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PROGRAMMER's REFERENCE MANUAL
LPT 706, LPT 707, and LPT 708 Serial Printers

Keywords : Programmer's Reference Manual, RC3600, and LPT 706, LPT 707, and LPT 708 Serial Printers.

Abstracts: This paper describes the logical structure of the LPT 706, LPT 707, and LPT 708 Serial Printers.

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1. MAIN CHARACTERISTICS

1.1. Description

The LPT 706/707/708 printers are connected to the RC 3600 Central Processor Unit via the programmed transfer channel. The line width is 132 characters, and the standard character set contains 64 printing characters.
The printers output alphanumeric hardcopy at rates of 60/120 lines per minute for full lines (165/330 characters per second).

1.2. The Data Medium

The data medium is standard edge-punched 1/2 inch centers fanfold paper from 10 to 38 cm wide and with up to 4 parts.
The printing density is 132 characters per line and 6 lines per inch. The characters are formed by a 5 x 7 dot matrix (9 x 7 dot matrix is optional).

1.3. Data Formats

The data format used during programmed transfer from the CPU is shown in fig. 1.1.

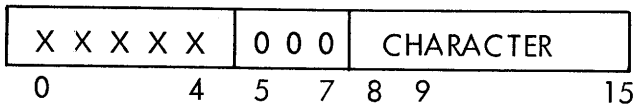


Fig. 1.1.

Bit 8 = 1 selects special character set if this is available. If not, it indicates a dummy character, causing a print operation.

For a printer equipped with the standard character set, this is shown in fig. 1.2.

USA STANDARD CODE II

(USASCII)

Character	Code (Octal)	Binary	Character	Code (Octal)	Binary	Character	Code	Binary
Blank	040	0100000	5	065	0110101	J	112	1001010
!	041	0100001	6	066	0110110	K	113	1001011
"	042	0100010	7	067	0110111	L	114	1001100
#	043	0100011	8	070	0111000	M	115	1001101
$	044	0100100	9	071	0111001	N	116	1001110
%	045	0100101	:	072	0111010	O	117	1001111
&	046	0100110	;	073	0111011	P	120	1010000
'	047	0100111	<	074	0111100	Q	121	1010001
(	050	0101000	=	075	0111101	R	122	1010010
)	051	0101001	>	076	0111110	S	123	1010011
*	052	0101010	?	077	0111111	T	124	1010100
+	053	0101011	@	100	1000000	U	125	1010101
,	054	0101100	A	101	1000001	V	126	1010110
—	055	0101101	B	102	1000010	W	127	1010111
.	056	0101110	C	103	1000011	X	130	1011000
/	057	0101111	D	104	1000100	Y	131	1011001
Ø	060	0110000	E	105	1000101	Z	132	1011010
1	061	0110001	F	106	1000110	[	133	1011011
2	062	0110010	G	107	1000111	\	134	1011100
3	063	0110011	H	110	1001000	]	135	1011101
4	064	0110100	I	111	1001001	^	136	1011110
						←	137*	1011111

* LPT 706/LPT 708 ONLY

CONTROL CODES

007 BELL

012 LINE FEED

013 VERTICAL TAB

014 FORM FEED

015 CARRIAGE RETURN

016 ELONGATED CHARACTER

177 DELETE

021 SELECT ON

023 SELECT OFF

Models LPT 706/LPT 708 only

Fig. 1.2

1.4. Applicable Documents

1.4.1. How to use the Nova Computers
A system Reference Manual.

1.4.2. Technical Manual.
MODEL 101A PRINTER
Centronics.

1.4.3. Technical Manual.
MODEL 101AL PRINTER
Centronics.

1.4.4. Technical Manual.
MODEL 102A PRINTER
Centronics.

2. PERFORMANCE CHARACTERISTICS

2.1. Equipment

The printer is equipped with a character set consisting of 64 different characters, all of the 5 x 7 dot matrix type.

The printer is connected via an external line buffer capable of buffering one line (132 characters).
The loading of a character will place the printer in the busy state for approximately 12 usec. During the print operation the printer will be busy in 6 ms/character plus 270 ms max. return time.

The duration of the paper movement is:

Line Feed	:	75-105 msec.
Vertical Tab	:	300-310 msec.
Form Feed	:	3-3.5 msec.

The duration of busy is for special control characters:

Bell : 2 sec
Delete : 3 msec.
Deselect: Until printer is selected.

The printer is equipped with a vertical format unit using 2-channel format tape.

After a power turn-on, the printer is in the off-line state, and the external line buffer is cleared.

3. LOGIC STRUCTURE

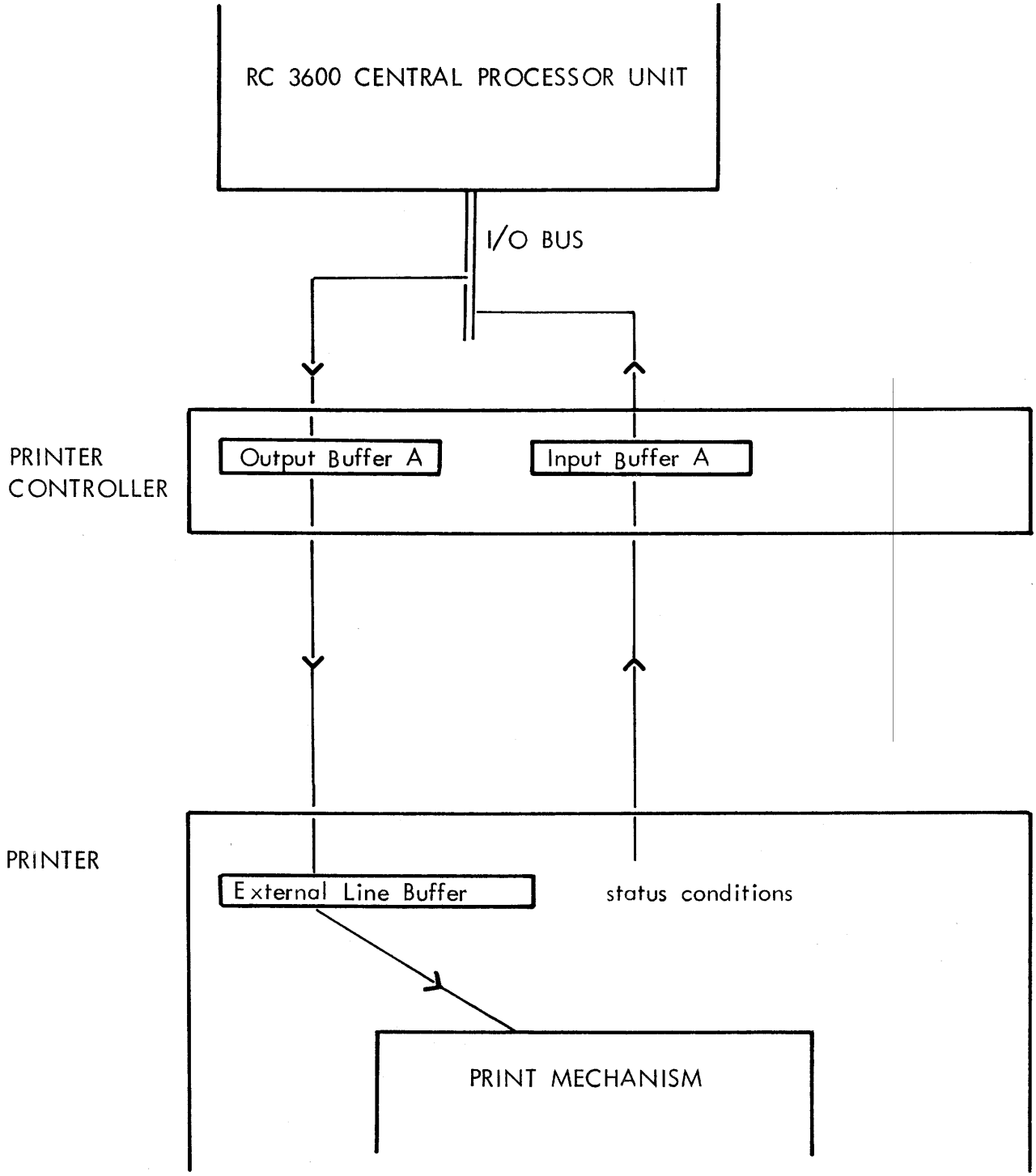


Fig. 3.1. Survey Diagram.

3.1. Logic Specifications

3.1.1. Program Control of the Printer.

The printer is activated by using programmed transfer from the RC3600 Central Processor Unit.
The printer accepts normal Input/Output Commands with device code 37 octal. (and 67 octal if it is a second printer).
The interrupt disable is controlled by interrupt priority mask bit 12.
The printer is able to answer an Interrupt Acknowledge Command (INTA) if the conditions herefore are fulfilled, i.e. if it has requested an interrupt and if it is the device which is physically closest to the processor on the Input/Output Bus among the units which have set their Interrupt Request Flags (INTR). If the conditions are fulfilled, the device code of the printer will be transferred to the accumulator addresses by the INTA instruction.

3.1.2. Definition of Operation Type

Data can be transferred from an accumulator in the processor to an output buffer of 11 bits in the printer controller by a DOA command, see fig. 3.2.

DOA AC, 17; Data Out A, Line Printer

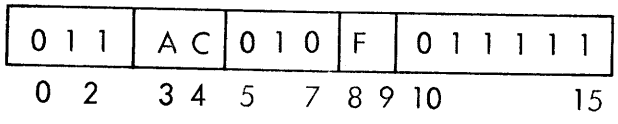


Fig. 3.2.

The Busy and Done Flags are controlled or sensed by the F field (bits 8 and 9) in all Input/Output Commands addressing the printer.

Setting the Busy Flag with a Start Command (mnemonic modifier S) causes the execution of a printer command if no status condition preventing the execution of the command is present.

Except for the modifier field F, output commands addressing registers B and C, and input commands addressing register C have no effect.

Note: Concerning input commands refer to 3.1.3. Sensing of the Device State.
The output buffer is cleared by the IORST instruction and after power start-up.

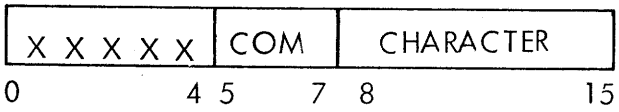


Fig. 3.3. Printer Data Word (X = irrelevant).

The Command field bit 5-7 is specified in Fig. 3.4.

Command Field (b5-7) (bit value)	Command
0	Load
1	No operation
2	No operation
3	No operation
4	Print
5	Paper
6	No operation
7	No operation

Fig. 3.4. Line Printer Commands.

Register A, Load Command

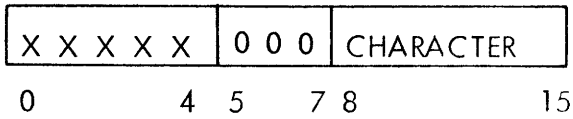


Fig. 3.5.

Executing the Load Command by setting the Busy Flag caused the loading of a character into the external line buffer.

When the operation is completed succesfully approximately 12 usec. later, the Busy Flag is cleared without requesting an interrupt by setting the Done Flag.
If the printer is deselected the operation is terminated on the trailing edge of the start function requesting an interrupt.
Loading a character with a value from 0 to 31, but not the values 10, 11, 12, and 13, the character will be skipped.

Register A, No Operation Command

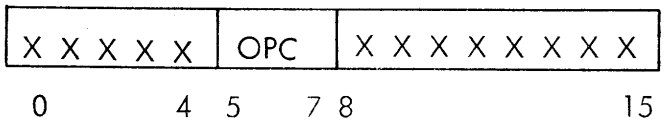


Fig. 3.6. (X = Irrelevant)
Value of OPC 1, 2, 3, 6 or 7

The No Operation Commands have the effect of preventing the printer from starting an operation when a Start Command is given by setting the Busy Flag. When a No Operation Command is executed, the Busy Flag is cleared without requesting an interrupt by setting the Done Flag.

Register A, Print Command

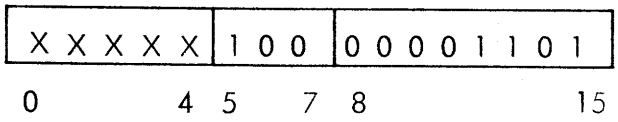


Fig. 3.7. (X = Irrelevant).

Executing the Print Command by setting the Busy Flag causes the printer to print the contents of the external line buffer on the paper.

When the operation is completed successfully within 1 minute or terminated by an error, the Busy Flag is cleared and the Done Flag set requesting an interrupt if Interrupt Disable is clear.

Note: When the Print Command is executed, the external line buffer is cleared.

Register A, Paper Command

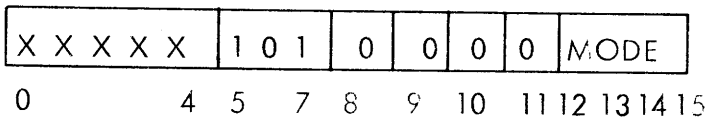


Fig. 3.8.

Executing the Paper Command by setting the Busy Flag causes the printer to move the paper according to the papermode field:

bit 12	13	14	15	
1	0	1	0	Line Feed
1	0	1	1	Vertical Tab
1	1	0	0	Form Feed

Line Feed advances the paper one line.

Vertical Tab advances the paper until the next hole is detected in channel 5 of the Vertical Format Unit paper tape.

Form Feed advances the paper until the next hole in channel 7 of the Vertical Format is detected.

When the operation is completed successfully, or terminated by an error, the Busy Flag is cleared and the Done Flag set requesting an interrupt if Interrupt Disable is clear.

3.1.3. Sensing of the Device State

1. Sensing the status word.

When no operation is in progress, the result of the latest program-initiated printer operation can be sensed by inputting a 16-bit status word to an accumulator by DIA command, see fig. 3.9.

DIA AC, 37; Data In A, Line Printer

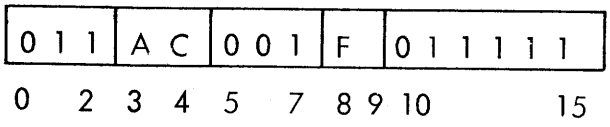


Fig. 3.9.

The status word transferred by the DIA instruction has the following data format.

Register A, Status Word

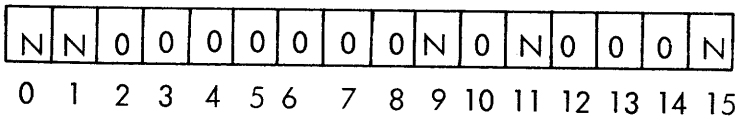


Fig. 3.10. (N = Status bit)

Bit No.	Meaning
0	Disconnected
1	Off Line
9	Not Ready
11	End of Paper
15	Not Available

Fig. 3.11. Status Conditions.

Bit numbers not mentioned above are always zero.

The contents of the input buffer A is undefined when the Busy Flag is set. The printer status conditions are buffered and will be available to the program when no printer operation is in progress.
The input buffer is cleared by the IORST instruction and after power start up.
Note: The input buffer must be sensed after each executed command to prevent loss of status information.

3.1.3.1. The Disconnected status bit indicates that the printer is disconnected.

3.1.3.2. The Off Line status bit indicates that the printer is deselected.

3.1.3.3. The Not Ready status bit indicates that the printer is deselected, an end of paper condition exists, or a malfunction in the video circuit of the printer. (each character position is detected by video signals).

3.1.3.4. The End of Paper status bit indicates that there is no more paper in the printer.

3.1.3.5. The Not Available status bit indicates that the Off Line or Not Ready status bit are present.

4. OPERATOR INTERACTION

Name	Pushbutton	Indicator
ON/OFF	x	x
TOP OF FORM	x	
PAPER STEP	x	
SELECT	x	x
FORMS OVERRIDE	x	
PAPER OUT		x

Fig. 4.1. Survey of pushbuttons and indicators.

4.1. Displays and Pushbuttons

4.1.1. ON/OFF Indicator and Switch

The ON/OFF switch controls the AC-power to the printer. When the switch is activated to apply power, the ON/OFF indicators lights. When the switch is activated to remove power, the ON/OFF indicator extinguishes.
When the ON/OFF switch has been activated to apply power, it will last approximately 100 msec before the printer becomes ready, as a power prime signal is generated for approximately 100 msec.

4.1.2. SELECT Indicator and Switch

The SELECT indicator will light if the printer is selected.
If the printer is in the deselected state, a depression of the SELECT switch places it in the selected state. A prime signal is generated at that time, with the printer in the selected state a depression of the SELECT switch deselects the printer.

The printer is by default placed in the deselected state by power turn-on.

4.1.3. PAPER OUT Indicator

The PAPER OUT indicator will light if there is no more paper left in the paper reservoir.

4.1.4. The TOP OF FORM and PAPER STEP Switches

These switches perform the same function as the 'FF' and 'LF' codes.

4.1.5. FORMS OVERRIDE Switch

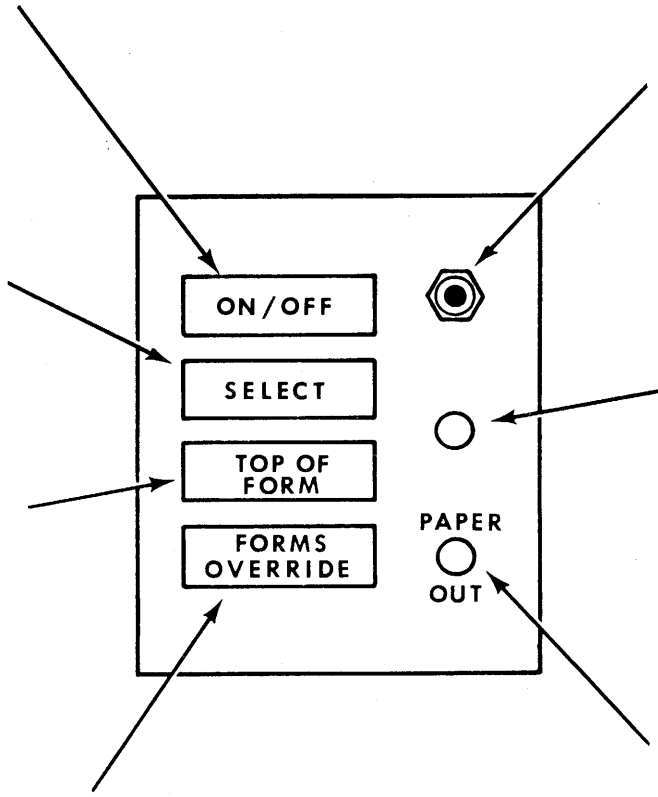
In case of a paper out condition keeping this switch depressed enables the printer to print the rest of the last form.

THIS SWITCH IS USED TO TURN AC POWER ON OR OFF. IT LIGHTS WHEN THE PRINTER IS ON.

THIS SWITCH IS USED TO SELECT THE PRINTER AFTER TURNING ON POWER. IT LIGHTS WHEN THE PRINTER IS SELECTED.

THE SWITCH IS USED FOR NORMALLY SLEWING PAPER TO TOP OF FORM. IT PERFORMS THE SAME FUNCTION AS A FORM FEED CODE.

THIS SWITCH WHEN DEPRESSED OVERRIDES THE INTERNAL PAPER OUT SWITCH, ALLOWING THE LAST FORM TO BE PRINTED BEFORE CHANGING PAPER.



THIS PUSHBUTTON SWITCH IS USED FOR MANUAL LINE FEEDS. IT PERFORMS THE SAME FUNCTION AS A LINE FEED CODE.

THIS INDICATOR IS PROVIDED FOR SPECIAL APPLICATIONS.

THIS INDICATOR IS USED TO INDICATE AN OUT-OF-PAPER CONDITION OR A PAPER HANDLING MALFUNCTION.

Figure 4.2. Operator Panel