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JUN 12 1984

9001

**PRODUCTION**  
CHANGE BY ECO ONLY

CHECK PRINT  
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PLUTO  
USED ON  
APPLICATION

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DWG APPROVAL DATE	
DWN <i>WD</i>	7/17/80
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MFG ENG	

**CENTRONICS**  
data computer corp  
HUDSON, NEW HAMPSHIRE U.S.A.

TITLE  
ENGINEERING PRODUCT SPEC  
  
PLUTO FORMAT CONT

DWG REL. DATE	DATE	SIZE	CODE IDENT	NUMBER	REV
	<i>C</i> 8/11/80	<b>A</b>	50163	80002131	<b>F</b>
SCALE			DO NOT SCALE PRINT		SHEET <u>1</u> OF <u>46</u>

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## 1.0 GENERAL DESCRIPTION

This specification defines the functional characteristics and requirements applicable for the design and construction of the hi-performance format controller. Pluto is the name of this formatter.

The hi-performance format controller is an electronic board which is the interface between a printer controller and the external world. It provides the communications interfaces - serial (RS-232C and current loop) and parallel - and the operator control panel, which makes a printer controller into a functioning printer.

## 2.0 RELATED DOCUMENTS

### 2.1 APPLICABLE DOCUMENTS

- A. 80002126-9001 Phoenix Specification
- B. 80002150-9001 350 Power Supply, Eng. Prod. Spec.

### 2.2 REFERENCE DOCUMENTS

- A. ANSI X3.41 - 1974
- B. ANSI X3.64 - 1979
- C. ISO International Register of Character Sets to be used
- D. 80001059-9001 - 703 Specification
- E. 80001118-9001 - 704 Specification
- F. 80002149-9001 - 350 Mechanism, Eng. Prod. Spec.
- G. 80002151-9001 - 350 Ribbon Cassette, Eng. Prod. Spec.

## 3.0 REQUIREMENTS

The hi-performance formatter will, in general, be compatible with the Model 703, except where noted before it will also offer features which are unavailable on the 703. This formatter is compatible with the Phoenix printer controller.

### 3.1 703/704 DIFFERENCES

- A. Horizontal tab code is not ignored.
- B. Pluto can't do single elongated characters.

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- C. Pluto doesn't provide an external oscillator signal to the data connector.
- D. The following control codes and escape sequences are under microprocessor control and will not be acknowledged by the hardware front end: SO, DC 1, ESC 3, ESC 4.
- E. Pluto has only a 2 channel electronic VFU.
- F. The maximum page length is 192 lines.
- G. The maximum number of vertical tabs set by escape sequence is 16. A vertical tab can be set on every line through the control panel.
- H. Pluto can stack 204 line feeds at 6 LPI, 272 line feeds at 8 LPI, and 408 line feeds in graphics mode.
- I. Pluto can stack vertical tabs or form feeds.
- J. Non-gated data strobe is not available.
- K. Parallel handshake timing is different.

## 3.2 PHYSICAL CHARACTERISTICS

### 3.2.1 Size

The hi-performance formatter will fit within the body cover of the above-mentioned printer controller.

### 3.2.2 Character Sets

The hi-performance formatter has the capability to provide the following character sets:

- A. 96 character standard ASCII plus 34 characters of the 7 international country codes.
- B. 96 character customer programmable character set (factory set is standard ASCII).
- C. 191 character downstream loadable character set (RAM).
- D. 130 character multipass character set (2 pass version of A).

Sets A and B are a 7x9 matrix. Set C is a 7x8 matrix. The multi-pass set is a 15x16 matrix.

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## 3.2.3 Graphics Capability

The hi-performance formatter has the capability to accept pin addressable graphics data. The maximum number of bytes per line is 872. In graphics mode, a data byte will consist of six bits of information representing one column of six adjacent rows. The host must offset the transmitted graphic data by adding 20H. This puts the data out of the control code region of the ASCII characters and into the printable region (20H-5FH). Control characters (00-1FH) must be transmitted without the offset, and thus, are unaffected by this mode. A line feed done while in graphics mode will cause a vertical displacement equal to six rows (pins) of data. This gives the best line-to-line registration. Entry into and exit from graphics mode is controlled as described in Section 3.4.3.16.

## 3.2.4 Cut Sheet Capability

The formatter allows cut sheet operation. When in this mode, the printer cannot be selected unless a form has been inserted. Once the form has been ejected with paper motion commands, the printer is deselected and the head will return to the left. The reverse line feed feature will be enabled. All other functions of the formatter are unchanged in the cut sheet mode.

## 3.2.5 Control Panel

The control panel consists of push buttons, indicators and a keyboard display section.

### 3.2.5.1 Push Buttons

The only push buttons operational while the printer is deselected are of the on-line/local PAPER FWD and PAPER REV push buttons.

#### 3.2.5.1.1 On-Line/Local

If the printer is configured for the parallel interface, this button alternately selects or deselects the printer. If the printer is configured for the serial interface, this button alternately places the printer on-line (and select) or local mode (and deselect). When put on-line, Data Terminal Ready is asserted.

#### 3.2.5.1.2 Multi-Pass

This button causes the printer to start or stop multi-pass printing. Two passes are made. Bi-directional multi-pass printing occurs, unless uni-directional multi-pass was previously designated. The ANSI sequences specified in Sections 3.4.3.14 and 3.4.3.15 overrides the effect of this button.

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This button is inhibited while in graphics mode. If depressed in graphics mode, the only reaction is a one second audio alarm, if enabled.

### 3.2.5.1.3 Override/Test

This function enables the printer to continue to print even though there is a paper empty condition. While depressed, the printer can be re-selected and printing continues until the button is released. A self-test feature is operated by activating the override switch while the printer is deselected and loaded with paper. The test prints out codes which represent the printer configuration. The test also prints out the entire character set(s). If the forms override switch is held depressed, test data is continuously printed.

If the serial input is being used, then this push button is used to select and deselect the printer. If the printer is in local and serial mode, then this button initiates self test.

### 3.2.5.1.4 Form Feed

When the printer is deselected and this button is depressed, form will advance to the top of the next form.

### 3.2.5.1.5 Line Feed

When the printer is not selected and this button is depressed, one line feed will take place. After 1/2 second, line feeds repeat.

### 3.2.5.1.6 Set Top of Form

When the printer is deselected and this button is depressed, the VFU pointer is moved to the top of the form. The audio alarm will sound for approximately one second, if enabled.

### 3.2.5.1.7 Paper Forward

When this button is depressed, fanfold paper moves up in steps of 1/120 inch, cut sheet in steps of 1/108 inch. After 1/2 second delay, steps repeat. This button does not move the VFU position pointer relative to the VFU table.

### 3.2.5.1.8 Paper Reverse

When this button is depressed, fanfold paper moves down in steps analogous to the forward paper motion button.

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## 3.2.5.1.9 Cut Sheet Mode

When the printer is deselected and out of paper, depressing this button puts the printer in the cut sheet mode. All paper out indicators are removed. When in the cut sheet mode, depressing this button causes the printer to leave this mode and the paper out indicators will reflect the fanfold paper status.

## 3.2.5.1.10 Cut Sheet Insert

When in the cut sheet mode and deselected, depressing this button causes one cut sheet to be inserted into the printer. The paper will be inserted to the line one inch from the top of the form or until the top margin, whichever is greater. The form normally moves down into the printer, but it may move up or not at all, depending on the placement of the top margin.

## 3.2.5.2 Panel Indicators

### 3.2.5.2.1 Power

When +5 volt power is on, this indicator is on.

### 3.2.5.2.2 On-Line

When the printer is on-line, this indicator is on.

### 3.2.5.2.3 Multi-Pass

When the printer is in multi-pass mode, this indicator is on.

### 3.2.5.2.4 Fault

When the printer is out of paper or has a malfunction, this indicator is on.

### 3.2.5.2.5 DSR

This indicator displays the state of the modem Data Set Ready line. It is on if signal lines CC (Data Set Ready) is at the +V or if it is not connected to the data set.

### 3.2.5.2.6 Select

If the parallel interface is being used, the select indicator follows the on-line indicator. If the serial interface is selected, the select indicator is controlled by the override switch as described in Section 3.2.5.1.3. When selected (indicator on), printing can occur. When deselected (indicator off), no printing can occur.

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## 3.2.5.2.7 Cut Sheet Mode

When the printer is in the cut sheet mode, this indicator is on.

## 3.2.5.3 Keyboard Display

### 3.2.5.3.1 Display

Display is a 3-digit liquid crystal display (LCD) with several legends included. These legends are:

- |            |            |
|------------|------------|
| A. Hor Tab | F. Country |
| B. Ver Tab | G. Auto LF |
| C. Forms L | H. Ver Mar |
| D. CPI     | I. Alarm   |
| E. LPI     | J. Memory  |
|            | K. Config. |

### 3.2.5.3.2 Keyboard Section

- A. MODE - Used to step the printer through the available modes.
- B. STEP - Step to next available selection within a mode.
- C. CLEAR - Clears the displayed value to the current configured value.
- D. ENTER - Enter the displayed entry as the current configured value.

### Display and Keyboard Layout

Display is an LCD (Liquid Crystal Display).

During normal operation, the display will be blank. The operation of this display and keyboard shall be as follows:

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## MODE Selection

The "MODE" key, when pressed, causes the display to be visible. To change modes, the operator must press the "MODE" key again. The current mode is displayed in the legend area of the LCD display. The modes are selected in sequence.

### Horizontal Tab Mode:

In the horizontal tab mode, the "HOR TAB" legend and "000" are displayed. To enter horizontal tabs, the operator shall press the step key to increment the displayed count to the desired horizontal tab position. The displayed count represents the character position. Holding the step key down causes the count, after a momentary delay, to automatically increment until the button is released or an already loaded horizontal tab position is encountered. Once the proper column is displayed, the operator presses "ENTER" to set the horizontal tab. Every column can be a horizontal tab position.

To examine the horizontal tab positions, the operator sets the display to "000" by stepping until the display cycles back to "000". Next, the operator presses the step key and hold it. The display will start incrementing until a horizontal tab position is encountered. The incrementing will stop and the tab position is displayed. To examine for additional positions, the operator releases the key and holds the key down again to display additional positions.

To clear a horizontal tab position, the operator steps to the position to be cleared then presses the "CLEAR" key. To clear all currently set horizontal tabs, the operator presses the "CLEAR" key with "000" displayed.

### Form Length Mode:

In the form length mode, the "FORMS L" legend and the current form length (in lines) are displayed. To change the form length, the operator must press the "STEP" key until the display shows the desired form length in number of lines, then press the "ENTER" key.

#### Form Length Selection

1 to 192 lines

#### Display

1 to 192

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## Vertical Tab Mode:

When the printer is in the vertical tab mode, the "VER TAB" legend and "000" are displayed. To enter vertical tabs, press the "STEP" key to increment the displayed line count to the desired vertical tab position. The displayed number represents the line number on the form. Holding the "STEP" key down causes the count, after a momentary delay, to automatically increment until the key is released or an already loaded vertical tab position is encountered. Once the proper line number is displayed, the operator must press "ENTER" to set the vertical tab. Every line can be a vertical tab position (line 1 is always a vertical tab position).

To examine the vertical tab positions, the operator presses the "STEP" key until the display stops on a vertical tab position. Then the operator releases and holds the "STEP" key until another position is encountered. In this manner, the operator can use the "STEP" key to observe each vertical tab position. At the end of the form, the display "wraps" around to "000".

To clear a vertical tab position, the operator steps to the position to be cleared and presses the "CLEAR" button. To clear all current vertical tabs, the operator presses "CLEAR" with "000" displayed.

## Characters Per Inch Mode:

In the characters per inch mode, the "CPI" indicator is visible and the current number of characters per inch is displayed. When the operator presses the "STEP" key, the next available number of characters per inch is displayed. To select another value, the operator presses the "ENTER" key when that value is displayed. With each key press, a new CPI is displayed. All CPI values are displayed in a cyclic manner.

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The available characters per inch selections are:

<u>Selection</u>	<u>Display</u>
10	10
5	5
12	12
6	6
13.2	13.2
6.6	6.6
15	15
7.5	7.5
16.5	16.5
8.25	8.3

## Lines-Per-Inch Mode:

In the lines-per-inch mode, the "LPI" indicator is visible and the current number of lines per inch is displayed. When the operator presses the "STEP" key, the next available number of lines per inch is displayed. With each key press, a new LPI will be displayed. All LPI values are displayed in a cyclic manner. To select a new value, the operator presses the "ENTER" key when that value is displayed. The available lines per inch selections are:

<u>Selection</u>	<u>Display</u>
3	3
4	4
6	6
8	8
12	12

## Country Code Mode:

In the country code mode, the "COUNTRY" legend and the current country code status are displayed. To change the country code, the operator presses the "STEP" key until the desired country code is displayed, then the "ENTER" key is pressed.

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<u>Selection</u>	<u>Display</u>
USA	USA
France	FR
UK	UK
Germany	GER
Italy	ITL
Sweden/Finland	S/F
Denmark/Norway	D/N
Spain	ESP

### Auto Line Feed

In this mode, the "AUTO LF" legend and the current setting is displayed - "1" for Enabled, "0" for disabled. To change the setting, the operator presses the "STEP" key, the display will toggle between "1" and "0", then press the "ENTER" key.

### Vertical Margins Mode

In this mode, the "VER MRG" legend and "000" is displayed. To enter the top margin, press the "STEP" key to increment the displayed line count to the desired number. The displayed number represents the line number on the form. Holding the "STEP" key down will cause the count, after a momentary delay, to automatically increment until the key is released or a previously loaded top margin position is encountered. Once the proper line number is displayed, the operator presses "ENTER" to set the margin. Any line can be the top margin. After the top margin is set, the procedure is repeated for the bottom margin. Two entries must always be made. When a new margin is entered, the old one is automatically cleared.

To clear both vertical margins -- that is, top margin is at Line 1 and bottom margin is at bottom of form (based on form length) -- the operator presses "CLEAR" with "000" displayed.

### Alarm Mode

In this mode, the "ALARM" legend and the current setting is displayed - "1" for Enabled, "0" for Disabled. This controls the formatter's response to the receipt of a "BELL" code,

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depressing "ENTER", "CLEAR", "SET TOF" pushbuttons or multi-pass pushbutton while in graphics, or Paper Empty Condition. To change the settings, the operator presses the "STEP" key, the display will toggle between "1" and "0", then press the "ENTER" key.

## Memory Mode

In this mode, the "MEMORY" legend is visible. The digit display is blank. This mode enables the operator to use the non-volatile memory in the formatter. The operator can store all the machine set-up and configuration choices programmed in working (volatile) memory by pressing the "ENTER" key. This copies working storage into the non-volatile memory, so that upon power-up, the machine will be in this state. Or the operator can recall the configuration stored in non-volatile memory by pressing the "CLEAR" key. This will copy the non-volatile memory into working (volatile) storage.

This mode is the only method of changing the non-volatile memory. All of the operator set-ups (indicated by the legends) plus all of the configuration choices (described below) are transferred.

## Entering and Exiting the Configuration Modes:

Pressing the "MODE" key at the last available mode will cause the display to go blank and cause all modes to be closed to modification from the front panel. Pressing the "MODE" key again will cause the first available mode to be displayed. Another way to exit the configuration modes is to press "ON-LINE".

The control panel also has a "LOCK MODE" for machine configuration. These features are not intended to be frequently changed and as such are a bit more "inaccessible" to the operator. They represent mostly "hardware" functions. In order to enter this mode, the operator must press "override" anytime during the set up modes. The "CONFIG" legend will become visible and the digits will display the baud rate. The operator can then use the "MODE" and "STEP" keys to choose from the available selections, just as in the normal set-up mode. However, there are no legends to prompt the operator. Except for the baud rate, all functions are coded, so the operator's manual must be used. The left two digits are the function codes and the right digit is the selectable option. The available baud rates are:

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<u>Selection</u>	<u>Display</u>
50	5
75	7
110	11
134.5	13
150	15
300	30
600	60
1200	120
1800	180
2000	200
2400	240
3600	360
4800	480
7200	720
9600	960
19200	192

The coded functions and their codes are:

1. Serial/Parallel - Selects either communications interface.  
1 = Serial                      0 = Parallel

2. Data Bits - Selects serial character length.  
0 = 5 Bits      1 = 6 Bits      2 = 7 Bits      3 = 8 Bits

NOTE: 5 and 6 bits accepted by serial input only. 7 and 8 bits are the only valid ASCII bytes.

3. Parity - Selects one of three choices.  
0 = None (Disabled)    1 = Odd      2 = None      3 = Even

4. Buffer Status - Selects the method to report buffer status for serial communications.

0 = None  
1 = Reverse Channel  
2 = DTR  
3 = X-On/X-Off

5. Printer Status (such as Paper Empty) - Selects the method to report printer status for serial communications.

0 = None                      2 = DTR  
1 = Reverse Channel        3 = X-On/X-Off



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6. Reverse Channel Polarity - Selects active (busy) state.  
0 = Active Low                      1 = Active High
7. Inverted Data Strobe - Selects position going parallel interface data strobe.  
0 = Normal                              1 = Inverted
8. Inverted Data Bit 8  
0 = Normal                              1 = Inverted
9. Bit 8 Control  
0 = Ignore Bit 8                      1 = Normal Control  
2 = Escape Control                      3 = Normal Control
10. 703/ANSI - Selects Centronics 703 or ANSI control sequence compatibility.  
0 = 703                                  1 = ANSI
11. Prime on Select  
0 = Disabled                              1 = Enabled
12. Prime on Delete  
0 = Disabled                              1 = Enabled
13. Print on Paper Motion - Selects one of four choices.  
0 = Paper motion does not cause print.  
1 = Paper motion causes print and returns the carriage.  
2 = Paper motion causes print without returning the carriage.  
3 = Paper motion does not cause print.
14. Page Mode Enable - When enabled, STX and ETX are used to bracket blocks of up to 4,096 characters including control codes without going BUSY.  
0 = Disabled                              1 = Enabled

### 3.2.6 Internal Self-Test

On printer power up, the internal formatter test indicator is turned on. The formatter performs a check of its RAM, ROM/PROM and non-volatile memory. It also checks the printer controller self-test byte in the C-RAM. If no errors are found, the internal formatter test indicator is turned off. If an error is found, the bell will sound, the fault indicator illuminates and a code is displayed as shown below:

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### Self-Test Failure

### LCD Error Code

1st PROM/ROM	0
2nd PROM/ROM	1
8755 PROM	2
1st 8156 RAM	3
2nd 8156 RAM	4
4K Data RAM	5
EAROM	6
Print Controller ROM	7
C-RAM	8
Character Generator RAM	9
Print Controller RAM (Scratch Pad)	10
Bad Video	11
No Head Movement	12
Bad VFU Load	14
Bad Character Set Load	15
Abort Event 1 (Reverse Paper Motion Before Print)	16
Abort Event 2 (Forward Paper Motion Before Print)	17
Abort Event 3 (Print)	18
Abort Event 4 (Reverse Paper Motion After Print)	19
Abort Event 5 (Forward Paper Motion After Print)	20
.....	21
.....	22
.....	23
Interlock Idle	24
Unresolvable Error	25

The printer cannot be selected for printing when one of these codes is displayed.

#### 3.2.6.1 RAM Check

During internal self-test, each RAM on the formatter -- scratch pad and data input buffer -- (but, not the C-RAM or character generator RAM, as these are checked by the print controller) is verified by writing and reading alternating ones (Hex 55 and AA) and zeros in each location. This check simultaneously checks the input data buffer size.

#### 3.2.6.2 PROM/ROM Check

A checksum is calculated for each of the PROM/ROM's during internal self-test. It is compared to the correct value stored at the end of the last PROM/ROM.

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## 3.2.6.3 Non-Volatile Memory Check

The EAROM has two locations which are tested and compared to values stored in PROM/ROM. If found to agree, the integrity of the configuration data EAROM assumed to be good and the printer is initialized. If not, an error code is displayed.

## 3.2.6.4 Printer Controller Self-Test

When the print controller fails its own self-test, an error bit is set in C-RAM. The formatter decodes the error bits and displays the appropriate error code on the LCD.

## 3.3 ELECTRICAL CHARACTERISTICS

### 3.3.1 High Performance Formatter

The high performance formatter consists of the following functional parts.

- A. 8085 Microprocessor System
- B. Character Generator
- C. Non-Volatile Memory
- D. Control Panel
- E. Parallel Interface
- F. Serial Interface
- G. Data Buffer
- H. C-RAM

A block diagram is shown in Figure 3.3.1.

Figure 3.3.1

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## 3.3.1.1 8085 Microprocessor System

The 8085 Microprocessor system consists of the following parts:

- A. 512 bytes of scratchpad RAM
- B. 60 I/O lines
- C. 10K bytes of program ROM
- D. 4K of Buffer RAM

## 3.3.1.2 Character Generator

The character generator, although physically on the formatter, is electrically on the printer controller microprocessor bus. The formatter has no access to it. The character generator consists of three parts. A block diagram is shown in Figure 3.3.1.2.

Figure 3.3.1.2

- A. 2K x 8 PROM Character Set - This is a standard and customer programmable character set. It also includes 7 country codes. All 256 codes are printable.
- B. 2K x 8 RAM - This is for a downstream loaded character set. This RAM is written into by the printer controller. The formatter passes the character set in the C-RAM. See Section 3.4.3.13 for the required control sequence.

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- C. 4K x 8 PROM - Multi-Pass Character Set - This is for a two-pass mode.

### 3.3.1.3 Non-Volatile Memory

The formatter has a 1K x 4 electrically alterable read-only memory (EAROM). This memory is used to store the machine configuration when power is off. All items described in 3.2.5.3 are stored. The present operating configuration is always stored in the scratchpad (volatile) memory. Any configuration changes, whether operator caused or downstream loaded, only change the working (volatile) configuration memory. Only the operator can cause the working memory to overwrite the non-volatile memory. This is done via the control panel as described in 3.2.5.3. The operator can also similarly cause the non-volatile memory to overwrite the working memory, via the control panel.

Upon power up, the microprocessor will check the integrity of the non-volatile memory. If found to be usable, the machine is initialized according to this configuration. If found to be unusable, the "Fault" indicator on the control panel blinks and "06E" is displayed on the LCD. The operator can also manually cause the printer to be initialized to this factory configuration by holding the "override" button depressed during power up.

This factory configuration is:

- A. Hor. Tabs - 16 tabs spaced every 8 characters.
- B. Form Length - 66 Lines.
- C. Ver. Tabs - 11 tabs spaced every 6 lines.
- D. Horizontal Pitch - 10 CPI.
- E. Vertical Pitch - 6 LPI.
- F. Country Code - USA.
- G. Auto LF - Disabled.
- H. Top Margin - Line 1, Bottom Margin - Line 66.
- I. Alarm - Enabled.
- J. Baud Rate - 9600 Baud.
- K. Serial/Parallel - Parallel.
- L. Inverted Data Strobe - Normal (Disabled).
- M. Inverted Data Bit 8 - Normal (Non-Inverted).
- N. Bit 8 Control - Normal (Not by Escape Control).
- O. 703/ANSI - 703 Compatible.
- P. Print on Paper Motion - Print With no CR.
- Q. Auto Answer - Disabled.
- R. Answerback - None.
- S. Buffer Status - X-On/X-Off.

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- T. Printer Status - X-On/X-Off.
- U. Parity - None.
- V. Data Bits - 7.
- W. Rev. Channel Polarity - Active High.
- X. Prime on Select - Disabled.
- Y. Prime on Delete - Disabled.
- Z. Page Mode Enable - Enabled.

## 3.3.1.4 Parallel Interface

The parallel communications interface is the standard Centronics model. It is implemented using a high-speed front end which interfaces to the microprocessor system. This front end can store incoming data via DMA directly into the microprocessor's data buffer memory. A block diagram is shown in Figure TBD. The high speed front end has three modes of operation:

- A. Normal (Line) Mode - In this mode, the front end will store all printable characters and will interrupt the CPU on control characters or a full buffer. This is the normal mode of operation.
- B. Character Mode - In this mode, the front end will interrupt the CPU upon receipt of each character. This is used for control sequences (ANSI, escape, etc.).
- C. Transparent Mode - In this mode, the front end will accept and store all incoming data. It will only interrupt the CPU upon receipt of an ETX or a full buffer. This is used for graphics data or a high speed page dump (of a CRT, for example).

A description of the customer parallel interface is found in 3.3.2.1.

## 3.3.1.5 Serial Interface

The serial communications interface provides an EIA RS-232C compatible interface. A 20 ma current loop interface capability is provided by an optional plug in the PC board. A detailed description is found in 3.3.2. An adapter for RS-449 is available, however, a drive distance of only 500 feet is provided.

## 3.3.1.6 Data Buffer

The communications input data buffer is a 4K x 8 RAM. The entire buffer is used in serial communications mode. In parallel communications, the entire buffer is only used in page mode. This enables an entire CRT screen to be dumped, without the interface going busy.

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In serial mode, the buffer full indication will be sent when room for only 512 characters is left. When the buffer content is 256 characters or less, buffer empty condition will be sent.

## 3.3.1.7 C-RAM

The C-RAM is the means of communication between the formatter and printer controller. It is a two-port memory accessible by both and constitutes the heart of the formatter/printer controller interface. The high-performance formatter C-RAM is 2K x 8.

The C-RAM (and character generator) are interfaced to the printer controller through the C-BUS interface connector. This interface is described in Section 3.3.5.2.2.

A map of the C-RAM is shown on the next page. For a more complete description, see Phoenix Specification (Section 2.1).

## 3.3.1.8 Non-Volatile VFU

The non-volatile VFU requires a power fail imminent signal from the power supply via the printer controller board. Upon receiving the power fail signal, the Formatter stores the current paper position in the non-volatile memory. The Print Controller is expected to pass the uncompleted paper movement of the mechanism back to the Formatter. When power is restored, the current form position is read from the non-volatile memory and the uncompleted partial paper movement is passed back to the Print Controller for completion.

In the event of a power fail during the execution of a paper movement, the printer cannot guarantee the exact restoration of the form position because power may be gone before the paper motion has stopped.

The Print Controller must return the uncompleted paper movement information within 2 milliseconds of the power fail detect. If the Formatter has possession of the C-RAM initially, then it will surrender the C-RAM within 1 millisecond of the power fail detect.

The Formatter goes BUSY to the outside world and into halt mode when the power fail occurs. Reselecting the printer will allow continuation of operation, but the integrity of the data being printed is lost.

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## COMMUNICATIONS RAM MAP

<u>BYTE</u>	<u>DESIGNATION</u>	<u>SOURCE</u>	<u>COMMENTS</u>
00	PRINTER STATUS	PRINT CONTROLLER	
01	ACCUMULATED PAPER	PRINT CONTROLLER	STATUS INFO.
02	MOTION STEPS		
03	UNCOMPLETED PAPER	PRINT CONTROLLER	STATUS OF
04	MOTION STEPS		FAILED MOTION
05	REVERSE PAPER MOTION	FORMAT CONTROLLER	EVENT 1
06	BEFORE PRINT		
07	FORWARD PAPER MOTION	FORMAT CONTROLLER	EVENT 2
08	BEFORE PRINT		
09	PRINT COMMAND	FORMAT CONTROLLER	EVENT 3
0A	REVERSE PAPER MOTION	FORMAT CONTROLLER	EVENT 4
0B	AFTER PRINT		
0C	FORWARD PAPER MOTION	FORMAT CONTROLLER	EVENT 5
0D	AFTER PRINT		
0E	SELF TEST BYTE	PRINT CONTROLLER	STATUS OF SELF
0F	DENSITY SELECTION		TEST
10		RESERVED	
1F			
20	ASCII DATA	FORMAT CONTROLLER	
FF			
20	GRAPHICS	FORMAT CONTROLLER	
7FF	PIN DATA		



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## 3.3.2 Customer Interfaces

### 3.3.2.1 Parallel Interface Signals

#### 3.3.2.1.1 Externally Generated Signal Description

A timing diagram of the interface control signals is shown in Figure 3.3.2.

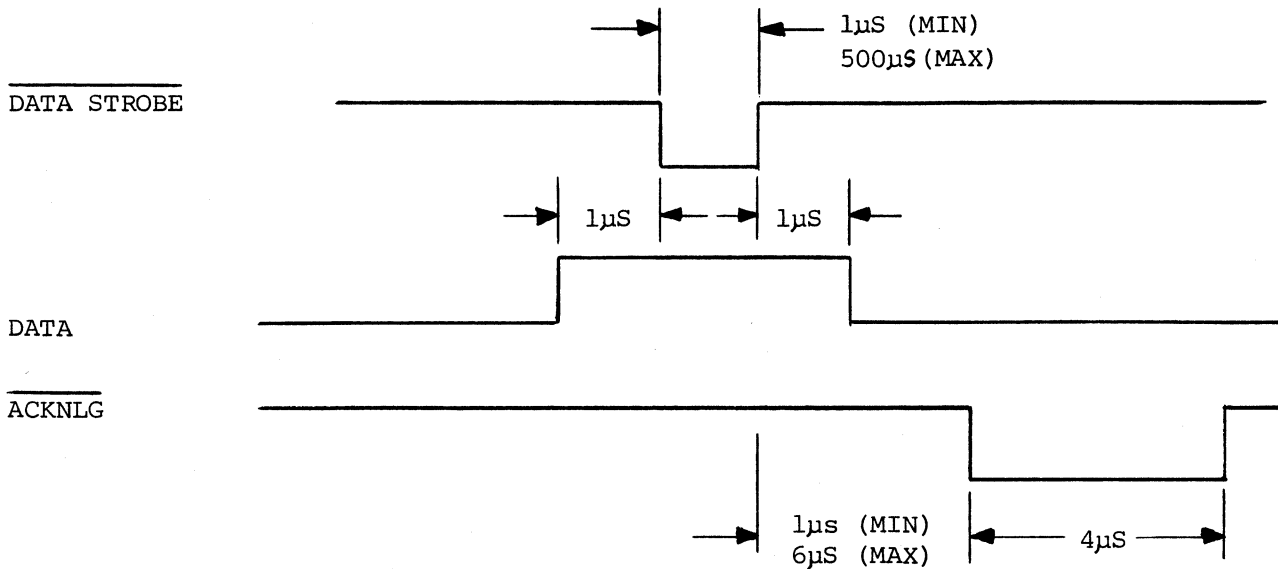


Figure 3.3.2  
(Printable Data Only)

#### 3.3.2.1.1.1 Data Strobe

This negative going pulse is used to transfer the incoming data into the electronics circuitry of the printer. The pulse duration must be a minimum of 1.0 microseconds. The relationship of the leading and trailing edges of the data strobe with the data lines is described in Section 3.3.2.1.1.2. This signal drives TTL logic and is terminated by a 470 ohm resistor to +5 volts.

#### 3.3.2.1.1.2 Data Lines

The 8 data lines drive TTL logic and are terminated by a 1K ohm resistor to +5 volts. The high logic level of each data line must be settled at least 1.0 microseconds before the leading edge of the strobe pulse and remain at its logic level until at least 1.0 microsecond after the trailing edge of the strobe pulse.

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## 3.3.2.1.1.3 Input Prime

This signal causes the printer logic to be reset after the trailing edge, and is terminated by a 470 ohm resistor to +5 Volts. Data should not be sent during Input Prime because factory testing reserves this area and the sequences are subject to change (Section 3.4.4).

## 3.3.2.1.2 Printer Generated Signal Description

### 3.3.2.1.2.1 Acknowledge

This negative going signal is used to verify the transfer of incoming data or to signify the end of a functional operation. Once a code is sent to the printer, an acknowledge pulse must be received before a new code can be sent. The acknowledge is sourced from a TTL logic circuit.

### 3.3.2.1.2.2 Busy Line

This high going signal is used to give a positive DC level signal indication during the time the printer cannot receive data. It is also positive when the paper empty or the fault status line is true.

During the transfer of any printable character into the printer buffer, the line will not go to a positive level. The busy line is sourced from the output of a TTL logic circuit.

### 3.3.2.1.2.3 External Oscillator

None.

### 3.3.2.1.2.4 Paper Empty (PE)

A high level that indicates the printer is out of paper.

### 3.3.2.1.2.5 Select (SLCT)

A high level indicates the select button has been depressed or a select code has been received and the printer is available for data transfer.

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### 3.3.2.1.3 Parallel Connector Pin Out

#### AMPHENOL 57 SERIES PIN OUT

<u>PIN</u>	<u>SIGNAL</u>	<u>PIN</u>	<u>SIGNAL</u>
1	DATA STROBE	19	TWISTED PAIR GND.
2	DATA BIT 1	20	TWISTED PAIR GND.
3	DATA BIT 2	21	TWISTED PAIR GND.
4	DATA BIT 3	22	TWISTED PAIR GND.
5	DATA BIT 4	23	TWISTED PAIR GND.
6	DATA BIT 5	24	TWISTED PAIR GND.
7	DATA BIT 6	25	TWISTED PAIR GND.
8	DATA BIT 7	26	TWISTED PAIR GND.
9	DATA BIT 8	27	TWISTED PAIR GND.
10	ACKNOWLEDGE (ACKNLG)	28	TWISTED PAIR GND.
11	BUSY	29	TWISTED PAIR GND.
12	PAPER OUT (PE)	30	INPUT PRIME RETURN
13	SELECT (SLCT)	31	INPUT PRIME
14	GROUND	32	FAULT
15	NOT USED	33	GROUND
16	GROUND	34	NOT USED
17	CHASSIS GROUND	35	NOT USED
18	+5 V	36	NOT USED

### 3.3.2.2 Serial Interface

The interface performs the following functions: disassembling of data characters, character buffering, control character decoding, error checking, and modem interface control.

#### 3.3.2.2.1 Input Buffer

The input buffer is 4096 characters long. It stores relevant ASCII control characters as well as printed characters. The formatter will give a buffer full indication (if enabled - see 3.1.5.3.2, Buffer Status) 512 characters from end of buffer. It gives a buffer empty indication at 256 characters remaining in the buffer. The formatter will lose data if the buffer overflows.

#### 3.3.2.2.2 Protocol

Line protocol will be control panel selectable for choice of none (no protocol), X-On/X-Off code, reverse channel (with choice of polarity) and Data Terminal Ready Control. These protocols can report both buffer and printer status (see 3.2.5.3.2). Data Terminal Ready control should not be selected with current loop installed.

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### 3.3.2.2.3 Status

The formatter can reply to a request for status. The request is made with the sequence DLE (Octal 20) ENQ (Octal 05). The reply will be the two character sequence DLE STATUS, where the STATUS character is defined as follows:

<u>Bit No.</u>	<u>Meaning</u>
0	1 = Paper Out
1	1 = Deselected
2	1 = Buffer Busy
3	1 = Receive Error

### 3.3.2.2.4 Word Length

Word length will be control panel selectable for choice of 5, 6, 7 or 8 data bits. Valid ASCII words are 7 or 8 data bits long.

### 3.3.2.2.5 Parity

Parity will be control panel selectable for choice of odd, even or none. In the event of an error detected in the received data, the character @ (Octal 100) is substituted for the character code.

### 3.3.2.2.6 Serial Data Connector

The printer provides an RS-232C 25-pin male body connector with female contacts. Signals provided are set forth in Section 3.3.2.2.8.

### 3.3.2.2.7 Baud Rates

Baud rate is control panel selectable for choice of 50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600 or 19,200 baud.

### 3.3.2.2.8 EIA RS-232C Series Pin Out

<u>Pin</u>	<u>Signal Name</u>	<u>Signal Description</u>
1	AA	Protective Ground.
2	BA	Transmitted Data: Used to indicate buffer status when in X-On/X-Off mode.
3	BB	Received Data: Data from source to Formatter.

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<u>Pin</u>	<u>Signal Name</u>	<u>Signal Description</u>
4	CA	Request to Send: This line is +V when in X-On/X-Off mode.
5	CB	Clear to Send: +V will enable X-On/X-Off to be transmitted, -V will disable transmitter. An open will be an enable condition.
6	CC	Data Set Ready: +V or open will allow transmitted data to be accepted by the Formatter. -V will not allow data to be accepted.
7	AB	Signal Ground.
8	CF	Carrier Detect: +V or open will allow transmitted data to be accepted by the Formatter. -V will not allow data to be accepted.
11	SBA	Reverse Channel: Used for transmitting printer/buffer status when in reverse channel mode. It is normally in a Mark (-V) condition. When buffer is full, this line goes to a Space (+V) condition until the printer is able to receive data again. Held at buffer empty polarity when in X-On/X-Off or Data Terminal Ready mode.
20	CD	Data Terminal Ready:
22	CE	Ring Indicator: Indicates an incoming call.

### 3.3.2.2.9 Current Loop (Option)

- Pin 12 - Current Loop Connector Host Receive Current Loop +
- Pin 13 - Host Receive Current Loop -
- Pin 14 - Printer Xmit Status +
- Pin 15 - Printer Xmit Status -

### 3.3.3 Power Supply

The DC power required by the formatter is obtained from the printer controller via a 6-pin molex socket. The pin connections are as follows:

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<u>Pin Number</u>	<u>Description</u>
1	+12V DC +5% @ .5 Amps
2	+12 V Return
3	-12V DC +5% @ .25 Amps
4	+5V Return
5	Chassis Ground
6	+5V DC +2% @ 2 Amps

The +12V and -12V will be used to power only the line driver circuitry.

### 3.3.4 Power Supply Filtering

As a minimum, a 0.1 uf capacitor is provided for every 10 gates.

### 3.3.5 Internal Interfaces

#### 3.3.5.1 Power Cable

The DC power harness is terminated at each end with a 6-pin molex plug. Pin out is described in Section 3.2.5.

#### 3.3.5.2 C-BUS

This is the Centronics standard universal printer/formatter controller interface. It is used to pass data, control and character generator information between the formatter and the printer controller (Phoenix).

##### 3.3.5.2.1 Signal Identification

###### 3.3.5.2.1.1 Data Bus - D0 Thru D7

These 8 bidirectional data lines allow the Printer Controller to communicate with the character generator ROM's or RAM and the C-RAM buffer.

###### 3.3.5.2.1.2 Address Bus - A0 Thru A12

These 13 unidirectional lines are used to address an 8K block of contiguous memory addresses. Two additional select lines are provided (3.3.5.2.1.3.4 and 3.3.5.2.1.3.5) to select either the C-RAM or character generator address block. The format controller uses additional decoding logic under firmware control to allow the character generator options to use the same address block.

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#### 3.3.5.2.1.3 Control Bus

There are six (6) control lines available at the remote C-BUS connector.

##### 3.3.5.2.1.3.1 $\overline{\text{RESET}}$

RESET originates from the Print Controller and is used to reset the logic on the Format Controller during power-on. A low level indicates the RESET condition.

##### 3.3.5.2.1.3.2 HOLD IT

This handshake originates from the Format Controller. A high level indicates that the Format Controller has read/write control of the C-RAM. The Print Controller is prohibited at this time from accessing the C-RAM. When this level goes low, it means that the Format Controller has relinquished control of the C-RAM and is requesting the Print Controller to act on the data in the C-RAM.

##### 3.3.5.2.1.3.3 GOT IT

This handshake signal originates from the Print Controller. A high means that the Print Controller has read/write control of the C-RAM and action is in progress. The Format Controller is prohibited from accessing the C-RAM at this time. When this signal goes low, it means that the Print Controller has relinquished control of the C-RAM, and that action is complete.

##### 3.3.5.2.1.3.4 $\overline{\text{CGSEL}}$

This line originates from the Print Controller and is used to select the 8K block of memory addresses for the character generator. A low level indicates that a READ or WRITE operation to the C.G. is in progress.

##### 3.3.5.2.1.3.5 CRSEL

This line originates from the Print Controller and is used to select the 8K block of memory addresses for the C-RAM and graphics RAM buffer. A HIGH level indicates that a READ or WRITE operation to the buffer is in progress.

##### 3.3.5.2.1.3.6 $\overline{\text{WRITE}}$

This line originates from the Print Controller and is used to strobe data into the C-RAM or character generator RAM. A low level indicates a data write to memory.

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### 3.3.5.2.2 Connector Pin Out

The 34 way connector on each P.C. board and F.C. board will use the following pin out. Any used signals that are flagged with an "\*" must be pulled high on the F.C. board with individual pull up resistors.

<u>34 WAY</u> <u>PIN #</u>	<u>DESCRIPTION</u>	
30	DATA D0	DATA
13	DATA D1	
29	DATA D2	
12	DATA D3	
28	DATA D4	
11	DATA D5	
27	DATA D6	
10	DATA D7	
1	ADDR A0	ADDRESS
18	ADDR A1	
2	ADDR A2	
19	ADDR A3	
3	ADDR A4	
20	ADDR A5	
4	ADDR A6	
21	ADDR A7	
14	ADDR A8	*
15	ADDR A9	*
16	ADDR A10	*
17	ADDR A11	*
32	ADDR A12	*
7	<u>RESET</u>	CONTROL
6	HOLD IT	
23	GOT IT	
8	<u>CRSEL</u>	
31	<u>CGSEL</u>	*
25	<u>WRITE</u>	*
33	PIN NINE DATA	
5	GROUND	
22	GROUND ** (FMAT to Print Controller)	
9	GROUND (Indicates Formatter Installed)	
26	GROUND	
24	Reserved for future power fail signal	
34	Not Used	



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## 3.4 PROGRAM CONTROL CODES

The high performance Format Controller reacts to three types of control codes (sequences)—Codes compatible with the 703/704, ANSI standardized codes and codes having the same function in both modes. When a conflict exists between the 703 and ANSI interpretation of a control sequence, it will be resolved according to the configuration chosen from the control panel.

### 3.4.1 Codes Having Same Function in Both Modes

#### 3.4.1.1 Line Feed Code (Octal 012)

Receipt of the line feed code while the printer is on-line will cause action according to the print on paper motion configuration. If "paper motion does not cause print" is selected, the printer will immediately advance one line. If print with or without CR is chosen, the printer will immediately print the line followed by an advance of one line (with or without a carriage return, as selected in the configuration).

#### 3.4.1.2 Carriage Return Code (Octal 015)

If the printer is in the select mode and printable characters have been received, receipt of a carriage return code will cause immediate printing. A carriage return is not acknowledged when the printer is in the deselected mode. If the printer is in the selected mode, data will be accepted by the printer until the carriage return character or a full buffer of printable characters have been received. In either case, the printer automatically prints the characters received. When printing is complete, an auto line feed is done if enabled. If CR is the first character in the buffer, then the CR will be acknowledged and ignored.

#### 3.4.1.3 DC1 Code (Octal 021)

Receipt of this code will allow the printer to be selected, independent of the operator control panel.

#### 3.4.1.4 DC3 Code (Octal 023)

Receipt of this code will allow the printer to be deselected, independent of the operator control panel.

#### 3.4.1.5 Vertical Tab (VT) (Octal 013)

If the vertical tab code is received by the printer while selected, the code is processed and then acknowledged. The vertical tab will not be acknowledged or processed while the printer is deselected.

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If VFU data is loaded in RAM, receipt of VT code will cause paper to advance to the next sequential vertical tab location. If no vertical tabs are set, the printer will perform a form feed.

The vertical tab position is relative to the number of lines not relative to actual vertical distance. If printable data precedes the VT, printing will occur as in Section 3.4.1.1.

## 3.4.1.6 FF Code (Octal 014)

If the form feed code is received by the printer while selected, the code is processed and then acknowledged. The form feed will not be acknowledged or processed while the printer is deselected. If printable data precedes the form feed, printing will occur as in Section 3.4.1.1.

Receipt of FF code will cause paper to advance to the next sequential top of form location. Paper will advance to the top of margin when the next printable line is received.

## 3.4.1.7 DEL Code (Octal 177)

If prime on delete is enabled on the control panel and the DEL code is received when the printer is in the select mode, the printer logic will be reset to zero.

## 3.4.1.8 BEL Code (Octal 007)

Receipt of this code with the printer in the select mode shall cause the speaker to sound a tone for approximately one second.

## 3.4.1.9 Horizontal Tab Code (Octal 011)

If the horizontal tab code is received by the printer while deselected, the tab will not be acknowledged or processed. If received while the printer is selected, the code is converted to the correct number of spaces in the input buffer and then acknowledged.

If horizontal tabs are set, receipt of the HT code will cause printing to continue at the next sequential horizontal tab location. If no horizontal tabs are set (or there are no more on the line being printed), the HT code will be changed to a space (Octal 40).

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### 3.4.1.10 DLE ENQ Sequence (Octal 20, Octal 05)

If the DLE ENQ sequence is received through the serial interface, the formatter will transmit a reply consisting of the two character sequence DLE STATUS. The status byte is defined in Section 3.3.2.2.5.

### 3.4.2 703/704 Compatible Codes

These interpretations apply only with 703 compatibility chosen in the configuration.

#### 3.4.2.1 SO Code (Octal 016)

If the printer is selected and receives the "SO" code, the printer will print characters from the print buffer in expanded characters. This command will be ignored if the current horizontal pitch is 5, 6, 6.6, 7.5 or 8.25 CPI. This mode will be cancelled by the receipt of a DEL code, an end of print command, or an input prime.

The number of elongated characters allowed per printable line shall not exceed one half the print buffer size. NOTE: Only lines of either all standard or all elongated characters can be printed.

#### 3.4.2.2 ESC 3 (Octal 033, 063)

If the printer is selected and receives the "ESC 3" sequence, it will select the alternate character set.

#### 3.4.2.3 ESC 4 (Octal 033, 064)

If the printer is selected and receives the "ESC 4" sequence, it will select the primary character set.

#### 3.4.2.4 VFU Down-Stream Loading (2 Channel Only)

The sequence for down-stream loading is initiated by sending a "Start Load" code (1D<sub>16</sub>) (Octal 35) followed by two bytes per line and terminated by a "Stop Load" code (1E<sub>16</sub>) (Octal 36).

Data Bits	7	6	5	4	3	2	1	0
1D <sub>16</sub>	0	0	0	1	1	1	0	1
Odd number byte Following Start Load; 1st, 3rd, 5th, etc.	X	1	X	X	X	X	CH2	CH1

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Even number byte Following Start Load; 2nd, 4th, 6th, etc.	X	1	X	X	X	X	X	X
1E <sub>16</sub>	0	0	0	1	1	1	1	0

### 3.4.2.5 VFU Commands

The VFU command consists of two bytes of sequential data. The two bytes will be a 1F<sub>16</sub> followed by a VFU control byte. The control byte will be formatted as follows:

Command Bit	7	6	5	4	3	2	1	0
Skip N Lines	X	X	X	1	N <sub>3</sub> MSB	N <sub>2</sub>	N <sub>1</sub>	N <sub>0</sub> LSB
					4-bit line count			
Skip to Channel	X	X	X	0	C <sub>3</sub> MSB	C <sub>2</sub>	C <sub>1</sub>	C <sub>0</sub> LSB
					1-2 VALID 1-2 Represents Channel 1-2 respectively.			

X = Don't Care.

If a command is received to skip to Channel X and Channel X is not loaded in VFU memory, the printer will generate a Fault condition, will deselect and display "14E" on the LCD.

### 3.4.3 ANSI Code Sequences

All ANSI code sequences are compatible with ANSI X3.41 - 1974 and ANSI X3.64 - 1979.

#### 3.4.3.1 Country Set Selection

These sequences designate the G0 character set:

ESC ( A (Octal 101)	Select United Kingdom Set
ESC ( B (Octal 102)	Select US ASCII Set
ESC ( 2 (Octal 62)	Select Sweden/Finland Set NATS Add'l
ESC ( 3 (Octal 63)	Select Norway/Denmark Set NATS
ESC ( K (Octal 113)	Select Germany Set
ESC ( l (Octal 61)	Select Italy Set
ESC ( R (Octal 122)	Select France Set
ESC ( 4 (Octal 64)	Select Spain Set

NOTE: The second character in the country code sequences is "(" (Octal 050).

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## 3.4.3.2 Horizontal Pitch

Horizontal pitch determines the width of printed characters as well as their spacing. Changes to horizontal pitch shall only be allowed at the start of a line.

ESC [ w (Octal 167)	Set Horizontal Pitch to 10 CPI
ESC [ 1 w	Set Horizontal Pitch to 10 CPI
ESC [ 2 w	Set Horizontal Pitch to 12 CPI
ESC [ 3 w	Set Horizontal Pitch to 13.2 CPI
ESC [ 4 w	Set Horizontal Pitch to 16.5 CPI
ESC [ 5 w	Set Horizontal Pitch to 5 CPI
ESC [ 6 w	Set Horizontal Pitch to 6 CPI
ESC [ 7 w	Set Horizontal Pitch to 6.6 CPI
ESC [ 8 w	Set Horizontal Pitch to 8.25 CPI
ESC [ 9 w	Set Horizontal Pitch to 15 CPI
ESC [10 w	Set Horizontal Pitch to 7.5 CPI

## 3.4.3.3 Vertical Pitch

Vertical pitch determines the spacing between lines, not the height of the printed characters. Changing vertical pitch will also clear vertical margins.

ESC [ z (Octal 172)	Set Vertical Pitch to 6 LPI
ESC [ 1 z	Set Vertical Pitch to 6 LPI
ESC [ 2 z	Set Vertical Pitch to 8 LPI
ESC [ 3 z	Set Vertical Pitch to 12 LPI
ESC [ 5 z	Set Vertical Pitch to 3 LPI
ESC [ 6 z	Set Vertical Pitch to 4 LPI

## 3.4.3.4 Form Length

Form length is defined in lines, not physical units. Therefore, changing vertical pitch will alter the physical form length. Forms may be from 1 to 192 lines in length. Changing form length clears vertical margins and defines the current line as line one.

ESC [ nt (Octal 164)	Set Form Length to n Lines.
	Set Top Margin to Line 1.
	Set Bottom Margin to Line n.
	Set Active Line to Line 1.

## 3.4.3.5 Vertical Margins

Printing is permitted only on lines within the inclusive top and bottom margins. When vertical pitch or form length is changed, these margins are cleared; that is, the top margin is set to line one and the bottom margin is set to the form length. The following must be true to successfully set new vertical margins.

$1 \leq \text{top margin} < \text{bottom margin} \leq \text{form length}$

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If it is ever the case that:

Current line < top margin or

Current line > bottom margin,

The active line is set to the top margin. For example, a line feed performed at the bottom margin will execute a form feed.

ESC [ nr (Octal 162)	Set Top Margin to Line n.
ESC [ ; nr	Set Bottom Margin to Line n.
ESC [ n <sub>1</sub> ; n <sub>2</sub> r	Set Top Margin to Line n <sub>1</sub> ; and Set Bottom Margin to Line n <sub>2</sub> .

### 3.4.3.6 Vertical Tabs

The high performance Formatter has up to 192 vertical tab stops. Vertical tab stops are associated with specific line numbers, not physical positions on the paper. Thus, changing vertical pitch will change the printing position of vertical tabs.

ESC J (Octal 112)	Set Vertical Tab Stop at current line.
ESC [ l g (Octal 147)	Clear Vertical Tab Stop at current line.
ESC [ 4 g	Clear all Vertical Tab Stops.
ESC [ n v (Octal 166)	Set Vertical Tab Stop at Line n.
ESC [ n <sub>1</sub> ; n <sub>2</sub> ; ... n <sub>x</sub> v	Set Vertical Tab Stops at Lines n <sub>1</sub> , n <sub>2</sub> , ... n <sub>x</sub> (x ≤ 16).

### 3.4.3.7 Horizontal Tabs

The high performance formatter has up to 218 horizontal tab stops. These are associated with specific character positions (columns). Thus, changing the horizontal pitch will change the physical location of the tabs.

ESC H (Octal 110)	Set horizontal tab stop at current column.
ESC [ g (Octal 147)	Clear horizontal tab stop at current column.
ESC [ 0g	Clear horizontal tab stop at current column.
ESC [ 2g	Clear all horizontal tab stops.
ESC [ 3g	Clear all horizontal tab stops.
ESC [ nu (Octal 165)	Set horizontal tab stop at column n.
ESC [ n <sub>1</sub> ; n <sub>2</sub> ; ... n <sub>x</sub> u	Set horizontal tab stops at columns n <sub>1</sub> , n <sub>2</sub> , ... n <sub>x</sub> (x ≤ 16).

A maximum of 16 tab stops may be set with the ANSI sequence. If more than 16 stops are required, an additional sequence may be sent.

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## 3.4.3.8 Primary and Alternate Character Sets

SO (Octal 016) Invokes the Alternate Set.  
SI (Octal 017) Invokes the Primary Set.

## 3.4.3.9 Reverse Line Feed

The high performance formatter can accept reverse line feeds only in cut sheet mode.

ESC [ nT (Octal 124) Move n (decimal) reverse lines.

## 3.4.3.10 Subscript/Superscript

The high performance formatter can accept and execute subscript and superscript commands. The paper movement which results coincides with a half line feed at 6 LPI. These sequences can only be used to offset by a partial line. For example: If subscript is on, all subsequent commands to "set subscript on" will be ignored. If a standard paper motion command is received while subscript or superscript is active, the printer will move to the non-offset line position of the commanded line.

ESC K (Octal 113) Set subscript on/superscript off.  
ESC L (Octal 114) Set superscript on/subscript off.

## 3.4.3.11 Underline

The formatter can accept underline commands. Full lines can be underlined in one pass, while partial underlines require two passes (transparent to the host). Once underline is set, all following characters in the data stream are underlined until it is reset.

ESC [ 4 m (Octal 155) Start Underline  
ESC [ m Stop Underline  
ESC [ Om " "

## 3.4.3.12 Page Mode (Parallel Only)

Upon receipt of a STX (Octal 002) the Formatter is put into the Page Mode. In this mode, the Formatter will be able to receive up to 4096 characters (including control codes), without going busy. Printing will not start until receipt of an ETX (Octal 003) or the buffer becomes full.

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## 3.4.3.13 Ram Character Set Loading

The Formatter has the capability to accept a 191 character downstream-loaded character set. In order to load this RAM, the character set data must be preceded by the sequence:

ESC [ n x data

- ESC - ASCII escape code.
- [ - ASCII open bracket.
- n - Three byte ASCII decimal number indicating the number of characters being loaded up to 191. The first digit is the most significant of the two digits.
- x - An ASCII lower case "x".
- data - An ASCII character string containing the dot pattern for the character generator. The length of this string is assumed to be 14 times the number represented by n. Each character being loaded into the character generator is described by 14 bytes. The patterns are conveyed in the least significant 4 bits of each byte and the value of the next three most significant bits shall be a 2. The most significant bit of the byte shall be ignored. The first character loaded will be accessed during printing by a 20H (i.e., 4th character pointed to by 24H). See the attached diagrams.

Pluto assumes that the number of data bytes is 14 times "n" and uses the data inside that string to load the RAM character set. If the sequence is violated and does not match any other Pluto control sequence, then Pluto will deselect and display an error code on the LCD. The 191 allowable characters are addressed during printing by ASCII codes 20H through 7FH and A0H through FEH.

Caution must be taken in the design of a RAM loaded character. Continuous adjacent horizontal pin firing in the character set will cause the printer to deselect and an error code is displayed on the LCD. If a ROM is installed in place of the character set RAM, the ROM must have 69H programmed in its last memory location (7FFH). A dummy load of one character must be performed before the ROM can be accessed as a character generator.



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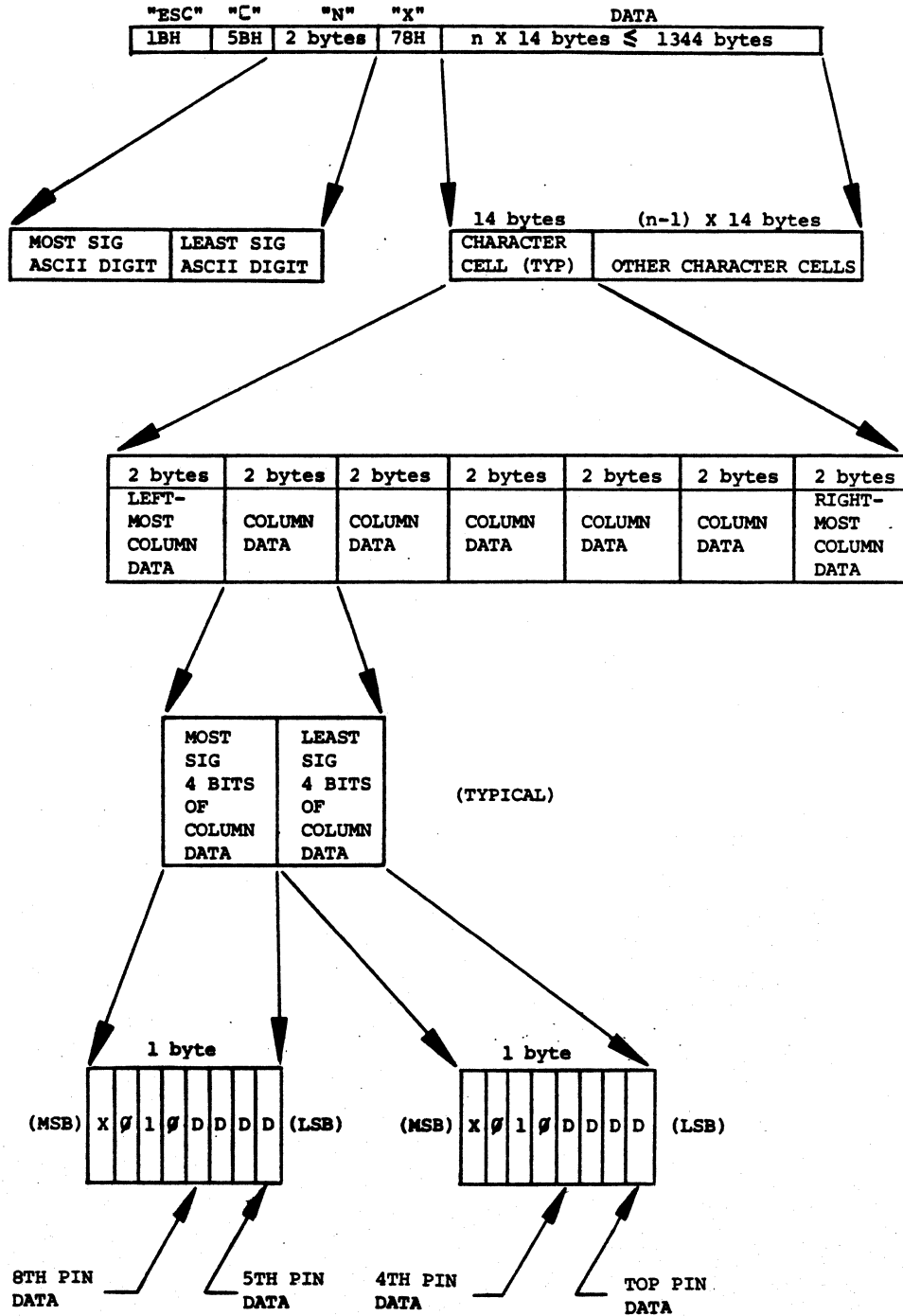
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PLUTO CONTROL SEQUENCE TO LOAD RAM CHARACTER SET



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### 3.4.3.14 Alternate Character Set Selection

In order to designate an alternate character set, the following sequences are provided:

ESC ) 0	(Octal 60)	Designate the Customer Programmable Character Set
ESC ) Sp @	(Octal 40)	Designate the RAM Character Set
ESC ) 1 or ESC ) 2		Multipass Character Set (see 3.4.3.15 below)

The selected character set is invoked as specified in 3.4.3.8.

### 3.4.3.15 Multi-Pass Printing

The formatter has the capability to command the printer to do multi-pass printing. Two passes are made (transparent to the host). Multi-pass is transparent to the printer controller, the formatter must command it to do each pass. The multi-pass character set is one of the alternate character sets. It is designated (see Section 3.4.3.14) by the sequence:

ESC ) 2	(Octal 62)	Designate (Unidirectional)
ESC ) 1	(Octal 61)	Designate the multi-pass character set. (Bidirectional)

Multi-pass is invoked as specified in Section 3.4.3.8. These commands override the effect of the multi-pass pushbutton. Multi-pass is always 10 CPI pitch.

### 3.4.3.16 Graphics

Pin addressable graphics is initiated (designated and invoked) by the sequence:

ESC % 0	(Octal 60)	Unidirectional Graphics
ESC % 1	(Octal 61)	Bidirectional Graphics

As explained in Section 3.2.3, control codes are unaffected in this mode, while other codes have 20H added to them. To exit from graphics, another character set must be invoked, as specified in Section 3.4.3.8, 3.4.2.2 or 3.4.2.3.

### 3.4.4 Factory Test Codes

This sequence is only for internal use by Test Equipment Engineering. The sequence is:

- A. Attach both serial RS-232 cable and the parallel input cable.

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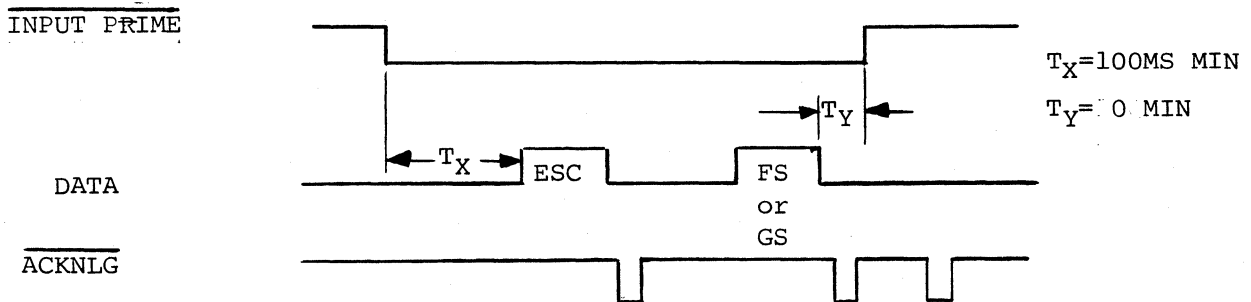
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- B. Over the parallel port, send an Input Prime signal.
- C. During Input Prime, one of two escape sequences are allowed:
1. If ESC Fs is sent, all following data will be transmitted over the serial port. The printer will default to the factory configuration in 3.3.1.3, except for serial, instead of parallel input.
  2. If ESC Gs is sent, all following data will be transmitted over the parallel port. The printer will default to the factory configuration in Section 3.3.1.3.

A timing diagram is shown below:



#### 4.0 ELECTROMAGNETIC CONFORMANCE

For regulatory compliance, shielded data input cables are mandatory. The maximum acceptable noise field strength radiated from the Formatter in accordance with VDE specifications is less than:

<u>Frequency Range</u>	<u>Distance</u>	<u>Field Strength</u>
100 KHZ to 30 MHZ	30 Meters	50 Microvolts/Meter
300 MHZ to 1300 MHZ	10 Meters	10 Microvolts/Meter

#### 4.1 THERMAL DESIGN

No component on the Formatter will exceed a temperature rise of 40°C above the operating internal ambient.

#### 4.2 ENVIRONMENTAL CONDITIONS

The printer mechanism and electronics shall be designed such that it will operate in a reliable manner under the following ambient conditions.

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## 4.2.1 Operating Conditions

### 4.2.1.1 Temperature

+50°F to +140°F (+10°C to +60°C)

Rate of change not to exceed 20°F (11.2°C)/hour.

### 4.2.1.2 Relative Humidity (Without Condensation)

10% to 90% RH

### 4.2.1.3 Altitude

-1,000 feet to 8,000 feet (-305m to 2,440m)

## 4.2.2 Storage Conditions

When not operating and in storage, the printer shall withstand the following temperature and humidity ranges:

### 4.2.2.1 Temperature

-40°F to +151°F (-40°C to 66°C)

Rate of change not to exceed 60°F (33.3°C)/hour.

### 4.2.2.2 Humidity (Without Condensation)

10% to 95% RH

### 4.2.2.3 Altitude

-1,000 feet to 30,000 feet (-305m to 9,145m)

## 4.3 MECHANICAL SHOCK

### 4.3.1 Shock Test - Operating:

The product or system will operate while a half sine shock pulse of 10 Gpk and 10 ± 3 ms duration is applied once in either direction of three orthogonal axes (3 pulses total).

The shock pulse may be generated by a commercial shock test machine, by an appropriate private drop test or by an appropriate flat drop test. The shock pulse will be measured, either on the shock table or on the product, adjacent to the mounting points.

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## 4.4 VIBRATION

### 4.4.1 Vibration - Operating:

The product must operate within specifications during the appropriate sine vibration test below. The test will be applied once in each of three orthogonal axes.

The machine will be tested hard mounted to the vibration table.

Class A & Class B Environment

Moderately controlled environmental conditions (such as office or computer facility).

5-22 Hz	0.16	DA
22-500 Hz	4.0	Gpk
500-22 Hz	4.0	Gpk
22-5 Hz	0.016	DA

Sweep rate of 1 octave/minute.

## 4.5 RELIABILITY

### 4.5.1 MTBF Design Goals

The population MTBF of the formatter shall exceed 20,000 power-on hours.

### 4.5.2 Definition of a Failure

A failure is any malfunction of electrical or mechanical hardware which prevents full use of the machine, or any non-scheduled interruptions, if the cause of the interruption is not an operator function. Malfunctions caused by neglect or scheduled preventive maintenance, defective ribbon or paper, or improper operator performance shall not be considered as printer failures.

Failures can be grouped into two categories:

#### 4.5.2.1 Inconvenient Failure

An inconvenient failure is any failure which can, with relative ease and speed, be traced and corrected by the operator without the presence of a serviceman.

#### 4.5.2.2 Critical Failure

A critical failure is defined as:

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- (A) Any failure or combination of failures that prohibits the use of the printer.
- (B) Any failure that results in repeated incorrect print.

The following lists a few failures and their classifications. Failures not listed are assumed to be easily classified.

	<u>Inconvenient</u>	<u>Critical</u>
Print Error		X
Paper Jam	X	
Cabinet (loose covers, etc.)	X	
Paper Advance (Repeated Failure)		X
Ribbon Jam	X	
Print Quality Due to Head Wand	X	

## 4.6 MAINTAINABILITY DESIGN GOALS

### 4.6.1 Adjustments

None.

### 4.6.2 Accessibility

Provide for maximum accessibility to enable rapid removal and replacement of assemblies and/or subassemblies (i.e., no captured bolts).

### 4.6.3 MTTR

Time to repair (average hours) shall be 0.5 hours - longest time not to exceed 1.0 hours.

### 4.6.4 Spare Parts

The design shall allow the availability of spare parts for a period of five years from the date of sale of each printer.

### 4.6.5 Scheduled Maintenance

None.

### 4.6.6 Life

The life of the printer shall be 600 million characters without major overhaul. Major overhaul is defined as replacement of parts exceeding 50% of the total dollar value of the printer.

The life of the formatter board shall exceed the life of the printer.