NEW AUXILIARY EQUIPMENT
THE HIGH SPEED PRINTER

by

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THE HIGH SPEED PRINTER

The HIGH SPEED PRINTER is a device for transcribing information from magnetic tape to paper; the tape is prepared within the UNIVAC System in blockette form, and the paper must be of continuous sprocket-fed stock. The HIGH SPEED PRINTER consists of four units: a Tape Reader, which is a modified clutch-operated UNISERVO, and which reads the information from the tape in blockettes of 120 digits; the Printing Unit, which includes the operator's control panel and the printing facilities; and two electronic units which contain the POWER SUPPLY, the gas-tube memory, and the control and checking circuits.

These specifications are of greatest interest to the Programmer:

1. The HIGH SPEED PRINTER can be set to print 200, 400, or 600 lines a minute.

2. Each line can contain no more than 130 characters, which are spaced at 10 characters to the inch. The vertical spacing is 6 lines per inch; single, double, or triple spacing results in 6, 3 or 2 lines per inch respectively.

3. The HIGH SPEED PRINTER recognizes 63 characters. Of these, 51 can be printed: the numbers 0 through 9, the 26 letters of the alphabet, and the following symbols and punctuation marks:

   # $ % . , - * ' + : ; ( ) & /

   Seven additional characters are used as HIGH SPEED PRINTER control symbols:

Σ	Printer Stop	|	Fast feed Symbol #2
β	Printer Breakpoint	?	Fast feed Symbol #3
r	Multiline Symbol	=	Fast feed Symbol #4
@	Fast feed Symbol #1		

   The five remaining characters, together with the control characters, are not normally printed, but can be represented by a "stand-in character" in computer-digit printing.*

4. The paper can be any sprocket-fed paper from 4" to 27" in overall width, and up to card stock in weight. Forms with as many as 4 carbons can be handled successfully. Special tissue-weight forms, with single-use carbons, can be used successfully in packs up to ten thick.

* See Appendix for complete UNIVAC Code.

5. The vertical movement of the paper is controlled by a punched-paper loop that is mechanically ganged to the paper-drive. Four channels on the paper loop are associated with the four programmed fast-feed characters. The 5th and 6th channels are used for automatic "start-stop" operation, and the 7th channel is associated with the "Home Paper" switch. The paper moves at the rate of 20 inches a second for fast-feed operation. A fast-feed symbol must appear in the 1st digit-position of the blockette.

6. A two-panel plugboard permits either Normal Line Printing, Multiline Printing, or a combination of the two. The following "editing" is done by the plugboard:

   a. Rearrangement of information
   b. Selection of information
   c. Duplicate or triplicate printing of information
   d. Suppression of zeros to the left of the most significant digit in as many as 18 fields
   e. Selection of single, double, or triple spacing.

7. Multiline Printing

   Any blockette is printed in a single line (Normal Line Printing) unless the multiline symbol is present. If the multiline symbol is present, the information in the blockette can be printed on from one to six lines, according to the wiring of the plugboard. The multiline symbol should appear in the 1st digit-position of the blockette unless a fast-feed symbol is used, in which case it should be placed in the 2nd digit-position. The format of Normal Line and Multiline printing need not be the same. The format of all lines printed on Normal Line must be the same and the format of all lines printed on Multiline must be the same for a given plugboard.

8. Corresponding to any programmed fast-feed symbol there must be a punched hole in the correspondingly numbered channel of the paper loop. Usually, for each problem or group of similar problems, there will be an associated plugboard and punched-paper loop.

9. A Printer Stop Symbol, Σ , is used to stop the printer. The symbol may be placed in any digit-position and will block the printing of the blockette in which it appears.

10. The Printer Breakpoint Symbol, β , acts as a printer stop symbol if the Breakpoint switch is in an "ON" position. Otherwise it is passed as a non-printing character.

THE HIGH SPEED PRINTER

11. Various checks are built into the HIGH SPEED PRINTER. When an error occurs, the Printer stops and one or more neon lights on the operator's control panel indicate the difficulty.

12. The HIGH SPEED PRINTER will accept tapes prepared by the CARD-TO-MAGNETIC TAPE CONVERTER, UNITYPER II, or UNIVAC (the Block Sub-divider button for the UNISERVO recording the output information must be pushed in.) These tapes are written in blockette form, with a space of one inch or more between blockettes.

PROGRAMMING FOR THE HIGH SPEED PRINTER

Programming for the HIGH SPEED PRINTER is relatively simple after the programmer determines what he wants. For the majority of problems, the only editing required is the insertion of the proper fast-feed symbols, multiline symbol as needed, printer stops symbols, and perhaps headings and pagination. The program should include an instruction to the operator, printed out on the SUPERVISORY CONTROL PRINTER, to depress the correct Block Sub-divider buttons on the SUPERVISORY CONTROL panel prior to the preparation of the output tape or tapes.

Fast-Feed Symbols

The four fast-feed symbols are @, |, ?, and = respectively. The paper is advanced during the "read" operation. If a fast-feed symbol is present in the 1st digit-position of the blockette, the fast-feed operation is initiated as soon as this character is read. The operation is concluded by the brushes sensing a hole in the corresponding channel of the paper loop. The information contained in the blockette will be printed on the line opposite the hole in the paper loop.

There is no special significance attached to the different fast-feed characters except for FF-I. This character can be used as a break-point for reading the tape. This is particularly effective if it is used for the first printing line of the form. If a printing error is made, the paper can be advanced easily to the next form by the manual "home-paper" switch and the tape repositioned by using FF-I as a break-point. The entire operation can be accomplished in a matter of seconds. The same end result could be obtained without FF-I used in this matter, at the cost of time, using a trial and error approach; but operators do not altogether appreciate a programmer, who does not take advantage of that which is available.

Fast-Feed Symbols (Continued)

The automatic "Start-Stop" channels 5 and 6, are most effective for overflow or when used to skip over the perforated area between sheets during the HIGH SPEED PRINTER listing of raw data from the CARD-TO-TAPE CONVERTER or UNITYPER II tapes. It is to be noted that the CARD-TO-TAPE CONVERTER does not place a Σ or β on the tape. Therefore, the operator should be advised of the fact and asked to stop the printer as soon as the CARD-TO-TAPE sentinels (all minus signs) appear on the paper. If a UNITYPER II tape is to be placed on the HIGH SPEED PRINTER, a symbol should be placed in the last blockette on the tape.

Channel 7 is used for the original positioning of the forms, or for any subsequent repositioning that is required.

It is important to remember that programmed fast-feeds will override punched controls. The length of the punched paper loop can vary from 11" to 22", and is always an even multiple of the length of the form for which it is used. The holes are punched by a hand punch and the two ends of the loop are glued together with a special rubber cement.

Multiline Symbol

The presence of the multiline symbol, r, in the 1st or 2nd digit-position (depending upon the absence or presence of a fast-feed character), will block normal line operations and will set up the multiline operation. The plugboard must be wired for the maximum number of lines that may be printed from a blockette in a particular problem. For example, 85% of names and addresses being printed by multiline, may be 3-line addresses, 10% may be 4-line addresses and only 5% may be 5-line addresses; but, the plugboard must be wired for 5 lines and each name and address group will require printing time for five lines. (It takes just as long to print a line of nothing or spaces as it does to print 130 characters.)

There are 15 relays controlling 12 digits each associated with the multiline operation. Any number of relays, preferably in sequence, may be plugged to print on any given line or no relays may be plugged for a given line. If two or less relays are plugged for a given line, a resistor is also wired into that line for electrical necessities.

It is obvious that since a fast-feed operation can be initiated only during the read operation and since the printing of successive lines in a multiline operation is executed without additional reads, it is impossible to have a fast-feed operation within lines of a multiline operation. When it is desired to skip one or two lines on a given

Multiline Symbol (Continued)

form in a Normal Line operation and this skip is random, that is, it is related to the information rather than to the physical form, the skip can be achieved by use of multiline. In this case the multiline is wired to print the required number of skip lines, but no relays are connected for the lines to be skipped. Similarly, it would be possible to print and skip lines in a multiline operation as long as the total number of print and skip lines does not exceed six.

It is very convenient to use multiline for headings and for pagination. The format for headings and so forth is usually quite different from the printed material, and normally no zero-suppression is required except for the page number. This leaves 17 fields for such Normal Line zero-suppression as may be needed.

It is possible to do selective printing by use of the multiline symbol. This can be achieved by wiring plugboard for 1 line multiline and plugging no relays in. However, before resorting to this method, investigate the possibility of writing the questionable information onto another tape, and printing only the tape containing the needed information.

It should be noted that there is a 20-millisecond delay in setting up the multiline operation. Ten milliseconds are absorbed by the completion of the read cycle when the multiline symbol is in either the 1st or 2nd digit-positions. This delay could become sufficiently significant to warrant inclusion in estimating printing times if the multiline operation is used a great deal, for example, if a problem were set up for 1 line multiline exclusively (the worst situation), each line would now take 0.11 seconds rather than the 0.10 seconds for Normal Line. Therefore, if the printer were set for 600 lines per minute, the corresponding rate would be 600 x .909 = 545.4 lines per minute. If the printer were plugged for 6-line multiline, the rate would be 600 x .983 = 589.8 lines per minute.

Repeating Information

Often it is desirable to repeat certain information either once or twice. This situation might arise, for example, when printing forms comprising a bill and two stubs, one to be returned, and the other to be retained for company records. The plugboard can triplicate information if necessary. However, it must be remembered that every Normal Line is treated in the same way and all multilines are treated alike. In printing this type of form (payroll checks, dividend checks, and premium notices are examples), it is often convenient to use both multiline and

Repeating Information (Continued)

Normal line printing in order to obtain slightly different formats. Occasionally, a multiline operation can be used effectively with double or triple spacing, especially with check writing.

Non-Printing Characters

The HIGH SPEED PRINTER will accept any seven-bit character with an odd count except 1 11 111, which would be to a 64th character outside the 63-character code. The special HIGH SPEED PRINTER control symbols are decoded and are used to set up certain courses of action. Normal printing characters are treated as follows: the print signal permits the output of the code generator, which is a 7-channel pulse code of the character opposite the print hammer, to probe the memory for identical pulse codes. Where identity is found, a pulse is sent to the thyratron and to the check thyratron. A second pulse is sent to the print thyratron which causes it to fire and subsequently the check thyratron is extinguished. A new read cycle is initiated after all check thyratrons have been extinguished. If any check thyratron remains on, a Print Error signal is generated and the HIGH SPEED PRINTER stops. Except where the printer is set for computer digit, all non-printing characters are suppressed during the read cycle. Likewise non-significant zeros are suppressed and during the read cycle never get into the memory.

Computer Digit

If the switch is set for computer digit, none of the control characters is decoded as such. Each blockette is printed on two lines, the first line containing all characters which are printed normally and the second line containing the "stand-in" characters for the non-printing symbols. The non-printing characters are not printed because no code is generated for which there is identity. The "stand-in" character is obtained by reversing the first digit of the numerical section of the 7 pulse code. In every case this results in the formation of the pulse code of a printing character. Reference is made to the table in the appendix for detailed information.

Zero Suppression

Zero suppression takes place only during the read cycle. As many as 18 fields may be plugged for zero suppression. A field here is defined as any number of continuous digits. Any character not equal to zero will stop zero suppression. For example if the field is $\pm$, the - will stop zero suppression and consequently two zero suppressions must

Zero Suppression (Continued)

be made to accomplish the job. There are times where there are too many ± fields to be taken care of by the HIGH SPEED PRINTER zero suppression. In these cases, it seems the best solution has been to supplement these by editing the sign digit during the UNIVAC run. The fields for the NL and ML may or may not be the same. However, a total of 18 fields including both NL and ML is the maximum that can be plugged for zero suppression.

THE PLUGBOARD

The plugboard is divided into two sections. The upper half is referred to as PB I and the lower half as PB II. Each section is further divided by solid lines into smaller sections according to the function performed. They have been lettered in the following manner to make the discussion simpler:

PB I

SECTION	NO. HOLES	LABEL	USED FOR
A	120	From Comparator	Input - NL, ML
B	130 pr.	To SL Relays	Output NL, Input ML
C	3 +1	Line Space	NL and ML
D	180 pr.	To ML Relays	ML - 15 relays
E	17	ML Counters	Number lines/ML blockette
F	6	ML Counters	Designate relays to be used in each line of ML
G	15 pr. (ML Relays)		
H	6	Resistors	Associated ML Relays
I	2	One Line	Always plug if more than one line used on ML

THE PLUGBOARD

PB II

SECTION	NO. HOLES	LABEL	USED FOR
J	130	To Thyratrons	ML output position
K	180 pr.	From ML Relays	Correspond to output side of Section D ML Relays
L	18 pr. Start SL) Start ML)	Start Zero Fields	Start Zero Suppression
M	18 (Associated with L)		
N	120	Address Lines	Input for Zero Suppression
P	18 pr., End SL, End ML	End Zero Fields	End Zero Suppression
Q	18	Associated with P	

Several sections of the plugboard have paired holes, namely, Sections B, D, G, K, L and P. Lines are drawn on the plugboard indicating this condition. This results in a paired hole being available when needed.

In addition, there are some holes which are connected but not indicated as such on the plugboard. The holes of Section D are connected via relays to the respectively numbered holes of Section K and those of Section L to Section M and Section Q to Section P. These will be discussed under the heading of ML and Zero Suppression Instructions.

Throughout all plugging procedures, be consistent in first using the top or the bottom of the pair of holes.

Normal Line Operation

If only NL operation is to be used, the sections of the plugboard with which we are concerned are:

A	Input (digit position)
B	Output (wheel position)
C	Line Space
LMNPQ	Zero Suppression

(For electrical reasons, also plug ML line counter section. One line ML will probably be preferred).

Normal Line Operation (Continued)

For each digit within the blockette (1-120) that is to be printed, a jumper is run from the input digit position (Section A) to the output wheel position (Section B). If the information is to be repeated, an additional jumper is run from the paired hole of the first wheel position to the second wheel position and again another jumper may be run from the second paired hole to the third wheel position.

Example: Print the contents of digit position 10 in wheel positions 2, 43, 107.

A 10 to B 2.

B 2′ (paired hole) to B 43.

B 43′ (paired hole) to B 107.

Line Spacing

The line spacing is set by running a jumper from C "out" to C1, C2 or C3 to produce single, double, or triple spacing respectively.

Zero Suppression

Prior to the actual plugging, all fields to have zero suppression are numbered. For reasons that will appear later, those fields to be suppressed during Normal Line operation are numbered starting with the numeral 1 and continued in ascending order; those which are to be suppressed during Multiline operation are numbered starting with 18 and continued in descending order. Both the starting and ending digit positions which are to be included in the zero suppression are indicated.

First wire the "Start Zero Suppression" by running a jumper from input digit position (Address Line, Section N) corresponding to Start 1 to M1, another from digit position of Start 2 to M2, etc. Next connect L1 to L "Start SL", remembering that corresponding holes of L and M are already connected. Next connect paired L1 to L2, paired L2 to L3 etc., so that all NL start zero suppressions are interconnected.

Wire the "End Zero Suppression" in a similar fashion. Example: Zero suppress the fields (23-27, 30-35, 49-59).

Zero Suppression (Continued)

S1 - 23; E1-27
S2 - 30; E2-35
S3 - 49; E3-59

Jumpers listed in order of easiest wiring:

N 23 to M 1	N 27 to Q 1
N 30 to M 2	N 35 to Q 2
N 49 to M 3	N 59 to Q 3
L 1 to L "start S.L."	P 1 to P "End S.L."
Paired L 1 to L 2	Paired P 1 to P 2
Paired L 2 to L 3	Paired P 2 to P 3

Multiline Zero Suppression is handled in a similar manner. In this case those fields which are to be zero suppressed are connected to the L "Start ML" or P "End ML".

If both NL and ML are used in the same problem with different fields in each, connect the NL fields to L Start S.L. and the ML fields to L Start ML and the same with the End Zero Suppression sections.

Example: First 11 fields are NL, last 7 fields are ML. The question arises over the jumpers in the neighbor hood of L 11, 12.

L 10 to L 11
L 12 to L 13

There is no jumper in either paired L 11 or L 12.

If both NL and ML are used in the same problem with the same fields in each, wire as for NL and then run a jumper from the last used L paired hole to L "Start ML" and a jumper from the last used P paired hole to P "End ML".

If both NL and ML are used in the same problem and some of the fields are the same and others are different, Y jumpers must be used on the common fields. The stem of the Y jumper is used for the N input position, one arm to the M S.L. section and the other to the M ML section. The ending plugging will be accomplished in a similar fashion. Thus 2 suppression fields will be used for each common field.

Zero Suppression (Continued)

Example:	S 1 - 23;	E 1 - 29	NL
	S 2 - 35;	E 2 - 43	NL
	S 3 - 56;	E 3 - 63	NL
	S 4 - 83;	E 4 - 90	NL - ML (13)
	S 5 - 101;	E 5 - 109	NL
	S 6 - 115;	E 6 - 119	NL - ML (14)
	S15 - 21;	E15 - 24	ML
	S16 - 36;	E16 - 42	ML
	S17 - 79;	E17 - 81	ML
	S18 - 95;	E18 - 99	ML
Plug	N 23 - M 1	N 29 - Q 1	
	N 35 - M 2	N 43 - Q 2	
	N 56 - M 3	N 63 - Q 3	
	N 83 - M 4, M13	N 90 - Q 4, Q13	
	N101 - M 5	N109 - Q 5	
	N115 - M 6, M14	N119 - Q 6, Q14	
	N 21 - M15	N 24 - Q15	
	N 36 - M16	N 42 - Q16	
	N 79 - M17	N 81 - Q17	
	N 95 - M18	N 99 - Q18	

and in the usual manner,

L1, L2, L3, L4, L5, L6, L Start NL
L13, L14, L15, L16, L17, L18, L Start ML
P1, P2, P3, P4, P5, P6, P End NL
P13, P14, P15, P16, P17, P18, P End ML

If a Zero Suppression field immediately follows another, the ending point of the first field need not be plugged. If a single digit field is to be suppressed, a Y jumper must normally be used. The stem of the Y is plugged to Section N, one arm going to Section M and the other to Section Q. If the single digit is immediately followed by another field, as in the case of a ± field, the ending of the single digit need not be plugged, therefore a straight jumper can be used.

Multiline Operation

In addition to the zero suppression and line space plugging which has already been covered, the multiline operation can be broken down into four stages of plugging, namely:

Multiline Operation (Continued)

1. Selection of the number of lines to be printed, Sections E, I.

2. Selection of information to be printed on each line A or B, D.

3. Selection of the relays that will be used for each line F, G, H.

4. Position of each bit of information on its line J, K.

Selection of the Number of Lines to be Printed

Section E is divided into three columns, the center column numbered 1 - Home (6), the right column numbered 1-5, and the left column numbered 1-6.

Run a jumper from "Home" to the hole in the left column corresponding to the number of lines to be printed from each multiline blockette.

Run jumpers from left column holes to the corresponding center column holes above the one just plugged.

Run jumpers from the remaining center column holes to the corresponding right column holes.

Example: 3 line ML - Section E.
Left 3 - Center "Home"
Left 2 - Center 2
Left 1 - Center 1

Center 3 - Right 3
Center 4 - Right 4
Center 5 - Right 5

In section 1, connect the two holes unless only one line is being printed from each ML blockette in which case omit the jumper.

Selection of the Information to be Printed on Each Line

Each column of Section D contains 12 paired holes and corresponds to one relay. There are 15 relays which we can assume to be numbered from left to right. The information which will be printed on any one line will be determined by relays connected to that particular line.

THE PLUGBOARD

Selection of the Information to be Printed on Each Line

The input to Section D may come from Section A or Section B or from a combination of the two. If only ML operation is involved, all input can come from Section A. If NL includes all ML fields, all input will come from Section B. If a mixture of the two is involved, that is both ML and NL with ML including some digit positions not printed in NL, some of the input will come from A and the remainder from B.

It is suggested that one start with Relay 1 using the holes as they come but remembering that no relay can be used on 2 different lines. If the same input information is to be repeated on a different line or lines, the paired holes are used and jumpers are run to the chosen relays.

Example: 3 line ML with 65 digits on line 1, 16 digits on line 2 including 8 digit repeat from line 1, and 60 digits on line 3 including 35 repeat digits.

Relays 1, 2, 3, 4, 5 and 6 (72 digits) will be used for Line 1.
Relays 7, and 8 (24 digits) will be used for Line 2.
Relays 9, 10, 11, 12, and 13 (60 digits) will be used for Line 3.

Selection of the Relays Used for Each Line

For each line of ML, a jumper is run from the hole in Section F corresponding to that line numer, to the top hole of the first relay used for that line; all relays used for that line are interconnected; and if the number of relays used is two or less, the resistor corresponding to the line number is connected with the relays.

For the problem given above, the jumpers for Sections F, G and H are listed:

F1-G1, G1-G2, G2-G3, G3-G4, G4-G5, G5-G6

F2-G7, G7-G8, G8-H2

F3-G9, G9-G10, G10-G11, G11-G12, G12-G13.

Position of Each Bit of Information on Its Line J, K

The information plugged into the relays, Section D, will be picked up on the respectively numbered holes, Section K, and from there, will be plugged to the desired wheel positions in Section J.

Position of Each Bit of Information on Its Line J, K. (Continued)

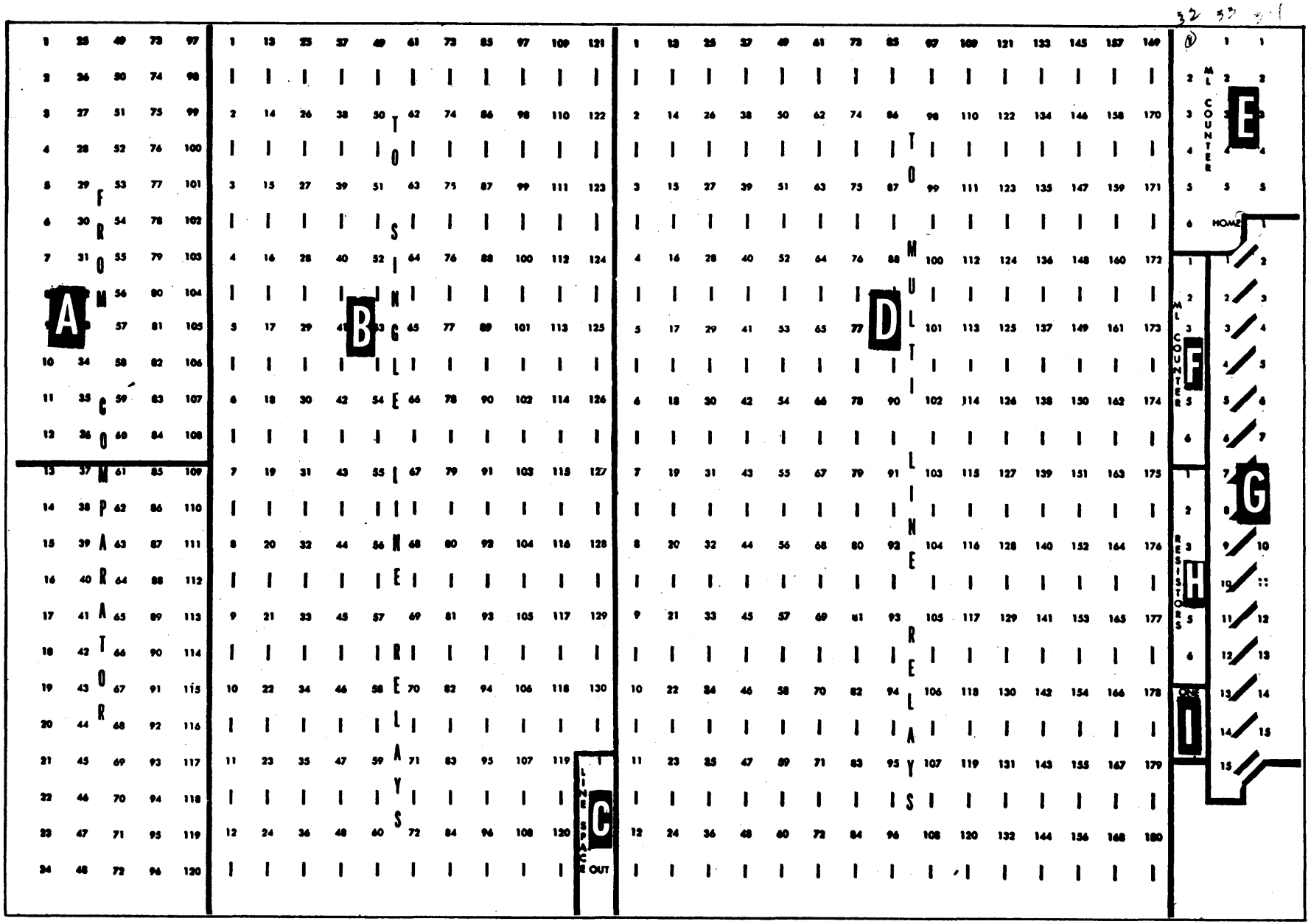
It must be remembered that during the multiline operation, only those relays connected with line one will be activated during the time when the 1st line is being printed, only those relays connected with line 2 will be activated when the 2nd line is being printed, etc.

Testing the Plugboard

It is assumed that all tapes will contain an identification block. If possible, the first tape of a given series of tapes to be printed could contain in addition to the tape identification, 3 blockettes of information so arranged that when the 3 blockettes have been printed, each input position could be read from a 3-digit column.

Another system would be to have the group of digits represent the wheel positions. In this manner, it would be easy to check the plugboard.

If $\not{B}$ symbol is used in the last blockette of the material not to be included in the printed report, it could be by-passed by using the "Read, No Print" and "Printer Breakpoint" switches.



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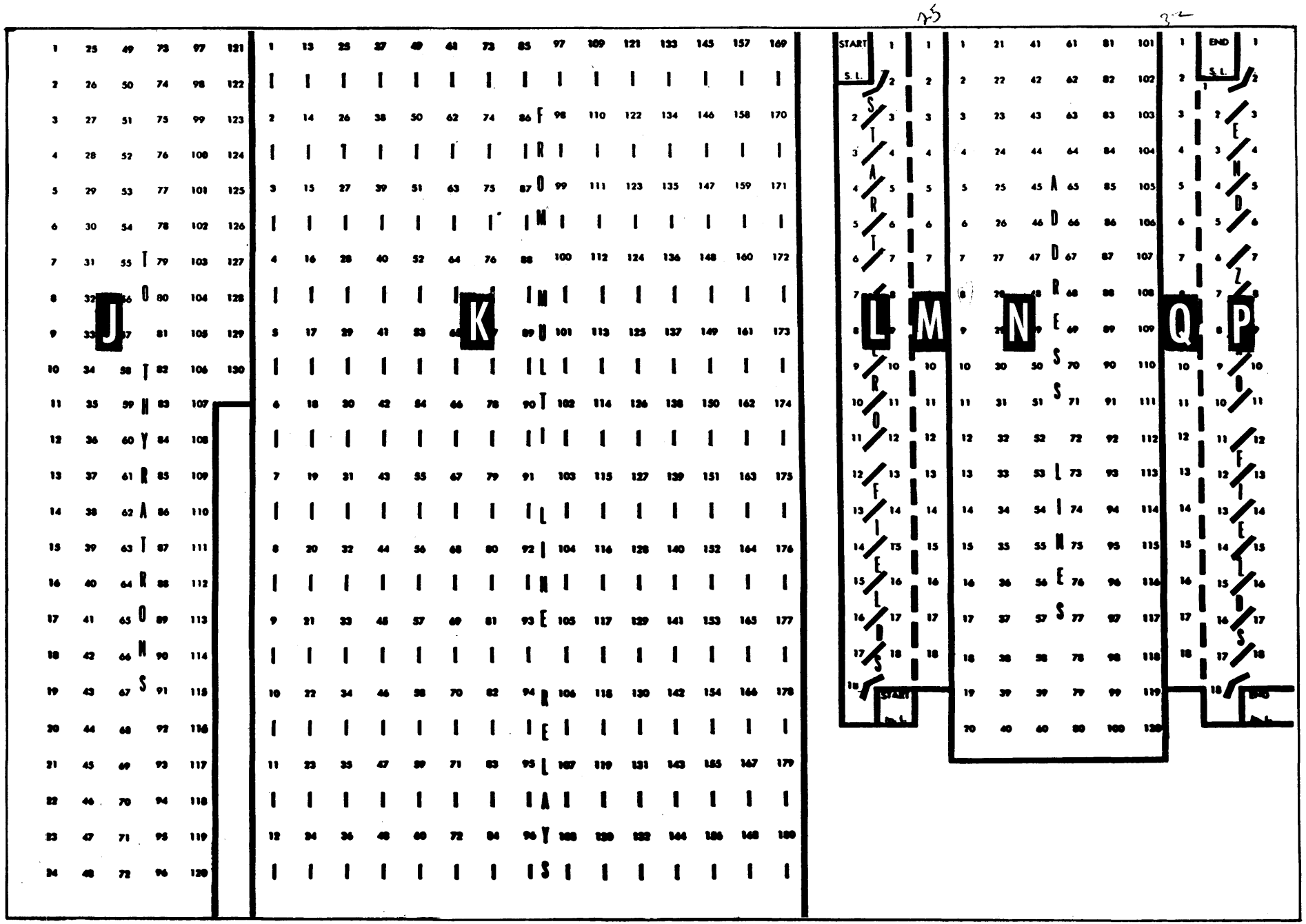
J
K
L
M
N
Q
P
START
END
S. L.
STARTING JACKS
FIELD JACKS
ADDRESS LINES
FIELD JACKS
TOP JACKS
FORMULA
FORMULA RESULT
FORMULA RESULT
FORMULA RESULT

63 CHARACTER UNIVAC PULSE CODE

o In the computer digit mode of operation for the HIGH SPEED PRINTER two lines are printed for every blockette: the first line as on normal, the second line as shown.

† These are machine functions. Nothing prints and the machine performs the operation.

* With the switch on "print", these are the characters that will be printed; on "stall" the printer behaves like UNIPRINTER I.

** In parenthesis are the punches that appear in the column of the card.

*** These characters will only be handled by the special model of the CARD-TO-MAGNETIC TAPE CONVERTER which will decode the special "407" punches. The grand total symbol (≤) will be decoded as ":".

The Verifier will act as the UNITYPER II or UNIPRINTER II depending on the mode of operation.

63 CHARACTER UNIVAC PULSE CODE

PULSE CODE	UNI-TYPER I	MODIFIED UNITYPER I and UNITYPER II	UNIPRINTER I			MODIFIED UNIPRINTER I			UNIPRINTER II		HIGH SPEED PRINTER		CARD TO-MAG. TAPE **	MAG. TAPE-TO-CARD **
			NORMAL		COMP. DIGIT	NORMAL		COMP. DIGIT	NORMAL	COMP. DIGIT	NORMAL	COMP. DIGIT		
			L. CASE	U. CASE		L. CASE	U. CASE							
1 00 0000	i	i	ignore †		X	ignore †		X	ignore†	i		5		
0 00 0001	△	△	space †		space†	space †		space†	space †	△		6	△ (blank)	△ (blank)
0 00 0010	-	-	-	_	-	-	_	-	-	-	-		-(X)	-(X)
1 00 0011	0	0	0	)	0	0	)	0	0	0	0		0(0 or blank)	0(0)
0 00 0100	1	1	1	1/2	1	1	1/2	1	1	1	1		1(1)	1(1)
1 00 0101	2	2	2	"	2	2	"	2	2	2	2		2(2)	2(2)
1 00 0110	3	3	3	#	3	3	#	3	3	3	3		3(3)	3(3)
0 00 0111	4	4	4	$	4	4	$	4	4	4	4		4(4)	4(4)
0 00 1000	5	5	5	%	5	5	%	5	5	5	5		5(5)	5(5)
1 00 1001	6	6	6	*	6	6	*	6	6	6	6		6(6)	6(6)
1 00 1010	7	7	7	&	7	7	&	7	7	7	7		7(7)	7(7)
0 00 1011	8	8	8	'	8	8	'	8	8	8	8		8(8)	8(8)
1 00 1011	9	9	9	(	9	9	(	9	9	9	9		9(9)	9(9)
0 00 1101		'				;*	:*	;*	'	'	'			
0 00 1110		&				;*	:*	;*	&	&	&		&(Y)	&(Y)
1 00 1111		(				;*	:*	;*	(	(	(			

63 CHARACTER UNIVAC PULSE CODE

PULSE CODE	UNI-TYPER I	MODIFIED UNITYPER I and UNITYPER II	UNIPRINTER I			MODIFIED UNIPRINTER I			UNIPRINTER II		HIGH SPEED PRINTER		CARD TO-MAG. TAPE**	MAG. TAPE-TO-CARD**
			NORMAL			NORMAL								
			L. CASE	U. CASE	COMP. DIGIT	L. CASE	U. CASE	COMP. DIGIT	NORMAL	COMP. DIGIT	NORMAL	COMP. DIGIT		
0 01 0000	₭	r	Car. Ret.†		/	Car. Ret.†		/	Car.† Ret.	r	M.L.†	E		
1 01 0001	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦		◦(0-3-8)***	
1 01 0010	.	.	.	.	.	.	.	.	.	.	.		.(Y-3-8)***	
0 01 0011	;	;	;	;	;	;	;	;	;	;	;			;(Y-0)
1 01 0100	A	A	a	A	A	a	A	A	A	A	A		A(Y-1)	A(Y-1)
0 01 0101	B	B	b	B	B	b	B	B	B	B	B		B(Y-2)	B(Y-2)
0 01 0110	C	C	c	C	C	c	C	C	C	C	C		C(Y-3)	C(Y-3)
1 01 0111	D	D	d	D	D	d	D	D	D	D	D		D(Y-4)	D(Y-4)
1 01 1000	E	E	e	E	E	e	E	E	E	E	E		E(Y-5)	E(Y-5)
0 01 1001	F	F	f	F	F	f	F	F	F	F	F		F(y-6)	F(Y-6)
0 01 1010	G	G	g	G	G	g	G	G	G	G	G		G(Y-7)	G(Y-7)
1 01 1011	H	H	h	H	H	h	H	H	H	H	H		H(Y-8)	H(Y-8)
0 01 1101	I	I	i	I	I	i	I	I	I	I	I		I(Y-9)	I(Y-9)
1 01 1101		#				;*	:*	;*	#	#	#		#(3-8)***	
1 01 1110		¢				;*	:*	;*	¢	¢		C		
0 01 1111		@				;*	:*	;*	@	@	FF I†	D	@(4-8)***	

63 CHARACTER UNIVAC PULSE CODE

PULSE CODE	UNI-TYPER I	MODIFIED UNITYPER I and UNITYPER II	UNIPRINTER I NORMAL L. CASE	UNIPRINTER I NORMAL U. CASE	UNIPRINTER I COMP. DIGIT	MODIFIED UNIPRINTER I NORMAL L. CASE	MODIFIED UNIPRINTER I NORMAL U. CASE	MODIFIED UNIPRINTER I COMP. DIGIT	UNIPRINTER II NORMAL	UNIPRINTER II COMP. DIGIT	HIGH SPEED PRINTER NORMAL	HIGH SPEED PRINTER COMP. DIGIT	** CARD-TO-MAG. TAPE	** MAG. TAPE-TO-CARD
0 10 0000	~~T~~	t	tab		-	tab †		-	tab †	t		N		
1 10 0001		"				;*	:*	;*	"	"		O		
1 10 0010		|				;*	:*	;*	|	|	FF II†	P		
0 10 0011	/	)	/	?	/	;*	:*	;*	)	)	)			)(X-0)
1 10 0100	J	J	j	J	J	j	J	J	J	J	J		J(X-1)	J(X-1)
0 10 0101	K	K	k	K	K	k	K	K	K	K	K		K(X-2)	K(X-2)
0 10 0110	L	L	l	L	L	l	L	L	L	L	L		L(X-3)	L(X-3)
1 10 0111	M	M	m	M	M	m	M	M	M	M	M		M(X-4)	M(X-4)
1 10 1000	N	N	n	N	N	n	N	N	N	N	N		N(X-5)	N(X-5)
0 10 1001	O	O	o	O	O	o	O	O	O	O	O		O(X-6)	O(X-6)
0 10 1010	P	P	p	P	P	p	P	P	P	P	P		P(X-7)	P(X-7)
1 10 1011	Q	Q	q	Q	Q	q	Q	Q	Q	Q	Q		Q(X-8)	Q(X-8)
0 10 1100	R	R	r	R	R	r	R	R	R	R	R		R(X-9)	R(X-9)
1 10 1101	~~L~~	$	Shift Lock†		Z	Shift Lock †		Z	$	$	$		$(X-3-8)***	
1 10 1110		*				;*	:*	;*	*	*	*		*(X-4-8)***	
0 10 1111	~~Ø~~	?	Unshift †		8	Unshift †		8	?	?	FF 111†	M		

63 CHARACTER UNIVAC PULSE CODE

PULSE CODE	UNI-TYPER I	MODIFIED UNITYPER I and UNITYPER II	UNIPRINTER I			MODIFIED UNIPRINTER I			UNIPRINTER II		HIGH SPEED PRINTER		** CARD TO-MAG. TAPE	** MAG. TAPE TO-CARD
			Normal											
			L. CASE	U. CASE	COMP. DIGIT	L. CASE	U. CASE	COMP. DIGIT	NORMAL	COMP. DIGIT	NORMAL	COMP. DIGIT		
1 11 0000	p	[illegible]	Prin. Stop †		Stop†	Prin. Stop †		Stop †	Prin. Stop †	[illegible]	Prin. Stop	V		Stop †
0 11 0001	B	[illegible]	Prin. Bkpt. †		Y	Prin. Bkpt. †		Y	Prin. Bkpt. †	[illegible]	Prin. Bkpt. †	W		
0 11 0010		:				;* :*		;*	:	:	:		: (Y-4-8)*** (=)	
1 11 0011		-				- @		+	+	-	+	+		
0 11 0100	+	/	+ @		+	/ ?		/	/	/	/		/(0-1)	/(0-1)
1 11 0101	S	S	s	S	S	s	S	S	S	S	S		S(0-2)	S(0-2)
1 11 0110	T	T	t	T	T	t	T	T	T	T	T		T(0-3)	T(0-3)
0 11 0111	U	U	u	U	U	u	U	U	U	U	U		U(0-4)	U(0-4)
0 11 1000	V	V	v	V	V	v	V	V	V	V	V		V(0-5)	V(0-5)
1 11 1001	W	W	w	W	W	w	W	W	W	W	W		W(0-6)	W(0-6)
1 11 1010	X	X	x	X	X	x	X	X	X	X	X		X(0-7)	X(0-7)
0 11 1011	Y	Y	y	Y	Y	y	Y	Y	Y	Y	Y		Y(0-8)	Y(0-8)
1 11 1100	Z	Z	z	Z	Z	z	Z	Z	Z	Z	Z		Z(0-9)	Z(0-9)
0 11 1101	ø	%	Single Shift †		-	Single Shift †		-	%	%	%		% (0-4-8)***	
0 11 1110		=				;* :*		;*	=	=	FF IV †	T		
1 11 1111														

PROGRAMMING MANUAL FOR THE
HIGH-SPEED PRINTER

1. General Characteristics

The Remington Rand High-Speed printer converts information stored in the form of magnetic pulses (the Univac XS-3 code) into a visible printed record. The speed of conversion is much greater than anything heretofore commercially available. Some general characteristic of the printer are listed below:

Characters printed per line	130
Lines printed per minute, optional at	200, 400, or 600
Horizontal character spacing	10 per inch
Vertical character spacing, optional at	6, 3, or 2 per inch
Number of different printable characters	51
Printing format control	plug board and paper loop

In brief, the High-Speed Printer operates in the following fashion. Coded data is read from the magnetic tape in groups of 120 digits called blockettes. Each blockette is stored in a memory with the data being in the same coded form as on the tape. A continuously revolving shaft, on which are mounted the 130 typewheels (actually 65 double wheels), also carries a commutator which causes to be generated sequentially the code for each of the characters on the typewheels. This coded representation is sent to a 120 place comparator which also receives in the same code the contents of the 120 place memory. Whenever agreement occurs, which may, of course, be in many places of the comparator at once, signals leave those places on separate wires.

Opposite each typewheel there is a hammer which can be driven against it. The paper, with an inked ribbon or special carbon paper in front of it, passes between the typewheels and hammers, and it is by making a hammer drive the local portion of the paper against a typewheel that printing is achieved.

The comparator output signals mentioned above ultimately release the energy which drives the hammers. Before doing so however, they pass through a plugboard by means of which they can be routed to any desired hammer. Thus any memory position can be made to print out in any print position.

Time is allowed for one complete typewheel revolution so that every character in the memory has a chance to print. Then the paper is spaced, a new blockette of information is read in and the cycle repeated.

Physically, the High-Speed Printer is composed of four units: the Uniservo, the Printer Unit, the Memory Unit, and the Power Supply Unit. These units are interconnected by means of cables. Figure 1 is a picture of the printer.

The above description of the printer implied that the magnetic tape input must be in blockette form. On the middle right quarter of the Univac Supervisory Control Panel is a series of ten Block Sub-Divider Buttons. Each button corresponds to a Uniservo. When one or more buttons are depressed, each block written on the corresponding Uniservos will be in blockette form. That is, the computer will automatically interrupt the write instructions for those Uniservos for a short period after each multiple of 120 digits has been written. Thus each block of 720 characters will be composed of 6 sets of 120 character blockettes, a small blank space appearing between each blockette.

Since the Tape-To-Card Converter also requires magnetic tape recorded in blockette form, but at a somewhat different spacing for its efficient operation, the Block Sub-Divider Buttons for Uniservos 1, 2, 3, 4, 5, 6, 7 contain the appropriate delays for High-Speed Printer tapes while the buttons for Uniservos 8, 9, - have deleays appropriate for the Tape-To-Card Converter.

To prepare High-Speed Printer tapes on the Univac, the programmer need merely depress the block Sub-Divider Button corresponding to the Uniservo he has selected from among those listed above to receive this output. All write orders for these Uniservos should be 5n m's. Because of the extra space needed between blockettes, a 1500' reel of tape can contain up to 7500 blockettes (1250 blocks). In making time estimates, the programmer should note that because of the reduced number of blocks there are fewer starts and stops, and thus a full tape recorded in High-Speed Printer blockettes can be made by the computer in 3.5 minutes.

2. Printing Format Control Features

In addition to the ability to print the contents of a memory location anywhere on the page, the High-Speed Printer also possesses several other highly useful editing facilities.

Zero Suppression. It is frequently desirable to suppress the printing of zeros to the left of the first significant (non-zero) digit in a result. It may be required to do this in several areas along a line of printing. By means of the plug board on the printer, this may automatically be done in as many as 18 independent arbitrary areas (or fields).

Fast Feed. On many forms there will frequently be areas where no printing is to occur. Rather than step through these areas a line at a time without printing anything, which would not only be slow but would require putting "blank" blockettes of information on the tape, thus wasting tape and computer time as well, the paper can be continuously moved at high speed from one printing area to the next. This operation is known as "Fast Feeding". It is controlled by means of a punched paper loop which is placed on the printer and moves in synchronism with the paper. the Fast Feed can be started by means of either a hole punched in the paper loop (in a certain channel) or by any of several special coded combinations written on the magnetic tape. It is stopped by sensing the appropriate punched holes on the paper loop.

Multiline. Normally the contents of the memory (one blockette or 120 digits) is printed out on a single line. By means of the "Multiline" symbol, placed at the beginning of a blockette of information, and in conjunction with the plugboard, a blockette can be broken up and printed out in as many as six consecutive lines. This feature may permit great savings of tape. An obvious use is in name-and-address printing.

Multiple Printing. By means of the plugboard, the contents of a memory location can be printed in not just one but in two or three places across the line. In addition, if the High-Speed Printer is operating in Multiline, the additional printings do not even have to be on the same line (subject to certain restrictions to be discussed later). Of course, no more than 130 characters can be printed on any one line.

3. Wiring For Single Line Printing

For printing of this nature; no Multiline, Multiple Printing, or Zero Suppression; only the top panel of the plugboard is involved. The complete plugboard is shown in Figure 3. The first 5 columns of holes on the left of the top panel of the plugboard are numbered 1-24, 25-48,..., 97-120. These holes are connected to the comparator output lines and are in one-to-one correspondence withthe 120 positions of the memory. In the next section of the plugboard to the right, there are 130 pairs of holes, each pair corresponding to a printing position. The two holes of a pair are vertically one above the other and are internally connected together. (The reason for using two holes is to have a free one into which a second jumper can be put so that the comparator signal can be sent to more than one point. This is necessary in Multiple and Multiline Printing.)

It is only necessary now to connect by means of jumpers the set of 120 holes, corresponding to the memory locations, to the set of 130 pairs of holes (that is, to one hole in each pair) corresponding to the hammers or printing positions. This can be done in one-to-one or any other desired pattern. If it is not required to print certain memory locations, or if it is known that certain locations will always contain non-printing characters, these may be left unplugged.

For most purposes, 6, 8, or 10 inch jumpers will be found best. Short jumpers make for a tight, neat-looking board but have the disadvantage that it becomes difficult to enter the heart of a heavily plugged-up area to change or add a jumper.

For electrical reasons only, it is necessary to place a few jumpers in the Multiline section of the plugboard even though no Multiline Printing is to be done. Connect (upper panel):

32A to 33F
33A to 34A
33B to 34B
33C to 34C
33D to 34D
33E to 34E

There is one more thing that must be done before the board can be used. The bottom four holes of the 16th column of the board determine the line spacing, i.e., whether single space, double space or triple space. A jumper is plugged from the bottom hole (marked "out") to any one of the three above (marked "1", "2", "3" and corresponding to single space, double space and triple space, respectively).

4. Modes of Operation

Under normal operation, the High-Speed Printer will stop printing (and reading tape) whenever a blockette is read which contains the printer stop symbol Σ (0 11 0000). The blockette containing the stop symbol is completely read into the memory but is not printed. If a blockette is read into the memory which contains a printer breakpoint symbol β (0 11 0001) and the breakpoint switch is in the breakpoint position, the printer interprets the β as a Σ. The blockette containing the β or Σ can be printed if desired.

When the "Print, No Read - Read, No Print" switch is placed in the "Read, No Print" position, the printer will read a tape without printing until a stop or breakpoint symbol is encountered. It is also possible to skip down a tape in either the forward or backward direction and stop when a Fast Feed I symbol (0 01 1111), printer stop, or breakpoint symbol is encountered.

There are 63 possible UNIVAC code combinations, only 51 of which appear as characters on the typewheels of the High-Speed Printer. The other 12 characters are nomrally not printed and are either completely ignored or serve as editing symbols, such as the stop and breakpoint mentioned above.

At certain times, however, it may be desirable to have a visual record of all the characters on the tape including the normally non-printing ones. This can be done by operation the Computer Digit switch. The effect of this is to cause each blockette to print out in two lines.

On the first line only the normal printing characters appear. On the second line, any normally non-printing symbols which may be present in the blockette will print, and only such symbols. They will print as regular characters and can be identified by the following table.

Pulse Code	Name	Computer Digit Print-Out
1 00 0000	Ignore	5
0 00 0001	Space	6
0 01 0000	Multiline	E
1 01 1110	¢	C
0 01 1111	Fast Feed I	D
0 10 0000	Tab	N
1 10 0001	[illegible]	O
1 10 0010	Fast Feed II	P
0 10 1111	Fast Feed III	M
1 11 0000	Stop	V
0 11 0001	Breakpoint	W
0 11 1110	Fast Feed IV	T
1 11 1111	[illegible]	␣

Note that in each pair of lines comprising a blockette, one and only one character should be printed in every column.

5. Zero Suppression

Zero suppression is controlled by the lower panel of the plugboard. As mentioned previously, up to 18 fields of arbitrary length may be employed.

It should be remembered that the zeros are suppressed on read-in to the memory, not on print-out, so that the way in which the memory is plugged to the printing positions must be borne in mind.

Single Line Printing Only. The holes in columns 26 through 31 on the lower panel of the plugboard (PB II) are numbered 1 to 120 and correspond to the 120 positions of the memory, or the 120 digits coming from the tape. To start a zero suppression field in "normal" or Single Line Printing, plug from the hole corresponding to the address where the first zero is to be deleted (if present) to the first of the 18 numbered holes in column 25 (hole 25A). Then plug from hole 23A (labled "Start (SL)"), to hole 24A. If there is to be more than one field to undergo zero suppression, plug the starting positionsof the successive fields to the 2nd, 3rd, 4th, etc. holes in column 25 and then plug 23B to 24B, 23C to 24C, etc.

To end each field, plug from the address corresponding to the last zero to be deleted (if everything has been zero up to that point, of course) to successive holes in column 32. Then plug 33A to 34A, and if several fields are to undergo zero suppression, plug 33B to 34B, 33C to 34C, etc.

The fact that the High-Speed Printer can be run in either "Multiline" or "Single Line" (Normal) fashion has already been discussed. Since these two modes of operation, both of which may occur in a run, in general produce different formats, it may be desirable to observe one set of zero fields on single line printing and a different set when on Multiline. Hthere are three possible cases to consider.

Fields for Single Line and Multiline Printing different. To do this, plug the fields for Single Line Printing as described above. They will not be observed when the printer is on Multiline. For theMultiline fields, plug the starting positions successively to holes 25R, 25Q, 25P, etc. (working upwards). Then plug 23S to 24S (Labeled "Start (ML)"), 23R to 24R, etc., terminating one hole below the topmost hole plugged in column 25 (in the Multiline group).

Plug the ending positions for the Multiline fields into holes 32R, 32Q, 32P, etc., again working upward, and then plug 33S to 34S, 33R to 34R, etc., terminating, as before, one hole below the top hole plugged in column 32. The Multiline fields will not be observed when the printer is on Single Line.

Fields for Single Line and Multiline identical. If the fields to undergo zero suppression are exactly the same, that is, occupy the same positions in the blockette, for Single Line and Multiline, the plugging is simplified. Plug the fields as for Single Line. Then run a jumper from the first unused hole in column 23 to the hole marked "Start (ML)" which is 24S. Likewise, run a jumper from the first unused hole in column 33 to "End (ML", hole 34S. All the fields will now be observed both on Normal and Multiline printing.

Some fields common to Single Line and Multiline. When only some of the zero suppression fields are common to both Multiline and Single Line Printing while others are distinct to one or the other, the situation is somewhat more complex. Here "Y" jumpers must be used for the common fields. The stem of the "Y" is plugged into the address location and then one fork is plugged in with the upper (Single Line) group in column 25 (or 32) and the other fork is plugged to the lower (Multiline) section of column 25 (or 32). The other (non-common) fields are plugged as before. The jumpers between columns 23 and 24 and between columns 33 and 34 are run as previously.

Two more points with respect to Zero Suppression should be noted:

1. If one Zero Suppression field follows another immediately (e.g., 22-37, 38-51), the ending point of the first field need not be plugged.

2. If a single digit field is to undergo zero suppression, a "Y" jumper must be used. The stem of the "Y" is plugged into the address location and one fork goes to column 25 (start) while the other goes to 32 (end). If the single digit field is followed immediately by another field (as in algebraic sign followed by number) then, as stated above, the ending of the single digit field need not be plugged and a straight jumper can be used (to plug the start).

6. Fast Feed

There are four magnetic tape symbols which may be used to initiate a Fast Feed. They are:

Pulse Code	Name	Modified Unityper I and Unityper II Symbol
0 01 1111	FF I	@
1 10 0001	FF II	/
0 10 1111	FF III	?
0 11 1110	FF IV	=

The Fast Feed symbol used is not printed and it will be observed as a Fast Feed instruction only if it is placed in the first digit position of a blockette. The fast-feeding is accomplished before the blockette containing the symbol is printed.

As mentioned in Section 4, it is desirable that the first blockette of a new form (or form group) should employ an FFI: otherwise there is no restriction on which Fast Feed symbols are used.

When started, a Fast Feed will continue feeding paper without printing or reading until a hole is encountered in that channel of the Paper Control Loop corresponding to the Fast Feed symbol (e.g., a Fast Feed started by a FF II symbol is stopped only be encountering a hole in channel 2 of the Paper Control Loop). A Fast Feed can also be started by punching a hole in channel 5 of the Paper Control Loop. This type of Fast Feed is stopped only by a hole sensed in channel 6. This "Loop Controlled" Fast Feed is useful in taking care of "overflow" from one form to the next. A Loop Controlled Fast Feed is never started until the first digit of the blockette currently being read is sensed. If this should be a Fast Feed symbol, it takes precedence ofer the channel 5 hole; i.e., the magnetic tape controlled Fast Feed is obeyed, the Loop Controlled Fast Feed is ignored.

A special punch with sprocket hole aligning keys is used in preparing the Paper Loop Control tape. To punch the start of a Fast Feed, punch a hole in channel 5 on the line corresponding to the first line to be skipped. To stop the Fast Feed, punch a hole on the line where the first line of printing is to occur after the Fast Feed. Channel 6 is used for stopping if the Fast Feed was started with a channel 5 hole. Channel 1, 2, 3, or 4 is used for a tape-started Fast Feed.

The longest loop the High-Speed Printer can handle is 22 inches; the shortest is 11 inches. Of course, the punching for one form can be repeated several times, if desired, (and if the form is eleven inches long or less). Indeed, this is preferable since greater loop life will result.

There are two restrictions that must be observed in the use of Fast Feed:

1. A Fast Feed, whether loop or tape started, must always cause at least one line to be skipped.

2. A channel 5 hole should never be punched on the same line with any other hole.

During a Fast Feed operation, the paper is moved at a rate of 20"/second, or, in other words, 7200 lines per minute.

7. Multiline Printing

The Multiline symbol ⌘ (0 01 0000) is used to put the High-Speed Printer into the Multiline mode of operation. It should be placed in the first digit position of the blockette to be multilined, unless there is a Fast Feed symbol required too, in which case the Fast Feed symbol is placed first, the Multiline symbol second.

The printer returns to normal operation at the end of each multilined blockette so that even if consecutive blockettes are to be done in Multiline, a new Multiline symbol must be placed in each. The Multiline symbol will not be printed.

Multiline operation is entirely a function of the plugboard and the plugging operations may be broken into three groups:

1. Selecting the number of lines in which a blockette is to be printed.

2. Selecting the memory positions which are to be printed on each line.

3. Selecting the Printing location on each line for each character.

Selection of the number of Lines. This plugging consists of four steps and only the upper right hand section of the plugboard is under concern.

1. Run a jumper from the hole marked "Home" (33F) to the hole in column 32, counting down from the top, the number of rows corresponding to the number of lines into which the blockettes are to be divided in Multiline.
2. For rows above the hole selected in (1), run jumpers between corresponding holes in columns 32 and 33.

3. For rows including and below the hole selected in (1), run jumpers between corresponding holes in columns 33 and 34, down to and including row E.

4. If the Number of lines selected is 2 to 6, connect holes 32S and 32T (marked "One Line") with a jumper; if the number of lines selected is 1, omit the jumper between these two holes.

The following examples will illustrate the required plugging:

Example 1: Four line printing
1. Connect 33F to 32D
2. Connect 32A to 33A; 32B to 33B; 32C to 33C
3. Connect 33D to34D; 33E to 34E
4. Connect 32S to 32T

Example 2: One line printing
1. Connect 33F to 32A
2. No plugging required
3. Connect 33A to 34A; 33B to 34B; 33C to 34C; 33D to 34D; 33E to 34E
4. No plugging required

Example 3. Six line printing

1. Connect 33F to 32F
2. Connect 32A to 33A; 32B to 33B;
   32C to 33C; 32D to 33D;
   32E to 33E
3. No plugging required
4. Connect 32S to 32T

Selection of the memory locations to be printed on each line.

In Multiline work there is a set of 15 relays brought into play, different ones of which can be energized on different lines under the control of the plugboard. Further, by plugging the memory locations to the contacts of these relays, the characters to be printed out on each line can be selected simply by the relays which have been chosen to be energized for each line.

Each relay has 12 contacts and thus can handle 12 digits. The first step, then, is to decide how many relays are required to print each line and to plug them accordingly. To avoid confusion, relays should be chosen sequentially. Thus, if 40 digits are to be printed on the first line, 48 digits on the second line and 6 digits on the third line, relays 1, 2, 3, and 4 (room for a total of 48 digits) should be plugged [illegible] to operate on the first line; 5, 6, 7, and 8 should be plugged for the second line and relay 9 for the third line.

This is accomplished as follows (see upper right hand portion of the plugboard): Holes 32G, H, I, J, K, and L (labled "ML Counter, 1, 2, 3, 4, 5, 6", respectively) give output signals in turn when the printer is on line 1, 2, 3, [illegible] etc., of a Multiline operation. Holes 33G and 34F (internally connected together), 33H and 34G, 33I and 34H,...,33U and 34T are pairs of holes going to the 15 relays coils in order. They are labeled 1 to 15 on the plugboard. To operate relay 1 on line 1, run a jumper between holes 32G and 34F. Then to also pick up relays 2, 3, and 4 on line 1, as required in the example, run jumpers between 33G and 34G, 33H and 34H, and 33I and [illegible]. This, of course, could be extended if more relays were required to be picked up on line 1. (As many as 10 relays may be used on any given line. This gives sufficient contacts--- 120, to handle the entire memory.)

For line 2, again assuming four relays are to be picked up, plug 32H (line 2 output) to 34J (relay 5 coil). Then plug 33K to [illegible] 34K, 33L to 34L and 33M to 34M.

On line 3, only one relay is assumed required. Pick this up by connecting 32I to 34N.

One important rule should now be noted: If, on any given line in a Multiline operation, zero, one, or two relays are used, then a resistor must be plugged in on that line. This is easily done by running a jumper--

a. From the unused hole in the pair corresponding to the second relay in the chain (if 2 relays are used), or
b. From the unused hole in the pair corresponding to the single relay (if only one relay is used). or
c. From the line output hole itself (holes 32G to L) if no relays are used (i.e., nothing is to print on that particular line) to one of the six holes in the section marked "Resistors" (holes 32M to R)

Thus, in the example above, since only one relay is used on line 3, a jumper should be run from hole 33O to 32M. Note carefully that this plugging of resistors applies only to the lines within the group size selected for the Multiline operation. Thus, in the above example where a 3 line Multiline was assumed, nothing at all need be plugged to the last three output lines (32J, K, and L) since they will never be excited. This should not be confused with the situation where, say, in a 4 line Multiline it is not desired to print anything on line 2. Here, no relay need be connected to line 2, but a resistor should be.

Having wired up the relay coils, the next step is to send the memory locations (actually, comparator outputs) to the proper relay contacts. The 180 relay contacts (12X15) go to 180 pairs of holes which are located in columns 17 through 31 in the upper plugboard panel. One column represents the contacts for one relay.

Now, unless the run is exclusively Multiline, the plugboard will have already been wired for Single Line Printing, as described in Section 3. That is, the holes in columns 1 through 5 (labeled "From Comparator") will be wired to the

paired holes in columns 6 through 16 (labeled "To Single Line Relays"). Thus, each memory location can, in general, be picked up from the unused hole in the pair here. If certain memory locations do not print in Single Line work (and are to print in Multiline work), or if there is to be no Single Line Printing at all, then the memory locations must be picked up from the first five columns directly. It is then simply a question of taking those memory locations which are to print on the first line and plugging them sequentially to the relays which have been assigned to the first line, and similarly for the other lines. Remember that the holes corresponding to the relay contacts are paired.

As an example, suppose the first 40 memory locations are to print in Single Line Printing in positions 1-40. Then hole 1A would have been plugged to 6A, 1B to 6C, 1C to 6E,..., 2P to 9G. Now suppose these same 40 memory locations are also to print on line 1 of a Multiline operation. The first 4 relays (columns 17, 18, 19, and 20) would have been allocated for this purpose. Then the plugging would be: 6B to 17A, 6D to 17C, 6F to 17E,..., 9H to 20G. Notice that many contacts on the fourth relay are unused. Information to print on line 2 would be plugged starting with the fifth relay (column 21).

Selection of the printing location for each character. The other sides of the Multiline relay contacts go to a set of 180 pairs of holes on the lower plugboard panel (columns 7 through 21). Again, each column corresponds to a relay. Thus, column 17 on the upper panel is the "input" side of relay 1, while column 7 on the lower panel is the "output" side of the same relay. The individual holes in the columns are likewise in one-to-one correspondence. Thus, a comparator signal entering the first (or second) hole in column 17 of the top panel will appear at the first (and second) hole in column 7 of the bottom panel when relay 1 is energized (i.e., on line one).

The first five columns and the first ten holes of the sixth column of the lower panel (making 130 holes in all) are connected one-to one to the 130 thyratrons which drive the printing hammers. The procedure now is to connect the line 1 relay outputs (however many relays may be used for line 1) to the thyratron holes in the manner desired. Now on line 2, some of the characters may need to be

printed in, as yet, unused positions. These are plugged directly to the corresponding thyratrons. Other characters (or more properly, memory locations) may need to be printed in positions already printed on line 1. To do this, plug from these particular holes in the line 2 relay output set to those unused holes of the pairs of the line 1 relay output, where the other hole of the pair is already plugged to the desired thyratron.

A similar procedure is followed for line 3 and the following lines. There will always be a free hole in a relay output pair into which a jumper from an output on a later line can be plugged to achieve printing in the same position as the earlier line.

As an example of the above plugging, consider the following exercise:

> Print the first three memory locations in the first three print positions on line 1; the next four memory locations in the first four positions on line 2; and the next 5 memory locations in the first five positions of line 3.

It is assumed that the first Multiline relay has been assigned for line 1, the second for line 2, and the third for line 3. Further, that the comparator outputs have been picked up and are plugged into, in order, 17A, 17C, 17E, 18A, 18C, 18E, 18G, 19A, 19C, 19E, 19G, and 19I (all on the lower panel). The required plugging then is (all on the lower panel):

7A to 1A, 7C to 1B, 7E to 1C	(line 1)
8A to 7B, 8C to 7D, 8E to 7F, 8G to 1D	(line 2)
9A to 8B, 9C to 8D, 9E to 8F, 9G to 8H. 9I to 1E	(line 3)

8. Multiple Printing

Plugging procedure for Single Line operation. By means of the paired holes in the section of the upper panel marked "To Single Line Relays" a memory location can be readily printed out as many as three times on a line.

to do this. simply plug from the unused hole in the first position chosen to one of the paired holes (preferably the top) in the second place where printing is desired. If triplicating is required, run a jumper from the unused hole of the second position to the third position.

Example: Print the contents of the first memory location in positions 1, 61, and 121.

Plug 1A to 6A
6B to 11A
11B to 16A

If some of the memory positions for Single Line Printing are common to Multiline Printing also, it is desirable to do the Multiple plugging for Single Line first, then the last unused hole in a pair may be connected to the Multiline relays.

Plugging procedure for Multiline operation. In Multiline work, a character cannot only be printed out 3 times on a given line, but then can be printed out up to 3 times again on any other line in the group. This is done by"chain plugging", as noted above, in the "To Multiline Relays" section of the plugboard. By connecting the output to contacts on relays (or a single relay), which close on the same line, the digit may be printed up to 3 times on that same line. Then by extending the chain of plugging to relays which close on other lines, the same character may be repeated on those lines. On the lower panel, the positioning of the characters on the line is taken care of as in regular Multiline work(discussed in Section 7).

Example: Print out memory location 1 in positions 1 and 61 on Single Line operation. On Multiline operation print out memory location 1 in positions 1, 25, and 49 on line 1, and in positions 25 and 49 on line 2.

Assume relay 1 is energized on line 1, and relay 2 on line 2. Then the plugging is, by panel:

On the upper panel, plug	1A	to	6A
	6B	to	11A
	11B	to	17A
	17B	to	17C
	17D	to	17E
	17F	to	18A
	18B	to	18C
On the lower panel, plug	7A	to	1A
	7C	to	2A
	7E	to	3A
	8A	to	7D
	8C	to	7F

Note that by this method it is possible to have, at most, 180 print-outs from one blockette in Multiline, since there are only 180 relay contacts. However, there is complete flexibility in the positioning of the information on each line and, of course, complete independence between Single Line and Multiline Printing.

There is another system for doing multiple printing on Multiline which allows the entire memory to be triplicated, if desired (i.e., produce as many as 360 print-outs from one blockette). However, in using this method there must be no Single Line work at all or, if Single Line operation does occur, one must accept the same duplicating or triplicating pattern as is plugged for the Multiline work.

This system is particularly useful where each line of the Multiline group is printed directly under the line above and the group as a whole is duplicated or triplicated across the page. This system is used as follows:

1. Plug for straight Multiline work as in Section 7. ignoring the Multiple Printing problem (i.e., simply plugging for one printing).

2. On the lower panel, in the "From Multiline Relays" section, outputs going to the same print position on different lines will have been chain plugged together and run to one set of thyratron holes. However, each of the outputs for the last line will have a free hole. If only duplicating of the group is required, run straight jumpers from these free holes to the appropriate thyratron holes. If

triplicating is required, "Y" jumpers are used to connect each free output hole to two thyratrons.

Example : Print the first memory location on line 1, the second memory location on line 2 and the third on line 3. On all three lines the printing is to be in triplicate, printing in columns 1, 49, and 97. (Use the first Multiline relay on line 1, the second on line 2 and the third on line 3.)

On the upper panel, plug	1A	to	17A	
	1B	to	18A	
	1C	to	19A	
On the lower panel, plug	7A	to	1A	
	8A	to	7B	
	9A	to	8B	
	9B	to	3A and 5A ("Y" jumper)	

Note that if the printer should go into Single Line Printing and if something were plugged to print (on Single Line) in either positions 1, 49, or 97, it would print in all three positions. This might be all right but, if independently some other memory location should be plugged to another of these three points, there would be trouble. (The printer would stop with a Print Check Error.) Thus, great care must be exercised in using this method of Multiple Printing if Single Line operation can also occur in the run.

9. Checking Features

The error detection circuits on the High-Speed Printer may be considered in the three sections through which information recorded on tape is printed: 1- reading of data from tape, 2- storage of data in the memory, and 3- printing of the memory.

Error detection in reading tape. Each digit read from tape is given a binary bit count. If the number of binary ones present is odd the character has been read from tape correctly. If an even count is detected, the remainder of the blockette is read, but the Odd-Even Check Error is set and the printer stpps. Nothing is printed.

Further, each blockette read from tape must contain exactly 120 digits. If a blockette is longer or shorter than 120 digits, the printer will set the 120 Check Error and stop. Nothing will be printed.

Error detection in storage. Each of the digits coming from the tape is placed in thepproper position in the memory by virtue of the set of 120 address lines, which are sequentially excited by the function table which decodes the Main (or Address) Counter. If an address line should fail to rise to the signal level when it is supposed to, the corresponding digit coming from tape could not enter the memory. The Address Check circuits look for this and, if an address line should fail to be excited at the proper time, the Address Check Error is set and the printer stopped.

Error detection in printing. The fundamental checking of the printing is done by means of the group of 130 check thyratrons working in conjunction with the All-Out Detector. At the end of each print cycle, all 130 check thyratrons should be extinguished and the All-Out Detector looks for this. If some column fails to print when it should or prints an incorrect character, its check thyratron will be on when probed. This causes the machine to stop with the Print Check Error set.

The determination of whether all check thyratrons have been extinguished or nto is made by a circuit called the All-Out Detector. If this circuit should fail in a certain way, a steady All-Out signal would be given and printing error would fail to stop the machine. To guard against this, the All-Out Detector is itself checked every line and, if not functioning properly, the printer will stop with the All-Out Detector Error set.

In addition to the major checking circuits described above, there are other checks applied to the control circuits and paper feed mechanism to ensure complete accuracy of printing. The description of these checks requires a detailed understanding of the printer logic.

TYPE WHEEL SYMBOLS

ORIGINAL

EX 3	ZONE			
	00	01	10	11
0000	~~K~~ IGNORE	ML ~~R~~	~~T~~	P S ~~P~~
0001	SPACE ~~Δ~~	;	"	P 8 ~~B~~
0010	–	.	FF II | SCICR	:
0011	0	;	)	+
0100	1	A	J	/
0101	2	B	K	S
0110	3	C	L	T
0111	4	D	M	U
1000	5	E	N	V
1001	6	F	O	W
1010	7	G	P	X
1011	8	H	Q	Y
1100	9	I	R	Z
1101	'	#	$ ~~L~~	% ~~Ø~~
1110	¢	¢	*	FF IV =
1111	(	FF I @	FF III ? ~~U~~	

TYPE WHEEL SYMBOLS
PROPOSED CHANGE #1

EX 3	ZONE			
	00	01	10	11
0000				
0001				
0010	–	.		:
0011	0		)	+
0100	1	A	J	/
0101	2	B	K	S
0110	3	C	L	T
0111	4	D	M	U
1000	5	E	N	V
1001	6	F	O	W
1010	7	G	P	X
1011	8	H	Q	Y
1100	9	I	R	Z
1101			=	
1110			*	
1111	(			

TYPE WHEEL SYMBOLS
PROPOSED CHANGE #2

EX 3	ZONE			
	00	01	10	11
0000	~~↑~~	~~ML~~	~~T~~	~~PS~~
0001	~~SPACE~~	>		~~PB~~
0010	–	.	~~FF II SCIER~~	:
0011	0	<	)	+
0100	1	A	J	/
0101	2	B	K	S
0110	3	C	L	T
0111	4	D	M	U
1000	5	E	N	V
1001	6	F	⊙	W
1010	7	G	P	X
1011	8	H	Q	Y
1100	9	I	R	Z
1101	≥	→	=	△
1110	≤		*	~~FF III~~
1111	(	~~FF I~~	~~FF II~~	

Programming for

THE HIGH SPEED PRINTER

On single line operation, the 120 digits of the input blockette are printed on the first 120 positions of the 130 digit line. The last 10 digit positions on the line are not used. There will be no zero supression on single line operation.

The multiline operation will be plugged for 6 line multiline and will print as follows:

On the first line, digits 13 thru 36 of the input blockette will print on positions 60 thru 84.

On the second line there will be no printing.

On the third line, digits 37 thru 48 will print on positions 7 thru 18,
digits 49 thru 60 will print on positions 31 thru 42,
digits 61 thru 72 will print on positions 55 thru 66,
digits 73 thru 84 will print on positions 79 thru 90,
and digits 4 thru 12 will print on positions 106 thru 114.

On the fourth line there will be no printing.

On the fifth line, digits 85 thru 88 will print on positions 8 thru 11,
digits 89 thru 92 will print on positions 23 thru 26,
digits 93 thru 96 will print on positions 38 thru 41,
digits 97 thru 100 will print on positions 53 thru 56,
digits 101 thru 104 will print on positions 68 thru 71,
digits 105 thru 108 will print on positions 83 thru 86,
digits 109 thru 112 will print on positions 98 thru 101,
digits 113 thru 116 will print on positions 113 thru 116.

On the sixth line there will be no printing.

There will be one zero supression field on multiline printing, it will be on digits 9 thru 12. Digits 1 thru 3 and 117 thru 120 will not print on multiline operation.

This plugboard will be used in conjunction with a 66 line paper loop with column 1 punched in line 2, column 2 punched in every even line, column 3 punched in every third line, column 4 punched every sixth line, column 5 punched in line 64, column 6 punched in line 1, and column 7 punched in line 1.