31, 32-47, 48-63, 64-79, 80-95, 96-111, and 112-125 respectively.

When 12-pitch is selected, the Model 2271P has a line length of 151 characters, divided into nine zones of 16 characters each and one zone of 7 characters. The zones constitute columns 0-15, 16-31, 32-47, 48-63, 64-79, 80-95, 96-111, 112-127, 128-143, and 144-150 respectively.

Specifying semicolons as the element separators in PRINT statements causes the printing of successive print arguments to occur in the next available column. The printer spaces right one character position then prints the next argument.

Example 1: PRINTING IN ZONED FORMAT WITH COMMAS

```
:20 SELECT PRINT 215 (126)
:30 PRINT "COLUMNS 0-15", "COLUMNS 16-31", "COLUMNS 32-47"
:RUN (EXECUTE)
```

Output:

```
COLUMNS 0-15          COLUMNS 16-31          COLUMNS 32-47
```

Example 2: SKIPPING OVER ZONES WITH COMMAS

```
:20 SELECT PRINT 215 (151)
:30 PRINT "ACCOUNT NO.",,, "BALANCE DUE"
:40 PRINT "(COLUMNS 0-15)",,, "(COLUMNS 48-63)"
:50 PRINT 10082,,,153.19
:RUN (EXECUTE)
```

Output:

```
ACCOUNT NO.                BALANCE DUE
(COLUMNS 0-15)            (COLUMNS 48-63)
10082                       153.19
```

Example 3: PRINTING IN PACKED FORMAT WITH SEMICOLONS

```
:20 SELECT PRINT 215 (126): DIM A$18,P$7
:30 A$= "4-BEDROOM SALT BOX": P$= "$53,000"
:40 PRINT "STYLE: "; A$; " PRICE: "; P$
:RUN (EXECUTE)
```

Output:

```
STYLE:4-BEDROOM SALT BOX PRICE $53,000
```

In zone printing on the Model 2271P, it is important to make sure that information supplied to the last zone does not exceed the legal length of the last zone (either 7 or 14 characters long depending on pitch selection). For instance, in a 10 pitch format, if the information for the last zone exceeds 14 columns then the information is presented in the first zone of the next line.

Example:

```
:10 SELECT PRINT 215 (126)
:20 PRINT "NO.",1.2,3.4,5.6,7.8,9.0,8.4,9.5,"BALANCE DUE NOW"
```

Output:

```
NO.    1.2    3.4    5.6    7.8    9.0    8.4    9.5
BALANCE DUE NOW
```

In the above example the eighth element in line 20 exceeded six characters in length and thus was printed on the next line.

The PRINTUSING Statement (The % IMAGE Format)

When it is desired to print columns of information across a line, or print numeric and/or alphanumeric values according to an exact image the PRINTUSING statement can be used to specify the print format.

The PRINTUSING statement operates in conjunction with a referenced IMAGE statement. Print elements in the PRINTUSING statement are edited into a print line as directed by the IMAGE statement. The IMAGE statement allows alphanumeric text to be printed between the inserted print elements, and user specification of the format for the inserted print element. The format for each numerical print element is composed of # characters to specify digits and optionally +, -, ., ^, , and \$ characters to specify sign, decimal point, exponent, blank and edit characters. If the number of print elements exceeds the number of formats in the IMAGE statement, a carriage return/line-feed occurs, and the IMAGE statement is reused from the beginning for the remaining print elements. The carriage return/line-feed may be suppressed by replacing the comma delimiting the print elements with a semicolon. A carriage return/line-feed normally occurs at the end of the execution of a PRINTUSING statement. This carriage return/line-feed can also be suppressed by placing a semicolon at the end of the PRINTUSING statement. PRINTUSING may not be used in the immediate mode.

For a complete discussion of the PRINTUSING and IMAGE statements, capabilities and general forms, see the BASIC Language Reference Manual applicable to the system's CPU.

Example:

```
:10 X=1: Y=2: Z=3
:20 PRINTUSING 30, X; Y; Z
:30 % #.#
:RUN(EXEC)
```

Output:

```
1.0 2.0 3.0
```

Example:

```
:100 PRINTUSING 200
:200 % PROFIT AND LOSS STATEMENT
:RUN(EXEC)
```

Output:

```
PROFIT AND LOSS STATEMENT
```

Example:

```
:100 A$ = "J. Smith" : T = 9237.51
:200 PRINTUSING 300, A$, T
:300 % SALESMAN ##### TOTAL SALES $$$,###.##
:RUN(EXEC)
```

Output:

SALESMAN J. SMITH TOTAL SALES \$9,237.51

Example:

```
:10 X=2.3: Y=27.123
:20 PRINT USING 30, X, Y,
:30 % ANGLE -#####.##### LENGTH=+##.#
:RUN(EXEC)
```

Output:

ANGLE 2.300000 LENGTH=+27.1

The PRINT TAB(); Function

The PRINT TAB();function can be used to programmably position the print location prior to typing a character. The Model 2271P advances to the column specified by the integer portion (in parentheses) of the TAB() expression, and then prints the indicated argument. Setting Tabs, clearing Tabs, and moving to Tab locations can also be performed using the special HEX codes specified as HEX literals in a PRINT statement. These procedures are discussed in the next section. The control codes for these processes are shown in Chapter 5. If the carriage position in the line being printed is greater than the TAB() argument, the TAB is ignored. For example, in the following statement

```
10 PRINT "123456789"; TAB(5); "No."
```

the TAB(5) is ignored.

Example:

```
:SELECT PRINT 215(151)
:10 PRINT TAB(75);"MASTER SEWERAGE PLAN"
:20 PRINT: PRINT
:30 PRINT TAB(40);"STREET";TAB(70);"LINE FEET";
      TAB(110);"PIPE DIA.";TAB(130);"CONNECTIONS"
:RUN (EXECUTE)
```

Output:

```
                          MASTER SEWERAGE PLAN

STREET                    LINE FEET            PIPE DIA.            CONNECTIONS
```

In the above example "MASTER SEWERAGE PLAN" is printed starting at column 75. The printer carriage returns and the form advances two lines. Then the headings specified in line 30 are printed at the specified TAB settings.

If the value of a TAB();expression is greater than the selected line length, the printer moves to the next line, ignores the TAB, and completes the PRINT statement starting at column 0.

Example:

```
:10 SELECT PRINT 215
:20 A=35
:30 PRINT TAB(A);"TANK MODE ";TAB(3*A);"CREW SIZE"
RUN (EXECUTE)
```

Output:

```
                TANK MODE
CREW SIZE
```

In the above example, "TANK MODE" is printed starting at column 35. The print position increments 105 spaces to column 149. The printer executes a carriage return/line feed and prints "CREW SIZE" starting at column 1.

When using the TAB() function to format tabular output of numeric values, it is necessary to take into account the leading sign and trailing blank which are output as a part of each number. Negative numbers are printed with a leading minus (-) sign and trailing blank. Non-negative numbers are printed with a leading and trailing blank.

Example:

```
:10 SELECT PRINT 215 (80)
:20 PRINT TAB(10);"POWER";TAB(20);"VALUE"
:30 FOR N=-1 TO 10
:40 PRINT TAB(10);N;TAB(20);(-2) N
:50 NEXT N
:RUN (EXECUTE)
```

Output:

POWER	VALUE
-1	-.5
0	1
1	-2
2	4
3	-8
4	16
5	-32
6	64
7	-128
8	256
9	-512
10	1024

The PRINT HEX() Literal

The Model 2271P uses a number of hexadecimal codes for specifying and formatting printed output. These commands allow the programmer to specify and print any character, or execute any printer control function such as moving to a preset form location (similar to using the mechanical tabs on a typewriter). The codes for these HEX literals are discussed in the next chapter and listed in the Appendices.

When printer character codes are specified in a PRINT HEX() statement the output is printed in character form (i.e. PRINT HEX(41) prints the character A. Untranslated HEX images are printed when using HEXPRINT, or PRINT HEX OF() (2200VP/MVP only). Whenever control codes and character codes are combined, the control codes are executed first before the line is printed in the order in which they are received irrespective of their location in the PRINT line. The control codes are very useful in forms filling applications where the user desires to move the platen and print element carriage in non-standard line-feed and character spacing, and move to positions on a form without respect to the current print position or length of data in previous fields.

For example, non-standard portions of a form might consist of a double column of figures starting four inches from the left margin, with the columns being five characters apart. The line feed spacing for each column might be 12 lines per inch. The left margin and line feed size could be set to non-standard values and then the column data printed using standard BASIC print techniques. The line feed size and left margin could then be returned to normal for the standard portions of the form.

Example:

```
10 SELECT PRINT 215
20 PRINT HEX(414243070A)
```

Output:

The printer sounds a one-half second tone, advances one line, then prints A B C. Hex(41) is character code for the letter A, Hex(42) is the character code for the letter B and Hex(43) is the character code for the letter C. Hex(07) and (0A) and the control codes for audio-alarm and line feed respectively.

CHAPTER 5: HEX CODES

5.1 THE HEX LITERAL

Hex literals are special forms of literal strings which can be used to represent the 2200 character set (including those not found on the keyboard) as well as printer control codes. In general, HEX literals are legal wherever alpha literal strings can be used (i.e., in PRINT and alpha assignment statements, etc.). A HEX literal has the form:

```
HEX(hh hh .. .)
```

where each h = a hex digit 0 to 9 or A to F. An even number of characters must always appear in a HEX literal; spaces are not allowed. (See Appendix A for hexadecimal characters and codes.) HEX codes for characters and printer control can be combined in a single HEX literal string. For example, the following program

```
:10 SELECT PRINT 215  
:20 PRINT HEX (410D0A42)  
:RUN (EXEC)
```

produces:

A

B

when run, since HEX(41) is the HEX code for the character "A", HEX(0D) is the printer control code for "carriage return", HEX(0A) is the printer control for "line feed" and HEX(42) is the HEX code for the character "B".

5.2 HEX CONTROL CODES

When the Model 2271P receives a HEX code for a printable character, it simply places the code into its print buffer. Unless the buffer is full, no immediate action is taken. However, certain special HEX codes do not enter the buffer, and instead cause immediate action by the printer. These special codes are the printer control codes.

See Appendix C for a discussion of how to convert inches into two's complement binary hexadecimal notation in those codes marked with a "*" in the following listing. For the examples in this chapter, the printer is always selected at address 215. The pitch switch is set at 10.

The special control codes for the printer are:

<u>FUNCTION</u>	<u>HEX CODE</u>	<u>DESCRIPTION</u>
*Set Left Margin	HEX(E8XXXX)	Allows program selection of a left margin location other than that set at "power on." Can be any integer multiple of 1/60 inch. Following the definition of a new left margin, all BASIC print output will be justified relative to the new margin specified. XXXX = the X coordinate of the margin location specified as a positive two-byte binary value in two's complement hexadecimal representation representing integer multiples of the step increment. If the value is negative or greater than the physical carriage width, it is ignored. The maximum left margin setting is 756 increments (HEX(E802F4)). This is the extreme right side of the platen. Whenever the HEX(E8) command is executed, the carriage moves to the new margin specified. A trailing semicolon will prevent a line feed following the Set Margin command. The left margin is reset to the default value whenever the printer is powered ON, or an Initialize (HEX(E5)) command is executed.

Example:

```
100 PRINT HEX (E8003C)
```

Output:

Causes the left margin to be 1 in. right of the default margin. (Hex 003C=60 multiples of the 1/60 in. increment.)

<u>FUNCTION</u>	<u>HEX CODE</u>	<u>DESCRIPTION</u>
*Move	HEX(E7XXXXYYYY)	Moves the print location to a specified X and Y position with respect to the currently specified Home position. It is important to recognize the effect of punctuation after HEX(E7) commands to keep character print position correct. See the example which follows. XXXX = the X coordinate, YYYY = the Y coordinate. This command allows the element to be repositioned to a specified location from the Home (X=0,Y=0) reference position to an accuracy of 1/60 inch. The X and Y coordinates are specified as two-byte two's complement binary values in hexadecimal representation which represent integer multiples of the 1/60 inch step increment.

Example:

```
100 PRINT HEX (E7003C003C);"ABC";
200 PRINT
300 PRINT X,Y,Z
```

Output:

Statement 100 moves the element one inch right and one inch down from the current Home position (HEX 3C=60 increment multiples) and prints "ABC" exactly at this location (print before space sequence). The trailing semicolon suppresses the line feed, therefore the PRINT at statement 200 is necessary to advance the line so that X,Y, and Z in statement 300 are not printed (in space-before-print sequence) on the same line as the output from statement 100. If the trailing comma at the end of statement 100 had been omitted, the PRINT at line 200 would make the output from statement 300 occur two lines under the output of statement 100. If all of the output on the form is created with HEX(E7) commands, it is not necessary to be concerned with trailing punctuation.

*Move	HEX (E6XXYY)	Moves the number of X and Y increments specified from the <u>current</u> character print position. XX = the number of X increments, YY = the number of Y increments. Each is specified as one byte two's complement value in hexadecimal representation representing up to <u>+127</u> increments for each axis.
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FUNCTION

HEX CODE

DESCRIPTION

Example:

200 PRINT HEX(E67F40);

Output:

Causes the print carriage to move X = +127 increments and Y = +64 increments from the current character print position.

*Set Line Feed HEX(E9YYFF)

Allows program selection of any non-standard line feed spacing which is a multiple of 1/60 in. YYFF = the line feed spacing, represented as a two-byte binary value in hexadecimal representation. The first byte (YY) equals integer multiples of 1/60 inch, and the second byte (FF) equals the fractional multiples of 1/256 of a step increment (1/15,360 inch each). If a fractional part (FF) of an increment is specified, the printer maintains a cumulative error factor, always rounding to the nearest increment (1/60). This minimizes the positional offset at the end of the form. Note that the value must always be positive. A trailing semicolon will prevent a line feed following the Set Line Feed command. Line feed spacing is reset to default whenever the printer is powered ON, or an Initialize HEX(E5) command is executed.

Example:

100 PRINT HEX(E91400);
200 PRINT HEX(E91480);

Output:

Statement 100 sets the line feed at an even 20 increments/line, or 3 lines/inch. Statement 200 sets the line feed at 20 1/2 increments/line or 2.93 lines/inch.

*Move

HEX(E0XXXXYYYY)

Moves the number of X and Y increments (1/60 inch) specified, from the current character print position. XXXX = the number of X increments and YYYY = the number of Y increments. Each is specified as a two-byte two's complement binary value in hexadecimal representation. The maximum vector for each X and Y axis is ± 32,767 increments.

<u>FUNCTION</u>	<u>HEX CODE</u>	<u>DESCRIPTION</u>
		<p>Example:</p> <pre>200 PRINT HEX(E0007F0040);</pre> <p>Output:</p> <p>Causes the print carriage to move X = +127 increments, and Y = +64 increments from the current character print position.</p>
Set Home	HEX(E4)	<p>Defines the present location of the print element and form as the Home position (X=0, Y=0, X+= + Y=)</p> <p>Example:</p> <pre>100 PRINT HEX (E4);</pre> <p>Output:</p> <p>Sets the Home (X=0, Y=0) at the current character print position.</p>
Initialize	HEX(E5)	<p>Resets the printer to default (power "on") values. It moves the typing element to the power "on" position at the left end of the carriage. The form is not moved in the vertical direction. The Home position, the Left Margin position, and the Line Feed size are automatically redefined to default, power-on values (i.e., left end of line, and 6 lines/inch). All preset TABS are also cleared. A trailing semicolon prevents a line feed following the initialize command.</p> <p>Example:</p> <pre>10 PRINT HEX(E5);</pre> <p>Output:</p> <p>Resets all printer values to default.</p>
Audio Alarm	HEX(07)	<p>Generates an audible tone about one-half second in duration in the speaker at the rear of the printer. This action is taken as soon as the HEX(07) code is received by the printer regardless of where the code occurs in the PRINT statement.</p>

FUNCTION

HEX CODE

DESCRIPTION

Example:

```

100 PRINT "1. DESELECT THE
        PRINTER"
110 PRINT "2. LOAD FORM #61.3B"
120 PRINT "3. RESELECT THE
        PRINTER"
130 PRINT "4. PRESS 'CONTINUE',
        'RETURN'; HEX(07)
140 STOP

```

Output:

The printer gives an audible tone, then prints the messages shown in lines 100 through 130.

Backspace

HEX(08)

Causes the internal line buffer pointer to be decremented by one character. Non-space characters entered prior to the backspace code(s) may be underscored (using HEX(5F)) but may not be overwritten with new characters.

Example:

```

100 PRINT "REPORT #113 - CHEMICAL
        ANALYSIS";
        HEX(08080808080808080808080808080808);
        HEX(5F5F5F5F5F5F5F5F5F5F5F5F5F5F5F5F)

```

Output:

Prints "REPORT #113 - CHEMICAL ANALYSIS" beginning at column 1.

Example:

```

100 PRINT "NAME ="; HEX (080808); "XXX"

```

Output:

Prints "NAME =" beginning at column 1.

TAB

HEX(09)

Causes the internal line buffer pointer to be incremented to the next pre-set TAB location. For setting TABS see HEX(1A).

FUNCTION

HEX CODE

DESCRIPTION

Example:

```

10 REM TAB IS PRE-SET AT COLUMN 30
15 PRINT TAB(30); HEX(1A); TAB(50);
   HEX(1A); TAB(70); HEX(1A)
20 PRINT HEX(09); "REPORT
   TITLE"; HEX(0909); "DATE"

```

Output:

Causes 'REPORT TITLE' to be printed starting at column 30, 'DATE' starting at column 70.

Line Feed

HEX(OA)

Causes the current contents of the line buffer to be printed and advances the paper one line.

Example:

```

10 PRINT "WATCH";
20 PRINT HEX(OA); "YOUR";
30 PRINT HEX(OA); "STEP"

```

Output:

```

WATCH
      YOUR
            STEP

```

Prints "WATCH YOUR STEP" on three lines

Vertical TAB

HEX(OB)

Advances the paper six lines or to the top of the next vertical tab zone (11 zones of six lines each).

Example:

```

10 PRINT "LIST OF DONORS"
20 PRINT HEX(OB); "NAME";
   TAB(25); "BLOOD TYPE"

```

Output:

LIST OF DONORS

```

NAME           BLOOD TYPE

```

Prints "List Of Donors", advances six lines and prints "Name" and "Blood Type".

<u>FUNCTION</u>	<u>HEX CODE</u>	<u>DESCRIPTION</u>
Reverse Index	HEX(FA)	Moves the paper backwards, one line at a time under program control.

Example:

```
10 FOR I = 1 TO 10
20 PRINT HEX(FA);
30 NEXT I
```

Output:

Moves the platen backward 10 lines.

Top-Of-Form	HEX(OC)	Advances the paper to the top of the next form (66-line format assumed).
-------------	---------	--------------------------------------------------------------------------

Example:

```
10 PRINT "LIST OF DONORS"
.
.
.
250 PRINT "THIS CONCLUDES THE LIST OF
DONORS"
260 REM START NEW LISTING
270 PRINT HEX(OC)
```

Output:

Prints the titles and the list, the printer advances to the top of the next form.

Carriage Return	HEX(OD)	Prints the current contents of the line buffer, returns the print element to the currently specified left margin and advances the paper one line.
-----------------	---------	---------------------------------------------------------------------------------------------------------------------------------------------------

Example:

```
10 PRINT "SPARE PARTS LIST"
20 PRINT HEX(ODODOD)
30 PRINT "ITEM", "QUANTITY"
```

Output:

SPARE PARTS LIST

ITEM QUANTITY

Prints "SPARE PARTS LIST", advances 3 lines and prints "ITEM" and "QUANTITY".

<u>FUNCTION</u>	<u>HEX CODE</u>	<u>DESCRIPTION</u>
Shift Up	HEX(0E)	Places the printer in uppercase mode. This code is for test purposes only. Printable characters automatically shift the type element up or down.
Shift Down	HEX(0F)	Places the printer in lowercase mode. This code is for test purposes only. Printable characters automatically shift the type element up or down.
Clear TAB	HEX(19)	Clears a TAB at the current location of the internal line buffer pointer. All preset tabs are automatically cleared when the power is turned ON, or an Initialize HEX(E5) command is executed.

Example:

```
20 PRINT TAB(30); HEX (1A)
30 PRINT HEX(0919)
```

Output:

Sets (line 20) then clears (line 30) the TAB at column 30.

A simple BASIC routine, such as the one shown below, may be used to clear all tabs under program control.

Example:

```
:10 SELECT PRINT 215(255)
:20 FOR I = 1 TO 126:REM 10 pitch
:30 PRINT HEX(0919);
:40 NEXT I : PRINT
:RUN(EXEC)
```

Output:

Clears all possible preset tabs from all print positions in the printer's buffer. The semicolon is placed at the end of statement 30 to suppress the normal carriage return (OD); otherwise a line would advance each time statement 30 was executed.

FUNCTIONHEX CODEDESCRIPTION

Set TAB

HEX(1A)

Sets a TAB at the current location of the internal line buffer pointer. Before setting a tab, the line buffer pointer must be set to the desired location in the line with a PRINT TAB() statement.

Example:

```
20 PRINT TAB(40); HEX(1A)
```

Output:

Positions the buffer pointer to column 40, where a tab is set.

Care must be taken when using the TAB() function to set multiple tabs. Succeeding TAB() function arguments must all be incremented by one.

Example:

```
:10 SELECT PRINT 215(126)  
:20 PRINT TAB(10); HEX(1A); TAB(21);  
HEX(1A); TAB(102); HEX(1A)  
:RUN(EXEC)
```

Output:

Statement 20 sets tabs at columns 10, 20 and 100.

If tabs are to be set near the end of the print line, it is generally advisable to select a line length greater than 126 (10-Pitch) or 151 (12-Pitch). Otherwise the TAB() argument may become greater than the actual length and cause an unwanted carriage return code HEX(0D) to be executed by the 2200 CPU.

Example:

```
:10 SELECT PRINT 215(255)  
:20 FOR I = 10 TO 120 STEP 10  
:30 PRINT TAB(I + K); HEX(1A);  
:40 K = K + 1  
:50 NEXT I  
:RUN(EXEC)
```

FUNCTION

HEX CODE

DESCRIPTION

Underscore

HEX(5F)

Output:

Sets tabs at columns 10, 20, 30, 40, 50, ..., 120 of the print line, although the TAB() function arguments are 10, 21, 32, 43, 54, ...etc.

Places an underscore character in the line buffer at the current location of the internal line buffer pointer.

Example:

```
10 PRINT "NO SMOKING PLEASE";
20 PRINT HEX(080808080808);
30 PRINT HEX (5F5F5F5F5F5F)
```

Output:

Prints "NO SMOKING PLEASE" starting in column 1.

Note that since the underscore code does not begin with a zero hexdigit, the 2200's internal line count is incremented as each underscore is executed. If underscoring is to be done near the end of the print line, it is advisable to select a line length greater than 126 (10-pitch) or 151 (12-pitch) to prevent an unwanted carriage return from being executed by the 2200 CPU.

Example:

```
10 SELECT PRINT 215(255)
20 PRINT TAB (120); "AB";
30 PRINT HEX(08085F5F)
```

Output:

Prints "AB" in print columns (120 and 121)

Delete

HEX(7F)

Clears buffer of characters sent before the '7F'. The HEX(7F) must appear in the buffer before the 125th character (150th for 12-pitch) or the buffer contents will be printed.

FUNCTION

HEX CODE

DESCRIPTION

Example:

```
100 PRINT "TITLE=";  
110 PRINT HEX(7F);  
120 PRINT "VALUE="
```

Output:

Prints "VALUE =" starting in column
1. "Title = " is not printed.

NOTE:

When control codes HEX(07), HEX(0B), HEX(0C), HEX(0E), HEX(0F) or HEX(7F) are combined with print characters in a single PRINT line, the control codes are executed first, in the order in which they occur in the PRINT line. Only after all control codes are executed is the line printed.

APPENDIX A

HEXADECIMAL CONTROL AND CHARACTER CODES

HEX CODE	PRINTER CHARACTER	HEX CODE	PRINTER CHARACTER	HEX CODE	PRINTER CHARACTER
HEX(07)	Audio Alarm	HEX(38)	8	HEX(5D)]
HEX(08)	Backspace	HEX(39)	9	HEX(5E)*	!
HEX(09)*	TAB	HEX(3A)	:	HEX(5F)*	Underscore
HEX(0A)	Line Feed	HEX(3B)	;	HEX(60)*	Space
HEX(0B)*	Vertical TAB	HEX(3C)*	[	HEX(61)	a
HEX(0C)*	Top of Form	HEX(3D)	=	HEX(62)	b
HEX(0D)	Carriage Return	HEX(3E)*	]	HEX(63)	c
HEX(0E)*	Shift Up	HEX(3F)	?	HEX(64)	d
HEX(0F)*	Shift Down	HEX(40)	@	HEX(65)	e
HEX(19)*	Clear TAB	HEX(41)	A	HEX(66)	f
HEX(1A)*	Set Tab	HEX(42)	B	HEX(67)	g
HEX(1E)*	¢	HEX(43)	C	HEX(68)	h
HEX(1F)*	°	HEX(44)	D	HEX(69)	i
HEX(20)	Space	HEX(45)	E	HEX(6A)	j
HEX(21)	!	HEX(46)	F	HEX(6B)	k
HEX(22)	"	HEX(47)	G	HEX(6C)	l
HEX(23)	#	HEX(48)	H	HEX(6D)	m
HEX(24)	\$	HEX(49)	I	HEX(6E)	n
HEX(25)	%	HEX(4A)	J	HEX(6F)	o
HEX(26)	&	HEX(4B)	K	HEX(70)	p
HEX(27)	'	HEX(4C)	L	HEX(71)	q
HEX(28)	(	HEX(4D)	M	HEX(72)	r
HEX(29)	)	HEX(4E)	N	HEX(73)	s
HEX(2A)	*	HEX(4F)	O	HEX(74)	t
HEX(2B)	+	HEX(50)	P	HEX(75)	u
HEX(2C)	,	HEX(51)	Q	HEX(76)	v
HEX(2D)	-	HEX(52)	R	HEX(77)	w
HEX(2E)	.	HEX(53)	S	HEX(78)	x
HEX(2F)	/	HEX(54)	T	HEX(79)	y
HEX(30)	0	HEX(55)	U	HEX(7A)	z
HEX(31)	1	HEX(56)	V	HEX(7F)*	Clear Buffer
HEX(32)	2	HEX(57)	W	HEX(E0)*	Move Vector
HEX(33)	3	HEX(58)	X	HEX(E4)*	Set Home
HEX(34)	4	HEX(59)	Y	HEX(E5)*	Initialize
HEX(35)	5	HEX(5A)	Z	HEX(E6)*	Move Vector
HEX(36)	6	HEX(5B)	[	HEX(E7)*	Move to Location
HEX(37)	7	HEX(5C)*	Space	HEX(E8)*	Set Left Margin
				HEX(E9)*	Set Line Feed
				HEX(FA)*	Backspace Line

NOTE:

*Indicates a character that differs from the CRT Character Set (See Appendix C). Although 112 print characters are available on the 80 x 24 CRT, the 2271P character set is only 86 characters (it does not include the accented vowels and foreign language characters etc., of the CRT, only the 86 characters of a typical selectric typeface).

APPENDIX B
SPECIFICATIONS

SPECIFICATIONS

Printer Dimensions:

Height 8 3/4 in. (22.2 cm)
Depth. 15 5/8 in. (39.7 cm)
Width. 22 in. (55.9 cm)

Approximate Net Weight:

51 lb (23.2 kg)

Stepping Rate: (incrementing only)

250 steps/sec. approx. (X or Y axis)

Stepping Increment:

1/60 in. (0.0423 cm) per step (X or Y axis)

Printing/Plotting Rate:

15 characters/sec. approx.

Accuracy:

+ 1/60 in. plus 0.003 in./in. (\pm 0.0423 cm
plus 0.003 cm/cm)

Character Element:

10-pitch or 12-pitch

Platen:

Friction-feed (standard)
Friction-feed/pin-feed (optional)

Paper Specifications:

Material: margin perforated continuous fan-fold or
discrete paper stock
Maximum form length: 11 in. (27.9 cm) 3.5 to 13 1/8 in.
(8.9 to 33.4 cm) wide
Maximum number: four copies plus original

For single part forms:

15 to 20 lb bond (20 lb recommended)

For multipart forms:

2 ply: 13½/13½ bond, 8 lb carbon
3 ply: 13½/13½/13½ lb bond, 8 lb carbon
4 ply: 12/12/12/12 lb bond, 6½ lb carbon
5 ply: 12/12/12/12/12/ lb bond, 6½ lb carbon

Carbon:

8 lb (med. hard) for 1 and 2 ply; 6½ lb, 3,4 and 5 ply.

Fastening multipart forms:

For improved forms handling use glued margins; otherwise fasten with crimps every two inches (5.1 cm) along both edges; crimps must not come closer than 0.5 in. (1.3 cm) to the fanfold.

Forms thickness:

Maximum in the print area: 0.018 in. (0.046 cm); over crimps in Margin: 0.030 in (0.076 cm); when using forms with wide and narrow copies in the same set, the top copy should be fullest width.

Sprocket holes:

Must run along both margins 0.25 ± 0.03 in. (0.635 ± 0.076 cm) from paper edge to hole-center lines; distance between hole-centers must be 0.5 ± 0.005 in. (1.27 ± 0.013 cm) non-accumulative in any five inch (12.7 cm) length; hole diameters must be 0.156 ± 0.005 in. (0.396 ± 0.013 cm); the two top and bottom drive holes (four per sheet) can be up to 0.200 in. (0.508 cm) in diameter to permit post or ring binding of output; distance between hole centers across the sheet must be uniform within 0.015 in. (0.038 cm) of 13 1/8 inches (33.4 cm).

For pre-printed forms:

Pin hole center in left margin to left side of left-most character not less than $3/8 \pm 1/16$ in. (1.0 ± 0.2 cm); pin hole center in right margin to right side of last character not less than $3/8 \pm 1/16$ in. (1.0 ± 0.2 cm).

Printing Density: Variable

Approx. 6 Lines/in. (0.167 in./line) (2.4 lines/cm vertical) when in print mode, normal character spacing (10 or 12-pitch). Minimum of 1/60 in. X and Y directions when in plot mode.

Character Set:

Full Alphanumeric (86 characters, ASCII)

Buffer Length (maximum characters/line):

151 characters (12-pitch)
126 characters (10-pitch)
126 or 151 characters (plotting)

Switches/Controls/Indicators:

ON/OFF, SELECT, PITCH, TOP OF FORM, LINE FEED/CARRIAGE RETURN, HOME, SET HOME, AUDIO ALARM, RIBBON OUT, INCREMENTAL OR CHARACTER SPACING, MANUAL ELEMENT MOTION, PRINT IMPACT, FORM THICKNESS

Programmable Functions:

Audio Alarm	Shift Up
Backspace	Shift Down
TAB	Clear TAB
Line Feed	Set TAB
Vertical Tab	Underline
Top of Form	Delete
Carriage Return	Move Print Location
Move	Set Margin
Initialize	Set line feed
Reverse Index	

Cable:

8 ft. (2.4 m) to controller board
8 ft. (2.4 m) to power source

Controller:

Standard line printer/CPU interface

Power Requirements:

115 or 230 VAC + 10%
50 or 60 Hz \pm 7 Hz
125 watts

Fuses:

3.0A (SB) for 115 VAC
1.5A (SB) for 230 VAC

Operating Environment:

50°F to 90°F (10°C to 32°C)
20% to 80% relative humidity,
non-condensing allowable
35% to 65% recommended

APPENDIX C

DECIMAL/BINARY HEXADECIMAL CONVERSION

The coordinate positions and displacement values used in the forms filling HEX literals are binary values specified in hexadecimal notation. The position is always measured with respect to: (1) the user defined Home position or (2) the current platen and print position. Positions to the right of or below the current or Home position are positive (+). Positions to the left of or above the Home or current position are negative (-). When possible, it is recommended that the Home position be defined as the extreme upper left corner of the form to simplify specification of the hexadecimal move vector. All positions will be positive with respect to this location. For certain applications, however, the Home is specified in the center of the form. Therefore two's complement notation is allowed for specifying these negative (to the left of or above Home) values. For positive one byte offset values less than $2 \frac{1}{8}$ inches, and two-byte offset values less than $4 \frac{1}{4}$ inches, the chart at the end of this Appendix provides the hexadecimal notation directly.

BINARY NOTATION

Binary numbers consist of digits whose value can only be 0 or 1. These binary digits are called bits. Each bit (digit) in a binary number represents a power of 2 greater than the bit to the right of it. For example, the binary number represented by the bits $X_7 X_6 X_5 X_4 X_3 X_2 X_1 X_0$ has a value of

$$X_7(2^7) + X_6(2^6) + X_5(2^5) + X_4(2^4) + X_3(2^3) + X_2(2^2) + X_1(2^1) + X_0(2^0)$$

Thus, if $X_7 X_6 X_5 X_4 X_3 X_2 X_1 X_0 = 0000 1011$

Its value in the decimal system equals

$$\begin{aligned} & 0(2^7) + 0(2^6) + 0(2^5) + 0(2^4) + 1(2^3) + 0(2^2) + 1(2^1) + 1(2^0) \\ &= 0 \quad + 0 \quad + 0 \quad + 0 \quad + 1(8) \quad + 0 \quad + 1(2) \quad + 1(1) \\ &= 11 \end{aligned}$$

TWO'S COMPLEMENT BINARY NOTATION

On the Model 2271P, all hexadecimal vectors (representing both positive and negative values) are specified in two's complement representation. In two's complement binary notation, the high-order bit is used to indicate the sign of the value. For positive values, the binary representation is formed as described in the previous Section. Any binary number $\leq +32,767$ is valid.

A negative binary value (two's complement format) is formed by complementing a positive value (i.e., changing all 1's to 0's, and 0's to 1's) and then adding 1. Any number $\geq -32,767$ can be specified. For example,

$$\begin{aligned} -11 &= \text{complement } (+11) + 1 = \text{complement of } 0000\ 1011 + 1 = \\ & \qquad \qquad \qquad 1111\ 0100 + 1 = 1111\ 0101 = \text{HEX}(F5) \end{aligned}$$

$$\begin{aligned} -4 &= \text{complement } (+4) + 1 = \text{complement of } 0000\ 0100 + 1 = \\ & \qquad \qquad \qquad 1111\ 1011 + 1 = 1111\ 1100 = \text{HEX}(FC) \end{aligned}$$

$$\begin{aligned} -10,000 &= \text{complement } (+10,000) + 1 = \text{complement of } 0010\ 0111\ 0001\ 0000 + 1 \\ & \qquad \qquad \qquad = 1101\ 1000\ 1110\ 1111 + 1 \\ & \qquad \qquad \qquad = 1101\ 1000\ 1111\ 0000 \\ & \qquad \qquad \qquad = \text{HEX}(D8F0) \end{aligned}$$

NOTE:

The high-order (leftmost) bit of the two's complement notation binary number is used to indicate the sign of the number (0 = positive, 1 = negative). For a two-byte number (16 bits) the high order bit is the 2^{15} position; for a one byte number (8 bits) the high-order bit is the 2^7 position. Therefore, in two's complement notation, the largest one byte binary value is ± 127 ($7F = +127, 81 = -127$). The largest two byte number is $\pm 32,767$ ($7FFF = +32,767, 8001 = -32,767$).

To form a positive value from a negative one, the number is again complemented and one is added. For example,

$$+11 = \text{complement}(-11) + 1 = \text{complement}(1111\ 0101) + 1 = (0000\ 1010) + 1 = 0000\ 1011 = \text{HEX}(0B)$$

$$+4 = \text{complement}(-4) + 1 = \text{complement}(1111\ 1100) + 1 = (0000\ 0011) + 1 = 0000\ 0100 = \text{HEX}(04)$$

$$\begin{aligned} +10,000 &= \text{complement } (-10,000) + 1 = \text{complement } (1101\ 1000\ 1111\ 0000) + 1 \\ & \qquad \qquad \qquad = 0010\ 0111\ 0000\ 1111 + 1 \\ & \qquad \qquad \qquad = 0010\ 0111\ 0001\ 0000 = \text{HEX}(2710) \end{aligned}$$

HEXADECIMAL NOTATION

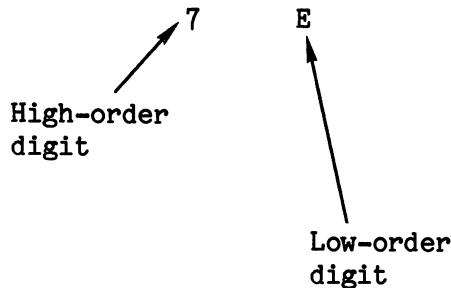
Binary numbers specified in a HEX command must be represented in hexadecimal notation. In this representation, each byte (eight bits) of the binary number is divided into four-bit groups and each group of four-bits is represented by a single hexadecimal character 0 - 9 or A - F as follows:

0000 = 0	1000 = 8
0001 = 1	1001 = 9
0010 = 2	1010 = A
0011 = 3	1011 = B
0100 = 4	1100 = C
0101 = 5	1101 = D
0110 = 6	1110 = E
0111 = 7	1111 = F

Therefore, HEX(23) = 0010 0011

2 3

HEX(7E) = 0111 1110



GENERATING THE BINARY VECTOR

In each instance, creation of the binary vector is similar. The steps to be taken are as follows:

- (1) Measure the amount to offset in inches, then convert this to a decimal value:
(i.e. offset 3/8 inch = .375 inch)
- (2) Multiply by 60 to convert the offset distance to increments:
(i.e. .375 * 60 = 22.5 increments)
- (3) For Set Line Feed (E9) do step 3(a); all others, step 3(b)
 - (a) With Set Line Feed it is possible to specify 256 fractional parts of the 1/60 inch increment. Each will equal 1/15,360 inch (1/256 of a step increment). Multiply the fractional remainder from step (2) by 256. This will be the FF portion of the command.

ASCII, HEX, Binary and Decimal (VAL) Equivalents

The character set and control codes shown below are for the 24 x 80 CRT. The character set and control codes for the printer are in Appendix A. This table can be used to convert positive one byte offsets up to 2 1/8 inches and two byte offsets up to 4 1/4 inches into binary hexadecimal notation (i.e., The largest usable one byte value on the chart is Hex 7F = + 127 x 1/60 inch = + 2 1/8 inches; the largest two-byte value on the chart is HEX 00FF = + 255 x 1/60 inch = 4 1/4 inches). For negative values, the number must be complemented as described previously.

LOW ORDER

HIGH ORDER

HEX →	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0	0000 NUL 0	0001 SOH (Cursor home) 1	0010 2	0011 (Clear screen, Cursor home) 3	0100 4	0101 Cursor on 5	0110 Cursor off 6	0111 (Alarm) 7	1000 (Cursor Back-Space) 8	1001 RT or Cursor right 9	1010 LF or Cursor down 10	1011 VT 11	1100 FF (Rev-Index) 12	1101 CR 13	1110 (Elongated Char.) 14	1111 SI (Shift Down) 15
1	0001 16	0010 â 17	0011 ê 18	0100 î 19	0101 ô 20	0110 û 21	0111 ä 22	1000 ë 23	1001 ï 24	1010 ö 25	1011 ü 26	1100 à 27	1101 è 28	1110 ù 29	1111 Ä 30	1111 Ö 31
2	0010 SP (Space) 32	0011 ! 33	0100 " 34	0101 # 35	0110 \$ 36	0111 % 37	1000 & 38	1001 (Quote) 39	1010 () 40	1011 * 41	1100 + 42	1101 (Comma) 43	1110 (Dash) 44	1111 (Period) 45	1111 / 46	1111 47
3	0011 0 48	0100 1 49	0101 2 50	0110 3 51	0111 4 52	1000 5 53	1001 6 54	1010 7 55	1011 8 56	1100 9 57	1101 : 58	1110 ; 59	1111 < 60	1111 = 61	1111 > 62	1111 ? 63
4	0100 64	0101 @ 65	0110 A 66	0111 B 67	1000 C 68	1001 D 69	1010 E 70	1011 F 71	1100 G 72	1101 H 73	1110 I 74	1111 J 75	1111 K 76	1111 L 77	1111 M 78	1111 N 79
5	0101 80	0110 P 81	0111 Q 82	1000 R 83	1001 S 84	1010 T 85	1011 U 86	1100 V 87	1101 W 88	1110 X 89	1111 Y 90	1111 Z 91	1111 [92	1111 \ 93	1111] 94	1111 ↑ 95
6	0110 (Prime) 96	0111 a 97	1000 b 98	1001 c 99	1010 d 100	1011 e 101	1100 f 102	1101 g 103	1110 h 104	1111 i 105	1111 j 106	1111 k 107	1111 l 108	1111 m 109	1111 n 110	1111 o 111
7	0111 112	1000 p 113	1001 q 114	1010 r 115	1011 s 116	1100 t 117	1101 u 118	1110 v 119	1111 w 120	1111 x 121	1111 y 122	1111 z 123	1111 \$ 124	1111 £ 125	1111 é 126	1111 < 127
8	1000 128	1001 NULL 129	1010 ♦ 130	1011 ▶ 131	1100 ◀ 132	1101 → 133	1110 ← 134	1111 | 135	1111 .. 136	1111 ' 137	1111 ^ 138	1111 ■ 139	1111 !! 140	1111 i 141	1111 β 142	1111 ¶ 143
9	1001 144	1010 145	1011 146	1100 147	1101 148	1110 149	1111 150	1111 151	1111 152	1111 153	1111 154	1111 155	1111 156	1111 157	1111 158	1111 159
A	1010 160	1011 161	1100 162	1101 163	1110 164	1111 165	1111 166	1111 167	1111 168	1111 169	1111 170	1111 171	1111 172	1111 173	1111 174	1111 175
B	1011 176	1100 177	1101 178	1110 179	1111 180	1111 181	1111 182	1111 183	1111 184	1111 185	1111 186	1111 187	1111 188	1111 189	1111 190	1111 191
C	1100 192	1101 193	1110 194	1111 195	1111 196	1111 197	1111 198	1111 199	1111 200	1111 201	1111 202	1111 203	1111 204	1111 205	1111 206	1111 207
D	1101 208	1110 209	1111 210	1111 211	1111 212	1111 213	1111 214	1111 215	1111 216	1111 217	1111 218	1111 219	1111 220	1111 221	1111 222	1111 223
E	1110 224	1111 225	1111 226	1111 227	1111 228	1111 229	1111 230	1111 231	1111 232	1111 233	1111 234	1111 235	1111 236	1111 237	1111 238	1111 239
F	1111 240	1111 241	1111 242	1111 243	1111 244	1111 245	1111 246	1111 247	1111 248	1111 249	1111 250	1111 251	1111 252	1111 253	1111 254	1111 255
HEX →	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

0 = Zero
 i = Letter i
 Numbers at lower right corner of each box are decimal (VAL) equivalents.

APPENDIX D

PREVENTIVE MAINTENANCE and ENVIRONMENTAL CONSIDERATIONS

PREVENTIVE MAINTENANCE

It is recommended that your equipment be serviced quarterly. A Maintenance Agreement is available to assure this servicing automatically. If no Maintenance Agreement is acquired, any servicing must be arranged for by the customer. A Maintenance Agreement protects your investment and offers the following benefits:

Preventive Maintenance: Your equipment is inspected quarterly for worn parts, lubricated, cleaned and updated with engineering changes, if any. Preventive maintenance minimizes "downtime" by anticipating repairs before they are necessary.

Fixed Annual Cost: When you buy a maintenance agreement, you issue only one purchase order for service for an entire year and receive one annual billing; more frequent billing can be obtained, if desired.

Further information regarding Maintenance Agreements can be acquired from your local Sales Service Office.

NOTE:

Wang Laboratories, Inc. does not guarantee or honor maintenance agreements for any equipment modified by the user. Damage to equipment incurred as a result of such modification becomes the financial responsibility of the user.

ENVIRONMENTAL CONSIDERATIONS

The Model 2271P is designed to operate in normal office environments, but users should be aware of general considerations which affect electronic equipment. Maintenance, temperature, humidity, airborne contaminants, AC power and electromagnetic interference are the major factors which must be considered and controlled for proper functioning of a computer system.

Temperatures outside the recommended operating range can cause component failure. All Wang electrical devices contain ventilating fans to prevent overheating. (Do not stack papers or any other materials on top of vents, do not place equipment near cabinets, walls and other upright obstructions, properly maintain all exhaust vents and fans on equipment, etc.)

Low humidity promotes static electricity, which in turn, may cause system malfunctions and loss of data. The static discharge that results when the operator touches the system can cause discomfort and electrical malfunction (a person wearing synthetic clothing and walking across a poorly ground carpet can build up a static potential of several thousand volts).

Airborne contaminants cause excessive mechanical wear and also create electrical malfunctions.

Ideally, a separate AC power line should be installed by a certified electrician in metal conduit derived from the main power distribution box. If the AC power line (or lines) is not grounded, constant and regulated within the voltage limits specified by the manufacturer, some type of corrective device must be installed between the AC power receptacle and the system.

Computer environments require maintenance as well as environmental precautions. Damp mop the floors; do not dry or wet-mop, vacuum clean carpeted floors, using nonconducting nozzles. DO NOT buff floors with steel wool.

Processing equipment is also sensitive to malfunctions due to electromagnetic interference (EMI). Install isolation transformers or line conditioners on the power line, route the power line through metal conduit properly connected to junction boxes, and do not place an interference causing electrical device within 10 to 15 feet of the system and system cables. The recommended operating environment is defined by the following parameters:

Temperature: 65° to 75° F (18° to 24° C)

Relative Humidity: 35% to 65%, non-condensing

Dust: NO accumulation should be obvious in a 24-hour period

Power: Grounded, noise-free, dedicated 115 or 230 VAC10%,
50 or 60 Hz+1Hz

Interference: All sources of static electricity, extreme magnetism and EMI must be controlled.

To help us to provide you with the best manuals possible, please make your comments and suggestions concerning this publication on the form below. Then detach, fold, tape closed and mail to us. All comments and suggestions become the property of Wang Laboratories, Inc. For a reply, be sure to include your name and address. Your cooperation is appreciated.

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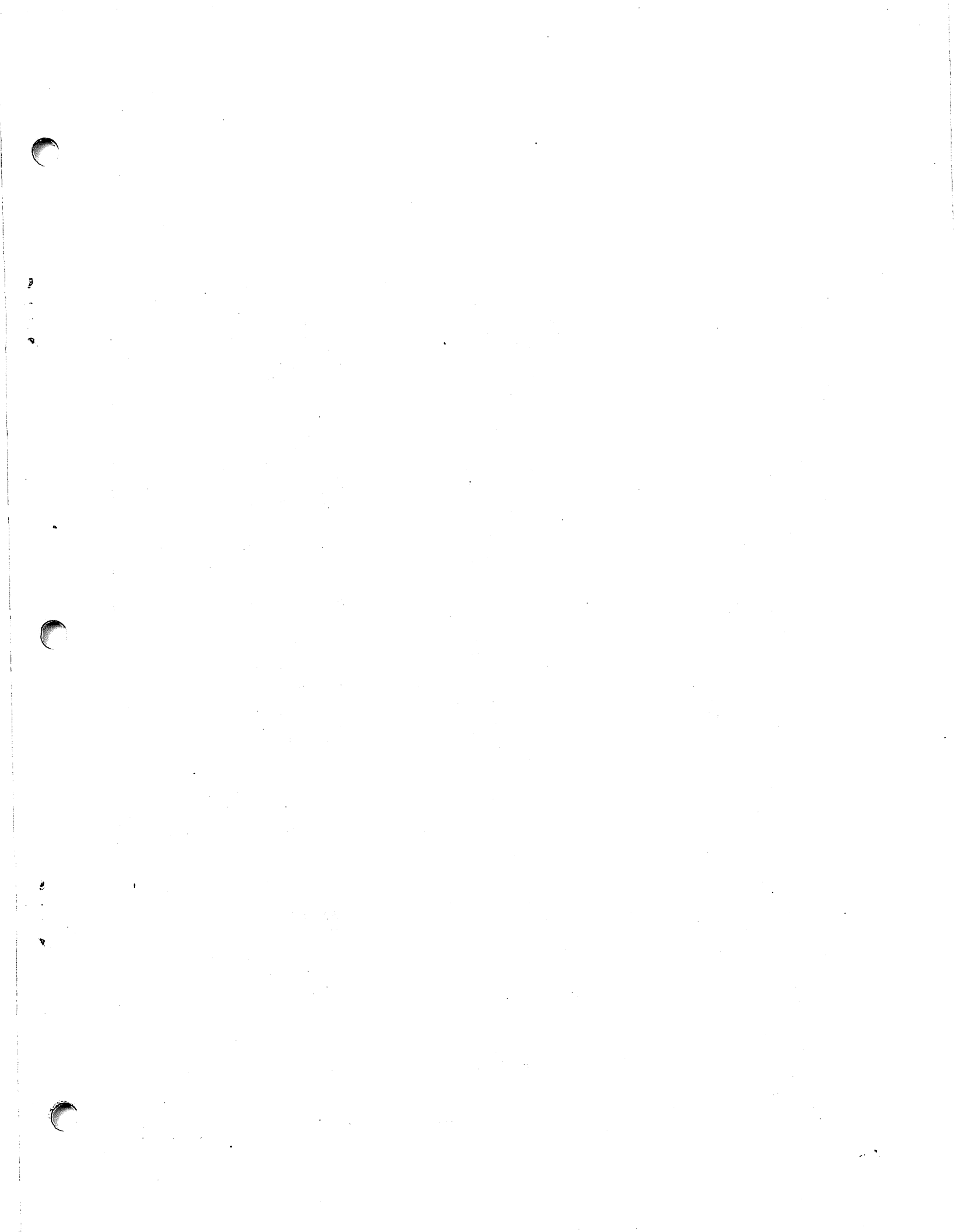
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