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RC 3600 PROGRAMMER'S REFERENCE MANUAL
RC 3632 LINE PRINTER

KEY : RC 3600/Programmer's Reference Manual, Line Printer/Reference Manual.

ABSTRACT : This paper describes the logical structure of the RC 3632 Line Printer for the RC 3600 support system.

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1. MAIN CHARACTERISTICS

1.1. Description

The RC 3632 line printer is connected to the RC 3600 Central Processor Unit via the programmed transfer channel. The line printer outputs alphanumeric hardcopy at a rate up to 1800 lines per minute in high speed mode and 1200 lpm in OCR speed mode. The line width is 132 characters, and the standard character set contains 64 printing characters.

1.2. The Data Medium

The data medium is standard edge-punched 1/2 inch centers fanfold paper from 4 to 19-7/8 inches wide and with up to 6 parts.

The printing density is 10 characters per inch, e.g. max. printing 13.2 inch width in the center of a 19-inch form.

1.3. Data Formats

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

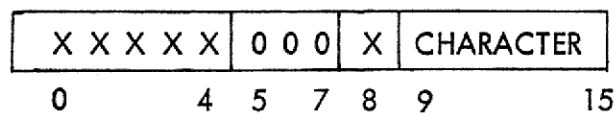


Fig. 1.1. (X = Irrelevant)

In fig. 1.2. the character set is shown. Bit 15 in the data format is the least significant bit corresponding to bit identifier b1 in the character set.

Note : The standard character set does not include space. Concerning the space character consult chapter 3.1.2. - Load Command.

Character set :

In the internal representation of a character the bits are identified by the bit identifiers b1 to b7, each bit having the binary weight as shown :

bit identifier	b7	b6	b5	b4	b3	b2	b1
weight	64	32	16	8	4	2	1

In the following code table the columns and rows are identified by the decimal equivalent to the following binary numbers :

column	b7	b6	b5	0	0	0	0
row	0	0	0	b4	b3	b2	b1

Accordingly, the decimal value of a character is the sum of the column and row numbers. For example, the character $\text{\AA}$ has numerical representation $64 + 8 = 72$.

Empty positions in the code table specify characters which are not available on the printer when using the standard 64 or 96 character drums.

1.4. Applicable Documents

1.4.1. How to use the Nova Computers

A system Reference Manual.

1.4.2. RC 3600 Programmer's Reference Manual

SH 3607 Line Printer

RCSL : 51-VB 1155.

1.4.3. Technical Manual

Model 2470 LINE/PRINTER

Data Products.

1.4.4. RC 3600 Interface Guide for connecting

Line printer DP 2470 to RC 3600.

RCSL : 44-RT 310.

For a Line printer equipped with the standard print drum with 64 chars, the character set is as shown in fig. 1.2. values 0-95.

The value 0-127 show the characters of a 96 character-drum.

Note:

Characters 0-31 do not physically exist on the drum, but will be converted to a space, with the exception of the characters 10, 12 and 13 which are not legal, also characters 96-127 will be converted to spaces on a 64 character-drum.

The standard character set :

	0	16	32	48	64	80	96	112
0			.	(	Ü	P	ü	p
1			,	)	Ö	O	ö	o
2			:	✕	Ä	N	ä	n
3			;	10	Z	M	z	m
4			0	=	Y	L	y	l
5			1	<	X	K	x	k
6			2	>	Å	J	å	j
7			3	/	Ø	I	ø	i
8			4	_	Æ	H	æ	h
9			5	%	W	G	w	g
10	PF		6	&	V	F	v	f
11			7	*	U	E	u	e
12	FF		8	!	T	D	t	d
13	CR		9	'	S	C	s	c
14			+	"	R	B	r	b
15			-	?	Q	A	q	a

Fig. 1.2.

For a line printer equipped with an ASC II print drum with 64 characters, the character set is as shown in fig. 1.3. values 0-95. The values 0-127 show the characters of a 96 character-drum.

Note : Characters 0-31 do not physically exist on the drum, but will be converted to a space, with the exception of the characters 10, 12 and 13 which are not legal, also characters 96-127 will be converted to spaces on a 64 character-drum.

The ASC II character set :

	0	16	32	48	64	80	96	112
0			spa- ce	Ø	●	P	\	p
1			l	l	A	Q	a	q
2			"	2	B	R	b	r
3			#	3	C	S	c	s
4			\$	4	D	T	d	t
5			%	5	E	U	e	u
6			&	6	F	V	f	v
7			'	7	G	W	g	w
8			(	8	H	X	h	x
9			)	9	I	Y	i	y
10	PF		*	:	J	Z	j	z
11			+	;	K	[	k	⌈
12	FF		,	<	L	◇	l	⌋
13	CR		-	=	M	]	m	⌋
14			.	>	N	^	n	l
15			/	?	○	♡	o	■

Fig. 1.3.

2. PERFORMANCE CHARACTERISTICS

2.1. Equipment

The line printer is equipped with a character set consisting of 64 different characters all of the font type OCR-B.

A character drum with 96 different characters can be delivered.

The line printer is connected via an external line buffer capable of buffering one line (132 characters).

The loading of a character or a printer command will place the line printer in the busy state for approximately 5 usec. During the print operation the line printer will be busy for up to 33 msec. when using the standard character set, and with the line printer in the high speed mode. The duration of the paper movement depends on the number of lines to be spaced :

1	line	to be spaced	15 msec.
2	lines	- - -	25 -
3	-	- - -	30 -
4	-	- - -	35 - , etc.

The line printer is equipped with a vertical format unit using 8-channel format tape. A vertical format unit using 12-channel format tape can be delivered.

After a power turn-on, the line printer is in the off-line state, and the external line buffer is cleared, i.e. the line printer will print a blank line if a Print Command is given before a new loading of characters.

3. LOGIC STRUCTURE

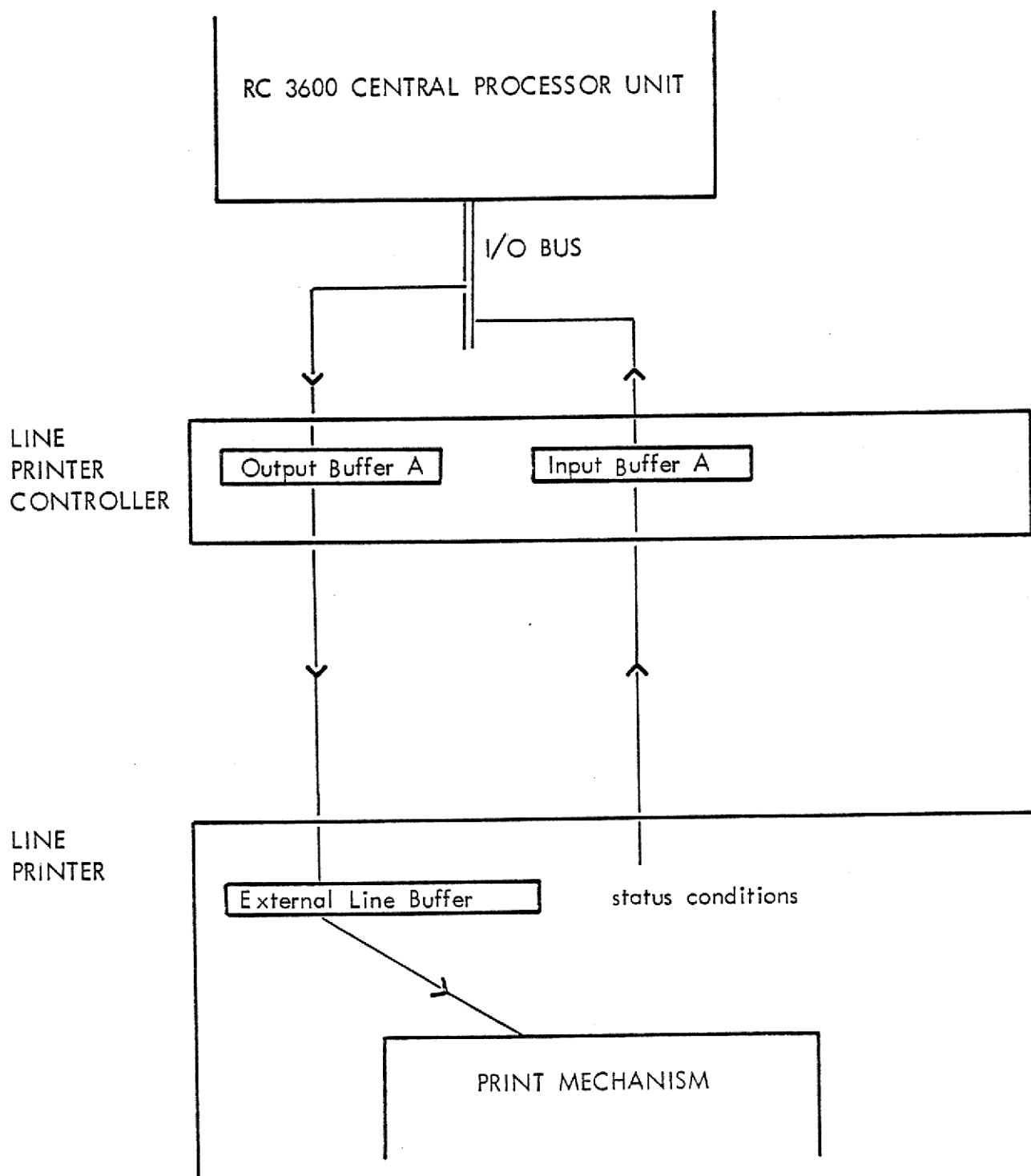


Fig. 3.1. Survey Diagram.

3.1. Logic Specifications

3.1.1. Selection of the Device for Input/Output.

The line printer is selected by using programmed transfer from the RC 3600 Central Processor Unit.

The line printer accepts normal Input/Output Commands with device code 17 octal. A second lineprinter will have the device-code 57 octal.

The interrupt disable is controlled by interrupt priority maskbit 12. The line 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 line 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 line printer controller by a DOA command, see fig. 3.2.

DOA AC, 17; Data Out A, Line Printer

0	1	1	A	C	0	1	0	F	0	0	1	1	1	1
0	2	3	4	5	7	8	9	10						15

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 line printer.

Setting the Busy Flag with a Start Command (mnemonic modifier S) causes the execution of a line 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. The data words transferred by the DOA instruction can be separated into two groups :

1. Characters to be printed.
2. Line printer commands.

The data words for the line printer commands are shown in fig. 3.4. to 3.8. An illegal command field (bits 5 to 7) has the effect of no operation.

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

Fig. 3.3. Line Printer Commands.

Register A, Load Command

X X X X X	0 0 0	CHARACTER
0	4 5	7 8
		15

Fig. 3.4. (X = Irrelevant)

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 successfully approximately 5 usec. later, or terminated by an error, the Busy Flag is cleared without requesting an interrupt by setting the Done Flag.

Loading a character with a value from 0 to 31, but not the values 10, 12 and 13, causes the line printer to skip one column on the paper thus producing a space.

Note : The characters 10, 12 and 13 are not legal.

Register A, No Operation Command															
X	X	X	X	X	X	0	0	1	X	X	X	X	X	X	X
0				4	5	7	8								15

Fig. 3.5. (X = Irrelevant)

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

Register A, Print Command															
X	X	X	X	X	X	1	0	0	0	0	0	0	1	1	0
0				4	5	7	8								15

Fig. 3.6. (X = Irrelevant).

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

When the operation is completed successfully 33-50 msec. later or terminated by an error, the Busy Flag is cleared and the Done Flag set requesting if Interrupt Disable is clear.

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

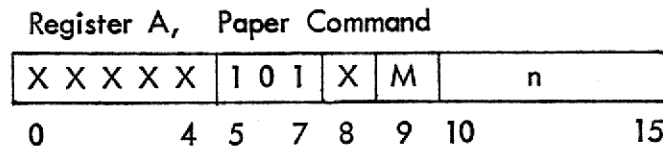


Fig. 3.7. (X = Irrelevant)

Executing the Paper Command by setting the Busy Flag causes the line printer to move the paper according to the paper mode field, bits 9 to 15.

bit 9 : paper feed mode
bit 10 to 15 : number 0 to 63

If bit 9 is zero, the line printer will skip the paper to channel n (modulo 8 or 12) on the vertical format tape.

If bit 9 is one, the line printer will space the paper n (modulo 15) lines.

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.

Note : During the paper movement, but after the paper command has been terminated, the line printer will accept all line printer commands. A paper- or Print Command will be buffered and not executed before the paper movement has settled down.

Note : In case of a Paper Skip Command specifying the tape loop channel which is present, the paper is only moved if the preceding line printer command was a Print Command.

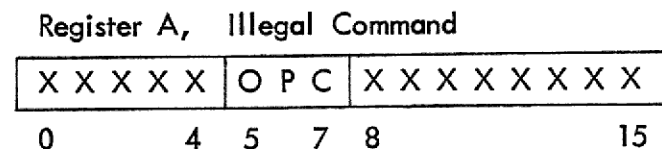


Fig. 3.8. (X = Irrelevant)

Value of OPC = 2, 3, 6 or 7.

Illegal commands are executed as No Operation Commands when executed by setting the Busy Flag.

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 line printer operation can be sensed by inputting a 16-bit status word to an accumulator by DIA command, see fig. 3.9.

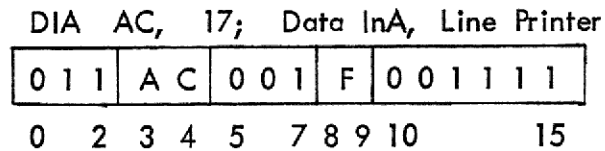


Fig. 3.9.

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

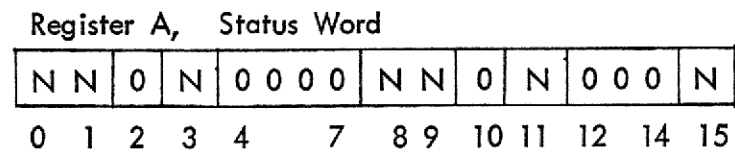


Fig. 3.10. (N = Status bit)

Bit No.	Meaning
0	Paper Fault
1) 1	Not Ready
3	Carriage Overflow
1) 8	Off Line
1) 9	Disconnected Paper
11	End of Paper
15	Not Available

Fig. 3.11. Status Conditions.

Bit numbers not mentioned above are always zero.

1) In these situations the line printer commands are executed as no operations.

4.2. ON Line/OFF Line change.

In the on line state the line printer is under program control, and the ON LINE indicator is lit.

In the off line state the operator may insert or adjust the printing forms etc. and he may operate the TOP OF FORM and PAPER STEP switches.

In this case the ON LINE indicator is extinguished.

The line printer is set to off line in the following situations :

1. after power start up
2. if the line printer is not ready
3. if a paper fault situation occurs
4. by setting the ON/OFF LINE switch to OFF

When setting the ON/OFF LINE switch to OFF during an operation, the transition to the off line state is delayed until the current contents of the line printer buffer is printed and a paper operation under execution is terminated.

Note : In this case printing of data is forced.

When a paper fault situation occurs the transition to the off line state is delayed until a paper operation is executed e.g. data but not Print- or Paper Commands may be loaded into the line printer buffer without initiating the transition to the off line state.

When a fault situation other than the Paper Fault, occurs, the line printer is switched to the off line state immediately, and the line printer is master cleared. This is the case if a Drum Speed Fault occurs, the drum gate interlocks are not satisfied or a Power Fault is detected.

If the operator switches the line printer to the on line state the transition is delayed until the operation under execution in the off line state has been completed (in case of testprint etc.)

Note : The Line printer can only be switched to the On Line state manually.

4.3. In the case of temperature fault or overspeed in the line printer the main power is switched off.