FUNCTIONAL PRODUCT SPECIFICATION

MODEL 353

Spec No.   80001131-9001

Rev. 02

January 8, 1982

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®

Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 2 OF

TABLE OF CONTENTS

— FUNCTIONAL PRODUCT SPECIFICATION —

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV 02
DATE January 8, 1982

PAGE   3   OF

TABLE OF CONTENTS

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   4   OF

TABLE OF CONTENTS

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®

Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 5 OF

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 6 OF

1.0 SCOPE

This specification defines the functional characteristics and requirements applicable for the design and construction of a serial matrix printer mechanism and associated control electronics identified as the Model 353 Serial Printer.

2.0 RELATED DOCUMENTS

2.1 SPECIFICATIONS

A.	80001158-9001	350 Series Overview Specification
B.	80001126-9001	Functional Product Specification, Model 350
C.	80002151-9001	Ribbon Cassette, 350 Series
D.	80001157-9001	Print Quality Standards, 350 Series

2.2 SAFETY STANDARDS

A.	UL 114, 478	Regulatory Agency Requirements
B.	CSA 22.2 #154	Regulatory Agency Requirements
C.	VDE 0550,0730, 0830,0871,0875	Regulatory Agency Requirements

2.3 REGULATORY STANDARDS

A. FCC Docket #20780, Part 15, Subpart J

3.0 REQUIREMENTS

The Model 353 printer will be compatible with the 703/704 except where noted (see Section 3.6); it will offer additional features not available on the 703/704. The format control board will be compatible with the standard Model 350 print control board.

3.1 PHYSICAL REQUIREMENTS

3.1.1 Description

The Model 353 is a single head, 132 column, 7x8 dot matrix, 200 cps, serial, impact, bidirectional printer utilizing a 9-pin free flight head for character formation. Printing is performed under microprocessor control utilizing linear servo and stepper motor technology. Bidirectional printing and the ability to seek the shortest path in printing successive lines results in maximum throughput printing rate.

The printer mechanism shall be a rear paper load design for fanfold paper capable of handling single through six part forms at a slew rate of 8 inches per second using standard tractor

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   7   OF

paper feed. The printer shall also be designed for top loading of single to six part cut sheet forms. In addition, a demand document capability for transaction-type forms will permit single to six part printing to within one inch of the top of the last printed form. The printer is capable of either serial or parallel operation. The control panel is an integral part of the format control board and incorporates a liquid crystal display for printer configuration and forms set-up.

3.1.2   Size

The printer external dimensions are 7.46 inches ~~(189~~ in height (excluding mounting feet), 22.4 inches ~~(569~~ in width and 18.35 inches ~~~~ in depth. Dimensions do not include paper guides. A minimum clearance of 0.70 inches ~~(18~~ is required between the bottom surface of the printer and the resting or mounting surface.

3.1.3   Weight

The weight of the basic printer shall not exceed 50 lbs ~~~~.

3.1.4   Finish

All metal parts shall have appropriate finishes to prevent corrosion from having an adverse effect upon the operation of the unit.

3.1.5   Character Sets

The standard character set will be a 7x8 matrix set of 96 standard ASCII characters, with 34 characters of the 7 optional countries (see Section 3.4.1.3). An alternate character set of 96 characters can be optionally installed by the customer (factory set is a duplicate of the standard ASCII set). A downstream loadable character set of 96 characters can be initiated by the host CPU and accepted by the Model 353. A multipass character set of 96 characters with 34 characters of the 7 optional countries is included utilizing a 15x16 matrix and having a dot density of 110x130 dpi.

3.1.6   Graphics

The Model 353 has the capability to accept pin addressable graphics data. The maximum number of bytes per line is 872. Dot density is 66 dots per inch in the horizontal plane and 72 dots per inch in the vertical plane. Print speed in the graphics mode is 7.5 inches per second.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®

Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 8 OF

3.1.7 Cut Sheet Mode

The printer will allow cut sheet operation. When in the cut sheet mode the printer cannot be selected unless a form has been inserted. Once the form has been ejected with a form feed, or combination of line feeds, vertical tabs, and VFU commands, the printer will be deselected and head will be returned to the left.

3.1.8 Control Panel

The control panel consists of membrane switches, panel indicators and a keyboard display section. See Figure 3.1.8.

3.1.8.1 Membrane Switches

The membrane switches are only operational while the printer is deselected with the exception of the on-line switch.

3.1.8.1.1 On-Line

If the printer is configured for the parallel interface, this switch will alternately select or deselect the printer. If the printer is configured for the serial interface, this switch will alternately put the printer on-line (and select) or local mode (and deselect). When selected, Data Terminal Ready will be asserted. See Section 3.1.8.1.3 for further interaction with Override/Test Switch while in serial mode.

3.1.8.1.2 Multipass

This switch will cause the printer to start or stop multipass printing. Two passes will be made. The ANSI sequences speci-fied in Sections 3.4.3.14 and 3.4.3.15 will supercede the effect of this switch.

3.1.8.1.3 Override/Test

This function enables the printer to continue to print even though there is a paper empty condition. While depressed, the printer is reselected and printing continues until the switch is released. A self-test feature is operated by activating the override switch while the printer is deselected and loaded with paper. The test will print out the printer configuration. The test will also print out the entire character set(s). If the forms override switch is held depressed, test data is contin-uously printed.

If the serial input is being used, then this switch will be used to select and deselect the printer. If the printer is not on-line and in serial mode, then this switch will initiate self-test.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.	80001131-9001
REV	02
DATE	January 8, 1982
PAGE	9 OF

SELECT	DSR	CUT SHEET		POWER		LIQUID
						CRYSTAL
ON-LINE	FAULT	MULTIPASS				DISPLAY

ON	SET	MULTI-	CUT	PAPER		MODE	ENTER
LINE	TOF	PASS	SHEET	FWD			
			MODE				

FORM	LF	OVRD	CUT	PAPER		STEP	CLEAR
FEED		TEST	SHEET	REV			
			MODE				

Figure 3.1.8.   DISPLAY AND KEYBOARD LAYOUT

FUNCTIONAL PRODUCT SPECIFICATION

CEᴎTᴙOᴎICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   10   OF

3.1.8.1.4   Form Feed

This switch is operational when the printer is deselected.
Forms will advance to the top of the next form.

3.1.8.1.5   Line Feed

When the printer is not selected and this switch is depressed,
one line feed will take place. If the switch is held depressed
for longer than 0.5 seconds, line feeds will be repeated until
it is released.

3.1.8.1.6   Set Top of Form

When the printer is deselected and this is depressed, the VFU
pointer is moved to the top of form, which is the current line
position.

3.1.8.1.7   Paper Forward

When deselected, this switch moves fanfold paper forward in
steps of 1/120 inch and cut sheet paper forward in steps of
1/108 inch. If held depressed for more than 0.5 seconds,
steps will be repeated until it is released.

3.1.8.1.8   Paper Reverse

When deselected, this switch moves fanfold paper reverse in
steps of 1/120 inch and cut sheet paper reverse in steps of
1/108 inch. If held depressed for more than 0.5 seconds,
steps will be repeated until it is released.

3.1.8.1.9   Cut Sheet Mode

When the printer is deselected and out-of-paper status is
indicated, depressing the switch will put the printer in the
cut sheet mode and extinguish the paper out indicator.
When in the cut sheet mode depressing this switch will cause
the cut sheet mode to be exited, and paper out indicator will
reflect the fanfold paper status.

3.1.8.1.10 Cut Sheet Insert

Depressing this switch when in the cut sheet mode and the
printer deselected will cause a cut sheet to be inserted
into the printer. The paper will be inserted to the first
line position one inch from the top of the form or until the

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 11 OF

top margin is located, whichever is greater. The form will
normally move down into the printer, but it may move up or not
at all depending on the placement of the top margin. See
Section 3.4.3.5 for proper setting of vertical margins.

3.1.8.2   Panel Indicators

3.1.8.2.1   Power

When the printer has power applied to it, this indicator will
be on.

3.1.8.2.2   Select

If the parallel interface is being used, the select indicator
will follow the on-line indicator. If the serial interface is
selected, the select indicator will be controlled by the
override switch as described in Section 3.1.8.1.3. When
selected (indicator on), printing can occur. When deselected
(indicator off), no printing can occur.

3.1.8.2.3   On-Line

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

3.1.8.2.4   Multi-Pass

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

3.1.8.2.5   Fault

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

3.1.8.2.6   DSR

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

3.1.8.2.7   Cut Sheet Mode

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

— FUNCTIONAL PRODUCT SPECIFICATION —

⊏Ɛ∩⊤ROПI⊏⑤°
Product Planning

SPEC NO.	80001131-9001
REV	02
DATE	January 8, 1982
PAGE	12 OF

3.1.8.3   Keyboard Display

3.1.8.3.1   Display

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

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.

3.1.8.3.2   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 will be a Liquid Crystal Display (LCD).

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

MODE Selection

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

Horizontal Tab Mode:

In the horizontal tab mode, the "HOR TAB" indicator will be
visible. The digits shall be "000". 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 will cause the count, after a momentary delay, to automa-

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 13 OF

tically increment until the button is released or an already
loaded horizontal tab position is encountered. Once the proper
column is displayed, the operator can press "ENTER" to set the
horizontal tab. Every column could be a horizontal tab position,
except column 1. A maximum of sixteen (16) tabs can be set
simultaneously.

To examine the horizontal tab positions, the operator should
start by setting the display to "000" by stepping until the
display cycles back to "000". Next, the operator should press
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 should release the key
and hold the key down again to get additional positions displayed.

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

By pressing the "MODE" key, the printer will exit the horizontal
tab mode.

Form Length Mode:

In the form length mode, the "FORMS L" legend shall become
visible. The current form length (in lines) will be 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.

To leave the form length mode, the operator must press the
"MODE" key again.

Form Length Selection	Display
1 to 192 lines	1 to 192

Vertical Tab Mode:

When the printer is in the vertical tab mode, the "VER TAB"
indicator will become visible. The digit display shall be
"000". To enter vertical tabs, press the "STEP" key to incre-
ment the displayed line count to the desired vertical tab
position. (The maximum number displayed is dependent upon the
forms length already loaded .) 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

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV 02
DATE January 8, 1982

PAGE   14   OF

increment until the key is released or an already loaded
vertical tab position is encountered. Once the proper line
number is displayed, the operator can press "ENTER" to set the
vertical tab. Every line can be a vertical tab position (line
1 is always a vertical tab position). A maximum of sixteen
(16) tabs can be set simultaneously.

To examine the vertical tab positions, the operator should
press the "STEP" key until the display stops on a vertical tab
position. Then the operator should release and hold 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 Line 1.

To clear a vertical tab position, the operator should step to
the position to be cleared and press the "CLEAR" button. To
clear all current vertical tabs, the operator must press
"CLEAR" with "000" displayed.

By pressing the "MODE" key, the printer will exit the vertical
tab mode.

Characters Per Inch Mode:

In the characters per inch mode, the "CPI" indicator will be
visible and the current number of characters per inch will be
displayed. If the operator now presses the "STEP" key, the
next available number of characters per inch will be displayed.
With each press of the key, a new number which is available
will be displayed until the original number displayed is
visible after which all subsequent selections are repeated
in a cyclic manner. In order to select another value, the
operator must press the "ENTER" key when that value is displayed.

When the "MODE" key is pressed, the display will show the next
available mode and the last entered selection becomes the
operational selection. The available characters per inch
selections are:

Selection	Display
10	10.0
12	12.0
13.2	13.2
15	15.0
16.5	16.5

— FUNCTIONAL PRODUCT SPECIFICATION —

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   15   OF

Lines-Per-Inch Mode:

In the lines-per-inch mode, the "LPI" indicator will become visible and the current number of lines per inch will be displayed. If the operator now presses the "STEP" key, the next available number of lines per inch will be displayed. With each press of the key, a new number which is available will be displayed until the original number displayed is visible after which all subsequent selections are repeated in a cyclic manner. In order to select another value, the operator must press the "ENTER" key when that value is displayed. When the "MODE" key is pressed, the display will show the next available mode and the last entered selection becomes the operational selection. The available lines per inch selections are:

Selection	Display
3	3
4	4
6	6
8	8
12	12

Country Code Mode:

In the country code mode, the "COUNTRY" indicator shall be visible and the current country code status shall be displayed. To change the country code, the operator must press the "STEP" key until the desired country code is displayed, then the "ENTER" key must be pressed. To exit from the country code mode, the operator must press the "MODE" key.

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

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®

Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   16   OF

Auto Line Feed

In this mode, the "AUTO LF" legend shall become visible. The
current setting will be displayed - "1" for Enabled, "0" for
disabled. To change the setting, the operator must press the
"STEP" key. The display will toggle between "1" and "0", then
the operator must press the "ENTER" key. To leave this mode,
the operator must press the "MODE" key.

Vertical Margins Mode

In this mode, the "VER MRG" legend shall become visible. The
digit display shall be "000". 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 must press "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. If only the bottom margin requires
changing, the top margin must be re-entered before the new
bottom margin is entered.

To clear both vertical margins -- that is, top margins is at
Line 1 and bottom margin is at bottom of form (based on form
length) -- the operator must press "CLEAR" with "000" displayed.
By pressing the "MODE" key, the printer will exit the vertical
margins mode.

Alarm Mode

In this mode, the "ALARM" legend shall become visible. The
current setting will be displayed - "1" for Enabled, "0" for
Disabled. This controls the formatter's response to the
receipt of a "BELL" code or Paper Empty Condition. To change
the settings, the operator must press the "STEP" key. The
display will toggle between "1" and "0", then the operator
must press the "ENTER" key. To leave this mode, the operator
must press the "MODE" key.

Memory Mode

In this mode, the "MEMORY" legend shall be visible. The
display will be 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

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   17   OF

will copy 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. 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 configura-
tion. 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:

Selection	Display
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

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.	80001131-9001
REV	02
DATE	January 8, 1982
PAGE	18 OF

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 = Invalid   1 = 6 Bits
    2 = 7 Bits   3 = 8 Bits

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

4. Buffer Status - Selects the method to report buffer status
    for serial communications.
    0 = None (disabled)   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 (disabled)   1 = Reverse Channel
    2 = DTR   3 = X-On/X-Off

6. Reverse Channel Polarity - Selects active (busy) state.
    0 = Active Low   1 = Active High

7. Reserved.

8. Reserved.

9. Inverted Data Strobe - Selects position going parallel
    interface data strobe.
    0 = Normal   1= Inverted

10. Inverted Data Bit 8
    0 = Normal   1 = Inverted

11. Bit 8 Control
    0 = Ignore Bit 8   1 = Normal
    2 = Escape Control   3 = Invalid

12. 703/ANSI - Selects Centronics 703 or ANSI control sequence
    compatibility.
    0 = 703   1 = ANSI

13. Prime on Select
    0 = Disabled   1 = Enabled

14. Prime on Delete
    0 = Disabled   1 = Enabled

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   19   OF

15.   Print on Paper Motion - Selects one of three 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 = Invalid

16.   Page Mode Enable - When enabled, STX and ETX are used to
      bracket blocks of up to 4096 characters including control
      codes without going busy.

3.1.9   Internal Self-Test

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

Error Codes: (R = Recoverable, F = Fatal)

LCD Error Code	Test Failure	
0	1st PROM	F
1	2nd PROM	F
2	3rd PROM	F
3	1st RAM	F
4	2nd RAM	F
5	4K RAM	F
6	EAROM	F
7	Print Controller ROM	F
8	C-RAM	F
9	Character Generator RAM	F
10	Print Controller RAM	F
11	Bad Video	F
12	No Head Motion	F
13	Serial Input Buffer Overflow	R
14	Bad VFU Load	R
15	Bad Character Set Load	R
16	Abort Event 1 (Reverse Paper Motion Before Print)	R
17	Abort Event 2 (Forward Paper Motion Before Print)	R
18	Abort Event 3 (Print)	R
19	Abort Event 4 (Reverse Paper Motion After Print)	R
20	Abort Event 5 (Forward Paper Motion After Print)	R
21		
22		
23		
24	Interlock Idle	R
25	Unresolvable Error	R

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   20   OF

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

3.1.9.1   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.

3.1.9.2   PROM/ROM Check

A cyclic redundancy check (CRC) will be calculated for each of the PROM/ROM's during internal self-test. It will be compared to the correct value stored at the end of the last PROM/ROM.

3.1.9.3   Non-Volatile Memory Check

The EAROM will have two nibbles (4 bits) stored as checks. These will be checked and compared to then correct values stored in PROM/ROM. If found to agree, the integrity of the configuration data stored will be assumed to be good and the printer will be initialized and stored. If not, an error code will be displayed and the factory configuration will be loaded into working memory.

3.1.9.4   Printer Controller Self-Test

When the print controller fails its own self-test, an error bit is set in C-RAM. This error will also be displayed on the LCD.

3.2   ELECTRICAL CHARACTERISTICS

3.2.1   Basic Architecture

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 3.2.1.

CENTRONICS'
Product Planning

3.2.1.1 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
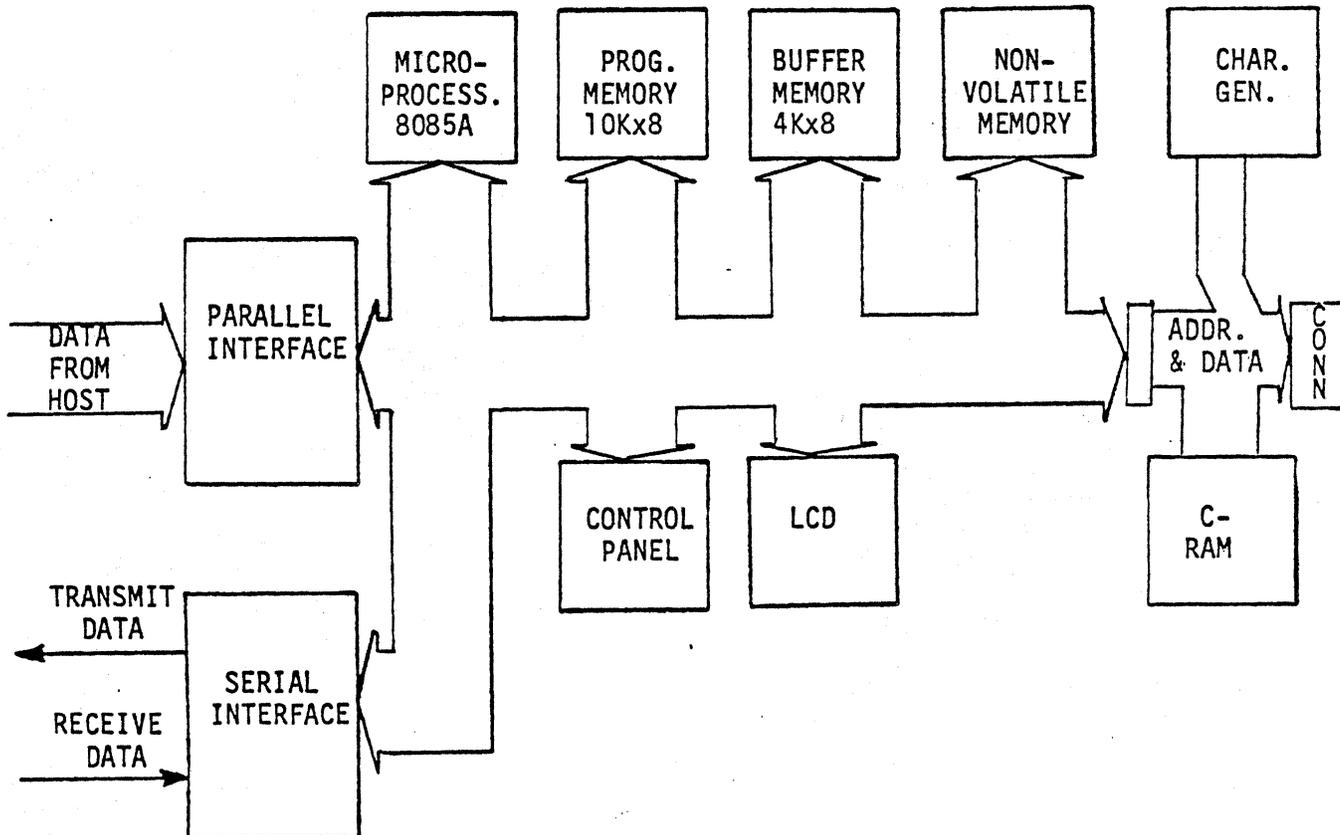D. 4K of Buffer RAM

Figure 3.2.1

3.2.1.2 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 3.2.1.2.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982-

PAGE   22   OF
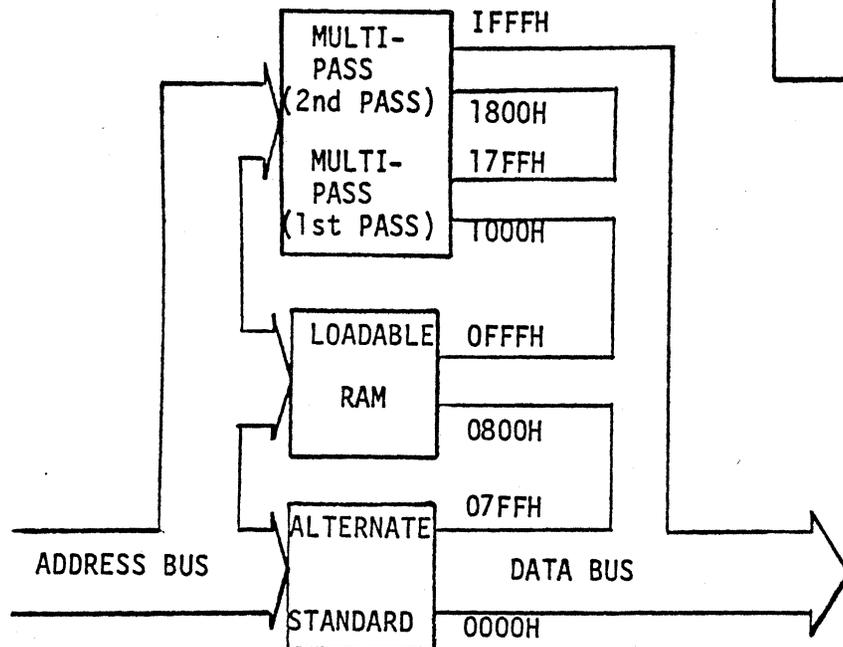
Figure 3.2.1.2

A.   2K x 8 ROM Character Set - This is a standard and alternate
     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 will be written into by the printer controller.
     The formatter will pass the character set in the C-RAM.
     See Section 3.4.3.13 for the required control sequence.

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

3.2.1.3   Non-Volatile Memory

The formatter has a 1K x 4 electrically alterable read-only
memory (EAROM). This memory will be used to store the machine
configuration when power is off. All items described in
3.1.8.3 will be stored. The information stored in this
memory is not (necessarily) the present operating configuration.

This is 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 3.1.8.3. The operator can also
similarly cause the non-volatile memory to overwrite the
working memory.

CENTRONICS®

Product Planning

Upon power up, the microprocessor will check the integrity of the non-volatile memory. If found to be usable, the machine will be initialized according to this configuration. If found to be unusable, the "Fault" indicator on the control panel will be illuminated and "06E" shall be displayed on the LCD. The machine will then be initialized to a factory configuration permanently stored in the program ROM's. This is also the configuration stored in the non-volatile memory when the machine is shipped from the factory. 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. Reserved.
R. Reserved.
S. Buffer Status - X-On/X-Off.
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 - Enabled.

3.2.1.4 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. The high speed front end has three modes of operation:

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®

Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 24 OF

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 3.2.2.

3.2.1.5   Serial Interface

The serial communications interface will provide an EIA RS-232C compatible interface. A 20 ma current loop interface capability is provided by an optional plug in the PC board. An adapter for RS-449 will be available as an option.

3.2.1.6   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 would be used in the page mode. An entire CRT screen could be dumped in this way, without the interface going busy.

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.

3.2.1.7   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 the Model 350 Functional Product Specification #80001126-9001, Section 5.0.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®

Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 25 OF

3.2.1.8 Reserved

3.2.2 Customer Interfaces

3.2.2.1 Parallel Interface Signals

3.2.2.1.1 Externally Generated Signal Description

A timing diagram of the interface control signals is shown in Figure 3.2.2.

3.2.2.1.1.1 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 3.2.2.1.1.2. This signal drives TTL logic and is terminated by a 470 ohm resistor to +5 volts.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®

Product Planning

SPEC NO.   80001131-9001

REV 02
DATE January 8, 1982

PAGE   26   OF
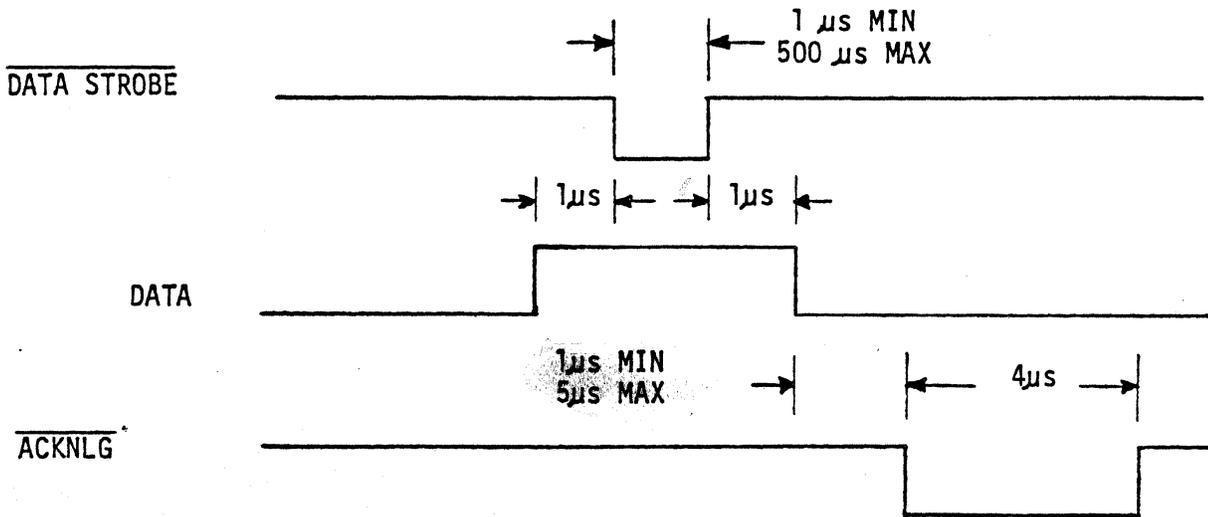
Figure 3.3.2

3.2.2.1.1.2   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.

3.2.2.1.1.3   Input Prime

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

3.2.2.1.2   Printer Generated Signal Description

3.2.2.1.2.1   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.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO. 80001131-9001

REV 02

DATE January 8, 1982

PAGE 27 OF

3.2.2.1.2.1   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.

3.2.2.1.2.2   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.

3.2.2.1.2.3   External Oscillator

None.

3.2.2.1.2.4   Paper Empty (PE)

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

3.2.2.1.2.5   Select (SLCT)

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

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®

Product Planning

SPEC NO.	80001131-9001
REV	02
DATE	January 8, 1982
PAGE	28 OF

3.2.2.1.3   Parallel Connector Pin Out

AMPHENOL 57 SERIES PIN OUT

PIN	SIGNAL	PIN	SIGNAL
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

3.2.2.2   Serial Interface

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

3.2.2.2.1   Input Buffer - 4K Characters

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
3.1.8.3.2, Buffer Status) 512 characters from end of buffer
(high water mark). It will give a buffer empty indication at
256 characters remaining in the buffer (low water mark). The
formatter will display "E13" on the LCD display if the buffer
overflows. All input characters will be ignored until the
overflow condition is removed.

3.2.2.2.2   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
3.1.8.3.2). Data Terminal Ready control should not be selected
with current loop installed.

— FUNCTIONAL PRODUCT SPECIFICATION —

CENTRONICS®

Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   29   OF

3.2.2.2.3   Reserved

3.2.2.2.4   Reserved

3.2.2.2.5   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:

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

3.2.2.2.6   Word Length

Word length will be control panel selectable for choice of 6,
7 or 8 data bits.

3.2.2.2.7   Parity

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

3.2.2.2.8   Serial Data Connector

The printer will provide an RS-232C 25-pin male connector
with female contacts. Signals will be provided as set forth in
Section 3.2.2.2.10.

3.2.2.2.9   Baud Rates

Baud rate will be 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.

3.2.2.2.10   EIA RS-232C Series Pin Out

Pin	Signal Name	Signal Description
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.

CENTRONICS®
Product Planning

Pin	Signal Name	Signal Description
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.

3.2.3 Current Loop

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

3.2.4 Serial EIA RS-449A

RS-449 Interface will be implemented via an external adapter option.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   31   OF

3.2.5   Power Supply

3.2.5.1   General Description

The 350 power supply is an "off-line" switching power supply which provides the primary power source for all 350 Series products. This supply provides regulated DC voltage from the 110 VAC/220 VAC, 50/60 Hz mains. It also provides the input line voltage to the printer cooling fan. An integral line filter provides the required filtering and is mounted to the EMI shield which encloses the power supply and fan. The filter/shield combination limits the EMI levels to those acceptable to regulatory agencies. The cooling fan provide cooling for the power supply.

3.2.5.2   Input Specifications

3.2.5.2.1   Input Voltage

Two wiring configurations provide the following input voltage ranges to be used:

#1 -   90 VAC to 128 VAC
#2 - 180 VAC to 256 VAC

3.2.5.2.2   Input Current

The rated current for the power supply is as follows:

#1 - 3A RMS Max for 110 VAC nominal input voltage
#2 - 1.5A RMS Max for 220 VAC nominal input voltage

3.2.5.2.3   Inrush Current

The power supply will limit the inrush current under worst case conditions of input line voltage, load, and temperature to a level which will not damage the supply or blow the input fuse. The printer mains fuse is a 4A Slo Blow (110) or a 2A Slo Blo (220) fuse.

3.2.5.3   AC Output Voltage

AC output power is provided for the cooling fan only.

3.2.5.3.1   Voltage

The output voltage is the same as the input voltage as described in Section 3.2.5.2.1.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 32 OF

3.2.5.3.2   Current

The maximum current is 0.5 A RMS.

3.2.5.4   DC Output Voltage

The DC output voltages are as follows:
+5 VDC
+12 VDC
-12 VDC
+35 VDC

3.2.5.5   Protection Circuits

3.2.5.5.1   Input Voltages

The power supply shall provide power fail indication and shutdown without physical damage for input voltages that are below the limits set forth as follows:

Output	Min. Level
+5.00	+4.90
+12.0	+11.4
-12.0	-11.4
+35.0	+35.0

3.2.5.5.2   Secondary Short Circuit

A short circuit from a DC output to any other DC output will force a full supply shutdown without physical damage.

3.2.5.5.3   Over/Under Voltage (+5 VDC)

A voltage level on the +5 VDC output of more than +5.5 V or less than +4.5 V, will force a full supply shutdown.

3.2.6   Power Cable

A ten foot ████████ power cable is provided with the Model 353. The printer end is terminated in the international standard plug. The power source end is terminated in 110 VAC socket for domestic markets and unterminated for international markets.

3.3   PAPER GUIDES

One set of paper guides consists of a lower and an upper wire form rack for guiding the paper into the printer mechanism and out to the receiving tray.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 33 OF

3.4 PROGRAM CONTROL CODES

The high performance Format Controller will have three types of control codes (sequences)— Codes compatible wth 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)

If the printer is on-line, receipt of the line feed code will cause action selected in 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 the 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.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   34   OF

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.

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.

Receipt of FF code will cause paper to advance to the next sequential top of form location. The 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 1 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 stored 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 seqnential 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).

3.4.1.10 Reserved

─ FUNCTIONAL PRODUCT SPECIFICATION ─

CENTRONICS®
Product Planning

SPEC NO.	80001131-9001
REV	02
DATE	January 8, 1982
PAGE	35 OF

3.4.1.11 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 3.2.2.2.5.

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 8.75 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 ($1D_{16}$) (Octal 35) followed by two bytes per line and terminated by a "Stop Load" code ($1E_{16}$) (Octal 36).

Data Bits	7	6	5	4	3	2	1	0
$1D_{16}$	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

——— FUNCTIONAL PRODUCT SPECIFICATION ———

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   36   OF

Even number byte Following Start Load; 2nd, 4th, 6th, etc.	X	1	X	X	X	X	X	X
$1E_{16}$	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 $1F_{16}$ 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_3 MSB	N_2	N_1	N_0 LSB
						4-bit line count		
Skip to Channel	X	X	X	0	C_3 MSB	C_2	C_1	C_0 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 "E14" 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 ( 1 (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).

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®

Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 37 OF

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

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®

Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 38 OF

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.

$1 \leq$ top margin $<$ bottom margin $\leq$ form length

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_1;n_2r	Set Top Margin to Line n_1; and Set Bottom Margin to Line n_2.

3.4.3.6 Vertical Tabs

The high performance Formatter has 16 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 [1 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_1;n_2;...n_x v	Set Vertical Tab Stops at Lines n_1, n_2..n_x (x $\leq$ 16).

3.4.3.7 Horizontal Tabs

The high performance formatter has 16 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_1; n_2;...n_xu	Set horizontal tab stops at columns n_1, n_2,...n_x (x $\leq$ 16).

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   39   OF

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 feed commands. This escape sequence will only be honored and executed 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.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 40 OF

3.4.3.13   Ram Character Set Loading

The Formatter has the capability to accept a 96 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   -   Two byte ASCII decimal number indicating the number of
            characters being loaded up to 96. 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 Figure 3.4.3.13.

The Formatter 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 control sequence, then the printer will deselect and display an error code on the LCD. The 96 allowable characters are addressed during printing by ASCII codes 20H through 7FH. Any characters not loaded are defaulted to blank.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   41   OF

CONTROL SEQUENCE TO LOAD RAM CHARACTER SET

"ESC"	"["	"n"	"x"	data	
1BH	5BH	2 bytes	78H	n x 14 bytes	1344 bytes

Most SIG ASCII Digit	Least SIG ASCII Digit

14 bytes   (n-1) x 14 bytes

Character Cell (TYP)	Other Character Cells

2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes
Left most column data	column data	column	column	column	column	Right most column data

Most SIG 4 bits column data	Least SIG 4 bits column data

(TYPICAL)

1 byte

(MSB) | X | 0 | 1 | 0 | D | D | D | D | (LSB)

1 byte

(MSB) | X | 0 | 1 | 0 | D | D | D | D | (LSB)

8th pin data   5th pin data   4th pin data   top pin data
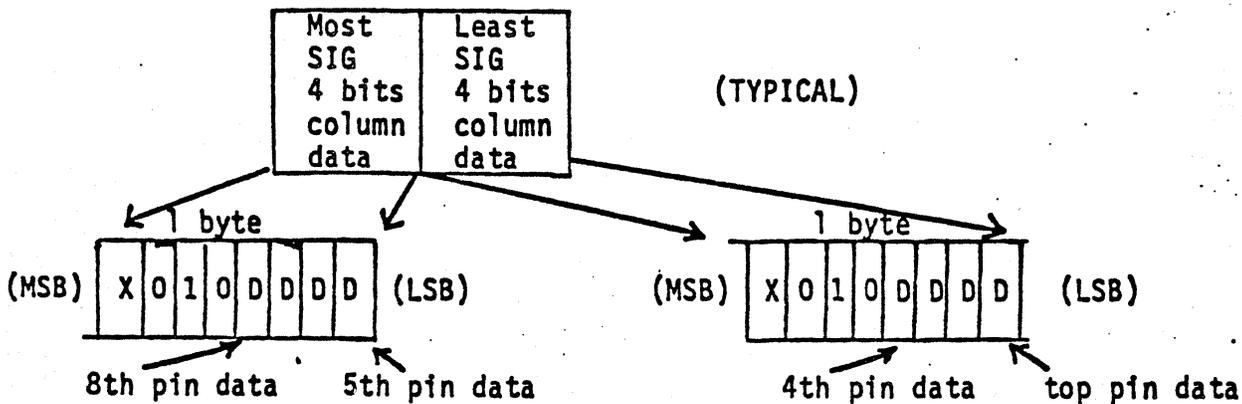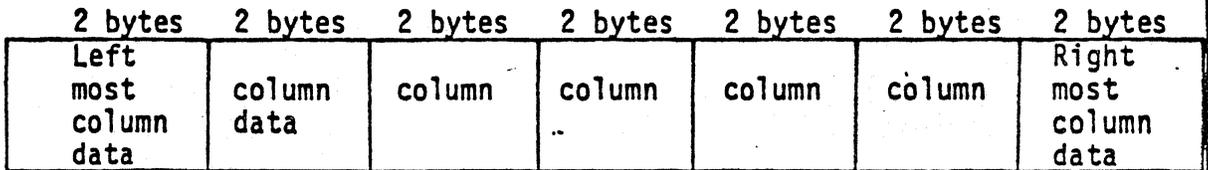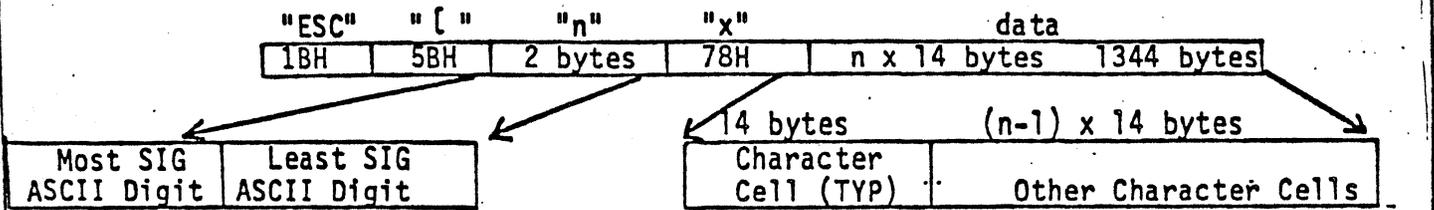
Figure 3.4.3.13.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   42   OF

3.4.3.14   Alternate Character Set Selection

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

ESC) 0	(Octal 60)	Designate the Alternate Character Set
ESC) Sp @	(Octal 40)	Designate the RAM Character Set
ESC) 1	(Octal 61)	Designate the Multipass Character Set
ESC) 2	(Octal 62)	Designate the Multipass Character Set

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 multipass character set is one of the alternate character sets. It is designated (see Section 3.4.3.14) by the sequence:

ESC) 1	(Octal 61)	Designates the multipass character set to be printed bidirectionally.
ESC) 2	(Octal 62)	Designates the multipass character set to be printed unidirectionally.

Multi-pass is invoked as specified in Section 3.4.3.8. These commands will override the effect of the multi-pass pushbutton.

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

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 3.4.2.2, 3.4.2.3 and 3.4.3.8.

3.5   CURRENT LOOP

20/60 MA current loop capability is provided by an optional plug-in PC board. The printer status and/or buffer status mode is selected via the control panel configuration set-up. Only X-On/X-Off and reverse channel modes may be selected.

FUNCTIONAL PRODUCT SPECIFICATION

CEMTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV   02
DATE   January 8, 1982

PAGE   43   OF

3.6   703/704 DIFFERENCES

A.   The Model 353 prints a 7x8 matrix with single dot descender and true underline capability.

B.   The Model 353 does not have single elongated character capability.

C.   The Model 353 does not 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, DC1, ESC 3, ESC 4.

E.   The Model 353 has 2-Channel Electronic VFU capability.

F.   The maximum page length is 192 lines.

G.   The maximum number of vertical tabs is 16.

H.   The Model 353 can stack 102 lines feeds at 6 LPI, 136 line feeds at 8 LPI, and 204 line feeds in graphics mode.

I.   The Model 353 can stack vertical tabs or form feeds.

J.   Non-gated data strobe is not available on the Model 353.

K.   Parallel handshake timing is different on the Model 353.

4.0   PERFORMANCE CHARACTERISTICS

4.1   PRINTING RATE

4.1.1   Head Speed

The Model 353 printer shall have a head speed of 20 inches per second nominal and be capable of printing 200 characters per second at 10 characters per inch (7x8 Dot Matrix).

4.2   PAPER SPEED

The Model 353 printer shall have a paper slew speed of 8 inches per second nominal.

4.3   PAPER MOVEMENT

To move paper in the fanfold mode, the printer electronics activate a stepper motor that is mechanically linked to the paper feed sprockets and a set of pinch rollers which provide

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 44 OF

tension during the printing operation. When in the cut sheet mode, the pinch rollers provide precise paper motion in either the forward or reverse directions.

4.4 PAPER OUT SENSOR

A sensor shall be provided in the paper path to detect out of paper condition while in the fanfold mode. It will result in an alert indication and the printer will deselect.

4.5 COLUMN SCALE/TEAR BAR

A steel bar will act as a tear bar and column scale indicator providing scales for use in fanfold and cut sheet applications.

4.6 PENETRATION CONTROL

An external penetration control shall be provided to compensate for forms thickness and to provide the specified print quality.

4.7 RIBBON LIFE

The ribbon life for the 70 yard 350 Series cassette ribbon will be a minimum of ten (10) million characters using a 7x8 dot matrix format with a USASCII random pattern for the operating environment specified in Section 5.1.

4.8 PRINT HEAD LIFE

The print head life for the 350 Series printers will be a minimum of one hundred (100) million characters using a 7x8 dot matrix format with a USASCII random pattern for the operating environment specified in Section 5.1.

5.0 ENVIRONMENTAL CHARACTERISTICS

5.1 TEMPERATURE/HUMIDITY

5.1.1 Operating

The operating temperature will be permitted to range from 10°C - 40°C (50°F - 104°F). The relative humidity may range from 10% - 90% with maximum wet bulb of 28°C (82°F) and maximum dew point of 2°C (36°F).

5.1.2 Non-Operating

The non-operating temperature will be permitted to range from -40°C (-40°F) to 66°C (151°F). The relative humidity may range from 10% - 95%.

FUNCTIONAL PRODUCT SPECIFICATION

CEПTROПICS®
Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 45 OF

5.2 ALTITUDE

5.2.1 Operating

The operating altitude may range from -303 M (-1,000 ft.) to 2,439 M (8,000 ft.).

5.2.2 Non-Operating

The non-operating altitude may range from -303 M (-1,000 ft.) to 9,146 Km (30,000 ft.).

5.3 MECHANICAL SHOCK

5.3.1 Operating

The operating shock allowable will be a one-half sine wave shock pulse of 10 Gpk and 10 $\pm$ 3 msec. duration applied once in either direction of three orthogonal axes (3 pulse total).

5.3.2 Non-Operating

The non-operating shock allowable to the printer in its shipping package without sustaining damage will be one-half sine wave shock pulse of 40 Gpk and 30 $\pm$ 10 msec. duration.

5.4 VIBRATION

5.4.1 Operating

The operating vibration allowable to the printer at a sweep rate of 1 octave/minute is as follows:

5 - 22 Hz	0.010" DA
22 - 500 Hz	0.250 Gpk
500 - 22 Hz	0.250 Gpk
22 - 5 Hz	0.010" DA

5.4.2 Non-Operating

The printer, when packaged, will withstand the random vibration listed below when the packaged product is attached to a shaker table.

Vertical Axis Excitation - 1.40 GRMS overall from 10-300 Hz.
Spectral Power Density - .029 g^2/Hz from 10-50 Hz with 8dB/octave rolloff from 50-300 Hz.
Logitudinal and Lateral Axis Excitation - 0.68 GRMS overall from 10-200 Hz.
Power Spectral Density - 0.007 g^2/Hz from 10-50 Hz with 8dB/octave rolloff from 50-200 Hz.

Test duration shall be one hour in each axis (3 hours total).

FUNCTIONAL PRODUCT SPECIFICATION

⊏EΠTRΠ∎⊏⅁®

Product Planning

SPEC NO.	80001131-9001
REV	02
DATE	January 8, 1982
PAGE	46 OF

6.0   SAFETY

The product shall meet the Safety Standards as specified in Section 2.2.

7.0   RELIABILITY

7.1   DEFINITIONS

7.1.1   Failure

A failure is any stoppage or malfunction of the printer mechanism or electronics which prohibits full use of the product as defined by the specifications and is directly caused by the mechanism or electronics. This excludes stoppages or substandard performance caused by operator error, power failure or environmental conditions exceeding specified limits. Failures are classified into two categories:

A.   Critical Failure: A critical failure is defined as any failure which cannot be corrected by a trained operator and requires the services of a trained field service representative for repair.

B.   Inconvenient Failure: An inconvenient failure is any failure which can be readily corrected by an operator without requiring the services of a field representative. Ribbon jams, paper jams, etc. are examples of inconvenient failures.

7.1.2   Print Density

Print density is defined as the percentage of characters printed to the maximum number of characters that can be printed on a given page.

7.1.3   Power-On Time

The period of time during which AC power is applied to the product is defined as power-on time. Unless stated otherwise, all hours are expressed in terms of power-on time.

7.1.4   Operating Time

Operating time is defined as that period of time which the product is moving paper or the print head carriage is in motion.

7.1.5   Duty Cycle

Duty cycle is defined as the ratio of operating time to power-on time.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS

Product Planning

SPEC NO. 80001131-9001

REV 02

DATE January 8, 1982

PAGE 47 OF

7.1.6 Operating Environment

The operating environment for reliability parameters for the product shall be:

A. Nominal voltage - 115/230 VAC.
B. 50/60 Hz.
C. Ambient room temperature of $21^\circ \pm 3^\circ C$ ($70^\circ \pm 5^\circ F$).
D. Ambient relative humidity of $50\% \pm 5\%$.

7.1.7 Mean Time Between Failure (MTBF)

The MTBF shall be defined only during the product useful life and is calculated as follows:

$$\text{MTBF} = \frac{\text{Power On Time}}{\text{Number of Critical Failures}}$$

7.1.8 Service Life

The service life is defined as that period of time the printer will oeprate before failures are no longer random and the failure rate increases above a specified value.

7.1.9 Mean Time To Repair (MTTR)

The MTTR is the average value of time required to perform on-site repair of the product by a properly trained and equipped service representative after it has failed. MTTR is calculated as follows:

$$\text{MTTR} = \frac{\text{Total Product Repair Time}}{\text{Number of Repair Actions}}$$

7.1.10 Useful Life

The useful life of the printer is defined as that period of time during the life of the product when the failure rate is maintained at a constant value due to random failures.

7.2 RELIABILITY PARAMETERS

All reliability parameters are based on the following:

A. A duty cycle of 25%.
B. A print density of 50%.
C. The operating environment as specified in Section 9.1.6.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV 02
DATE January 8, 1982

PAGE   48   OF

The population MTBF shall exceed 2,700 hours per failure (excluding the print head, since the print head is operator replaceable).

The mean service life shall exceed 12,500 hours.

The mean time to repair (MTTR) shall be equal to or less than 0.5 hours per repair action.

8.0   MAINTAINABILITY

8.1   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.

8.2   SCHEDULED MAINTENANCE

The design shall require no scheduled preventive maintenance during the useful life of the printer. Some routine cleaning of the mechanism may be necessary depending upon the quality of the paper used in printing.

9.0   OPTIONS

9.1   CURRENT LOOP

Previously described in Section 3.5.

9.2   RS-449 ADAPTER

Allows operation in the RS-423 mode.

9.3   FORMS RECEIVING TRAY

For use in table-top operations to dispense and stack various types of fanfold paper.

9.4   PRINTER STAND

This stand enables use of the printer as a free-standing printer.

9.5   SPECIAL PAINT

Allows the customer to purchase Model 353 printers to their own color requirements. Paint qualification process is necessary for special paint applications.

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®
Product Planning

SPEC NO.   80001131-9001

REV 02
DATE January 8, 1982

PAGE   49   OF

APPENDIX

A1.0   Forms Specification

The Model 353 is designed to handle pin feed, continuous fan-fold forms and cut sheet forms.

A1.1   Fan-fold Forms

A1.1.1   Sprocket Holes

The forms must have sprocket holes punched along both margins 0.25 + .03 in. (6.4 + .7 mm) from the paper edge to the hole center lines. The distance between hole center lines must be 0.5 + .005 in (12.7 + .05 mm) non-accumulative in any five inch (127 mm) length and the diameter of the holes must be 0.156 + .005 in. (4.0 + .1 mm). The distance across the sheets between sprocket hole center lines must be uniform within 0.015 in. (0.381 mm). If paper does not conform to this specification, degraded forms handling may occur.

A1.1.2   Fastening

Forms may be glued or crimped. When gluing, the form thickness should not exceed .0204 in. (.52 mm). When fastened with crimps, they must be spaced a minimum of 2 in. (50.8 mm) along both edges of the forms. Crimps must not come closer to the fanfold than 0.5 in. (12.7 mm). Metal staples cannot be used.

A1.1.3   Size and Weight

Length - 3.0 to 15.5 in. (7.6 to 39.4 cm).
Width - 3.0 to 15.0 in. (7.6 to 38.1 cm).
Thickness - A.   Single part - 15 lb. paper minimum, .010 in. (.25 mm) maximum.
            B.   Multi-part - Up to six part with carbon, .0204 in. (.52 mm) maximum.
Weight -   A.   Single part - 15 to 20 lb. bond (56 g/m^2 to 75 g/m^2).
            B.   Multi-part

Ply	Paper	Carbon
2	15 lb (56 g/m^2) bond	#7 (16.5 g/m^2) tissue
3	15 lb (56 g/m^2) bond	#7 (16.5 g/m^2) tissue
	12 lb (45 g/m^2) bond	
4-6	12 lb (45 g/m^2), except last copy	#7 (16.5 g/m^2) tissue
	15 lb (56 g/m^2)	

FUNCTIONAL PRODUCT SPECIFICATION

CENTRONICS®

Product Planning

SPEC NO. 80001131-9001

REV 02
DATE January 8, 1982

PAGE 50 OF

A1.1.4   Recommendations for Improved Print Quality

A. On multi-part forms, use 12 lb (45 g/m^2) as first copies with heaviest copy last.
B. On multi-part forms over four parts, use a 5 lb (12 g/m^2) carbon tissue.

A1.1.5   Recommendations for Improved Forms Handling

A. Use 20 lb (75 g/m^2) bond for single part forms.
B. Glued margins will improve multi-part paper handling.
C. For forms having wide and narrow copies in the same form, the top copy should always be the fullest width.

A1.1.6   Other Comments

A. Multi-part carbonless forms up to six parts may be used.
B. Split forms with each side containing a different thickness or number of sheets are not recommended.

A1.2   Cut Sheet Forms
A1.2.1   Size

Length - 3.0 to 15.5 in. (7.6 to 39.4 cm).
Width - 4.0 to 12.0 in. (10.1 to 30.5 cm).
Thickness/Weight -
A. Single part - 20 lb (70 g/m^2) minimum.
B. Multi-part - Up to six part with carbon, .0204 in. (.52 mm) maximum as follows:

Ply	Paper	Carbon
2	15 lb (56 g/m^2) bond	#7 (16.5 g/m^2) tissue
3	15 lb (56 g/m^2) bond	#7 (16.5 g/m^2) tissue
	12 lb (45 g/m^2) bond	
4-6	12 lb (45 g/m^2), except last copy 15 lb (56 g/m^2)	#7 (16.5 g/m^2) tissue

A1.2.2   Recommendations for Improved Print Quality

A. Multi-part forms may be glued on the top or bottom.
B. Stapled forms must not be used.
C. Split forms with each side containing a different thickness or number of sheets are not recommended.