

**GENERAL ELECTRIC
COMPUTERS**

GE-200 Series High-Speed On-Line Printer

GENERAL ELECTRIC

**GE-200 SERIES
HIGH-SPEED
ON-LINE PRINTER**

REFERENCE MANUAL

November 1964

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GENERAL  ELECTRIC

INFORMATION SYSTEMS DIVISION

PREFACE

Several printers are available for use with General Electric's Compatibles/200 Information Processing Systems. This manual describes the functions and operations of the High-Speed On-Line Printer. The manual tells how the printer operates and gives a detailed description of all instructions used in writing the program. In Appendix A is a list of printer routines available from the General Electric Computer Equipment Department Program Library, 13430 North Black Canyon Highway, Phoenix, Arizona 85029.

Detailed information for the Compatibles/200 systems can be found in the following manuals:

GE-215 System Manual	CPB-334
Compatibles/200 Operating Manual	CPB-247
GE-225 Programming Reference Manual	CPB-252
GE-235 System Manual	CPB-267
GE-235 Central Processor Reference Manual	CPB-374
Ge-225 Information Processing System	CPB-244

This publication supersedes CPB-321A bearing the same title. Changes are indicated by a bar in the margin. Appendix E, describing the COC-5 option, has been added.

Suggestions and criticisms relative to form, content, purpose, or use of this manual are invited. Comments may be sent on the Document Review sheet in back of this manual or may be addressed directly to Engineering Publications Standards, B-90, Computer Equipment Department, General Electric Company, 13430 North Black Canyon Highway, Phoenix, Arizona 85029.

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1. GENERAL DESCRIPTION

INTRODUCTION

The Compatibles/200 high-speed printer subsystem permits the rapid printing of information while operating on line under control of a computer program. The printer subsystem is used where volumes of information must be transformed into permanent visual records. The basic subsystem is shown in Figure 1.

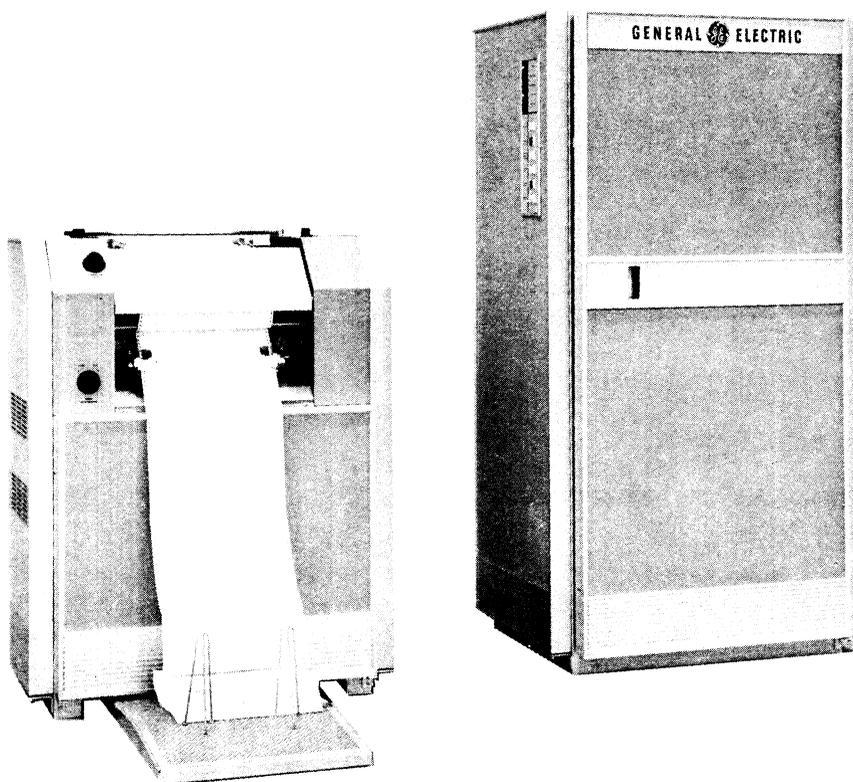


Figure 1. High-Speed On-Line Printer Subsystem

FEATURES

The printer subsystem has the following standard features:

- Prints 900 lines per minute
- Prints 120 alphanumeric characters per line

GE-200 SERIES

- Prints in open gothic type style, spaced 10 characters per inch horizontally and 6 lines per inch vertically
- Provides automatic editing of printed format and buffering of information from the central processor
- Skips lines (paper slewing) vertically at 25 inches per second, under program control
- Prints up to five copies, depending on paper weight
- Accommodates paper forms ranging in width from 3-1/2 to 19-1/2 inches and up to 22 inches in length per page in fan-folded continuous form
- Provides 50 characters on the print wheels, as follows:

Numbers	0-9		
Alphabet	26 letters A-Z		
Special Characters	14 (plus space, or blank):		
	+	Plus	/
	.	Period	=
	-	Minus	,
	\$	Dollar	[
	*	Asterisk]
	%	Percent sign	#
	_	Underscore	@
		Space or blank	"At" sign

It has the following checking features:

- Parity checking on each word received from the central processor
- Out-of-paper detection
- Inoperative print hammer detection

The optional features include:

- Choice of both 6 and 10 vertical lines per inch. This option gives the printers symmetrical plotting capability.
- FORTRAN character set option provides special print characters to print IBM FORTRAN tapes (see list in Appendix B). Special print characters are not needed to print G-E FORTRAN.
- A special printer controller and printer head assembly can be furnished a user requiring a 160 character print line. The printer subsystem is identical to the standard 120 character printer subsystem.

SYSTEM CONFIGURATIONS

All instructions and information for the printer subsystem originate with the central processor. For on-line operations, the printer controller serves as the link between the memory of the central

processor and the printer. Only one printer can be connected to a printer controller; however, more than one printer controller can be connected to the central processor. Figure 2 shows the minimum and maximum on-line printer subsystems for the Compatibles/200 systems.

	Controllers per System		Printers per Controller	Total Units per System	
	Min.	Max.		Min.	Max.
GE-215	1	2	1	1	2
GE-225	1	8	1	1	8
GE-235	1	2	1	1	2

Figure 2. Subsystem Configurations

ON-LINE PRINTING OPERATIONS

Control of data and instructions is passed from the central processor to the printer controller during on-line printing operations. Data is transmitted to the printer controller from the central processor's M-register (Figure 3). The M-register is used to check parity of each 20-bit word (three binary-coded decimal characters) as the word leaves memory. Parity is again checked in the printer controller before the word is stored for printing.

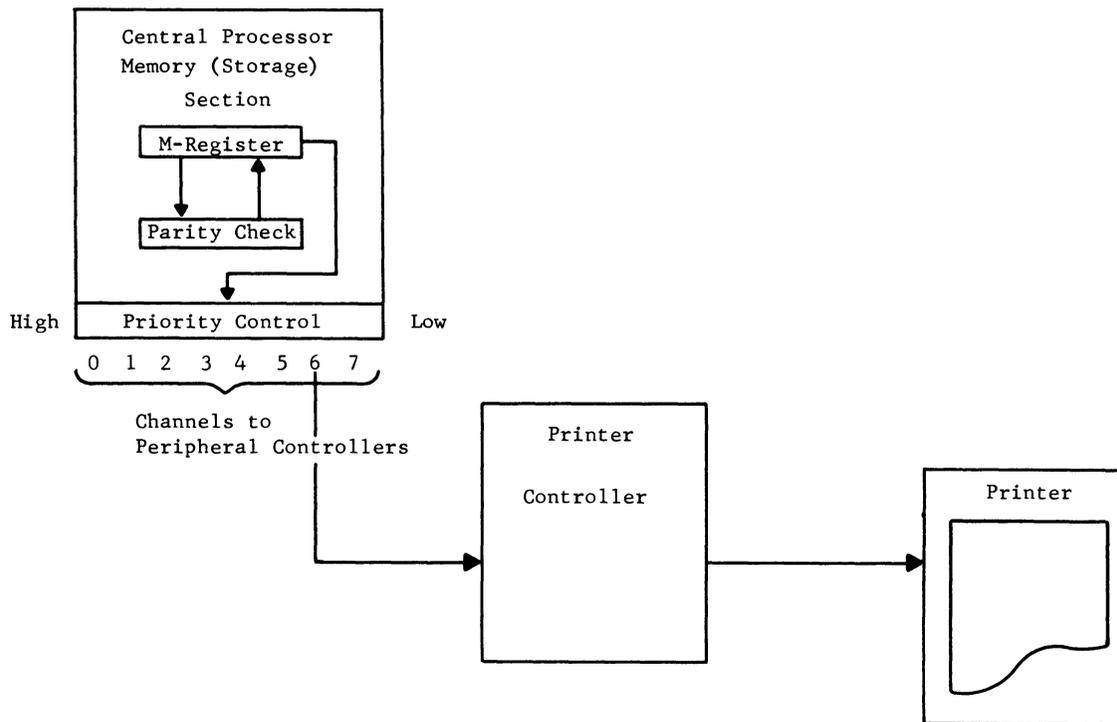


Figure 3. Printer Subsystem Control Logic

Priority

When operating with other peripheral subsystems, a printer subsystem is granted access to memory according to its level of priority. (See "System Control Operations" in the GE-235 Central Processor Reference Manual, CPB-374.) This level of priority is pre-established within the system by channel assignments.

Each printer controls itself through its respective printer controller and through a priority interrupt feature of time sharing, executes its own instructions, thus permitting print operations to occur simultaneously with central processor computations. Normally, the printer subsystem occupies a low-priority channel because the printer can afford to wait for a priority without a loss of information. Figure 3 illustrates the control logic of on-line printing operations.

Printer Controller

The printer controller contains electronic elements capable of performing the following functions:

- Monitors the flow of information between memory of the central processor and the printer
- Receives and interprets printing instructions from the central processor
- Accumulates and stores printable characters in the actual operation of the printer
- Edits, automatically, each horizontal print line

The controller has an operator panel which provides for manual operations of the printer. By using the switches (controls) on this panel, an operator can slew paper or print out a central processor memory dump in octal form. A detailed description of this panel and its features will be found in "Operating the Printer Subsystem" page 33.

Printer

The printer is an electromechanical device for printing 120 alphanumeric characters at a rate of 900 lines per minute. It operates in response to electrical signals from the printer controller actuating individual character print hammers.

Printing is executed by printer hammers striking engraved characters on a continuously rotating print wheel drum. As the print wheel drum rotates, rows of characters are brought into position over the row of hammers. Actuation of a hammer is timed to occur as the required character turns into printing position. Inked ribbon and paper pass between the print wheels and the hammers.

OPTIONS

FORTRAN Character Set

This option provides special print characters to print IBM FORTRAN tapes. A list of FORTRAN characters is shown in the appendix on page 51.

Special print characters are not required to print G-E FORTRAN.

160 Character Print Line

A special printer controller and printer head assembly can be furnished a user requiring a 160 character print line. The printer subsystem is identical to the standard 120 character printer subsystem.

2. PROGRAMMING ON-LINE OPERATIONS

Programming on-line operations is accomplished in a manner similar to that for other devices connected to the priority control of the central processor. Three instruction words are required for each printer operation. In each case, the first instruction word (SEL) selects the proper channel for the printer controller and transfers to it the next two words specifying the exact operation to be performed and the address of data to be operated upon. As the controller receives each instruction word, it checks its parity and indicates any error by a light on the control and indicator panel of the printer, also setting the error condition for testing by the programs. Figure 4 illustrates the transfer of instructions and data between the central processor and the printer controller during a printing cycle.

PRINTING CYCLE

The printer subsystem begins a printing cycle upon receipt of an SEL instruction. The printer controller requests that it be supplied with format and/or data words in their printing sequence.

FORMAT ADDRESS COUNTER. The format address counter receives the central processor memory address where the next horizontal formatting word is stored. The address is automatically incremented as each new format word is read into the format buffer.

FORMAT BUFFER. The format buffer is an 18-bit register into which a format word is read when the print line is to be formatted.

DATA ADDRESS COUNTER. The data address counter receives the address of the next print line data word. The address is automatically incremented as each new print line data word is read into the data buffer.

DATA BUFFER. The data buffer is a 21-bit register into which a data word is read. Each data word contains three 6-bit binary coded decimal (BCD) characters plus 2 extra bits and a parity bit.

The printing cycle runs through three phases to the completion of a print line.

Filling Phase

Each format word and its related data word is examined character by character, starting with the first character of the format word and then the first character of the data word. In the examination process, the printer controller determines if the character is an automatic format control character or a printable character.

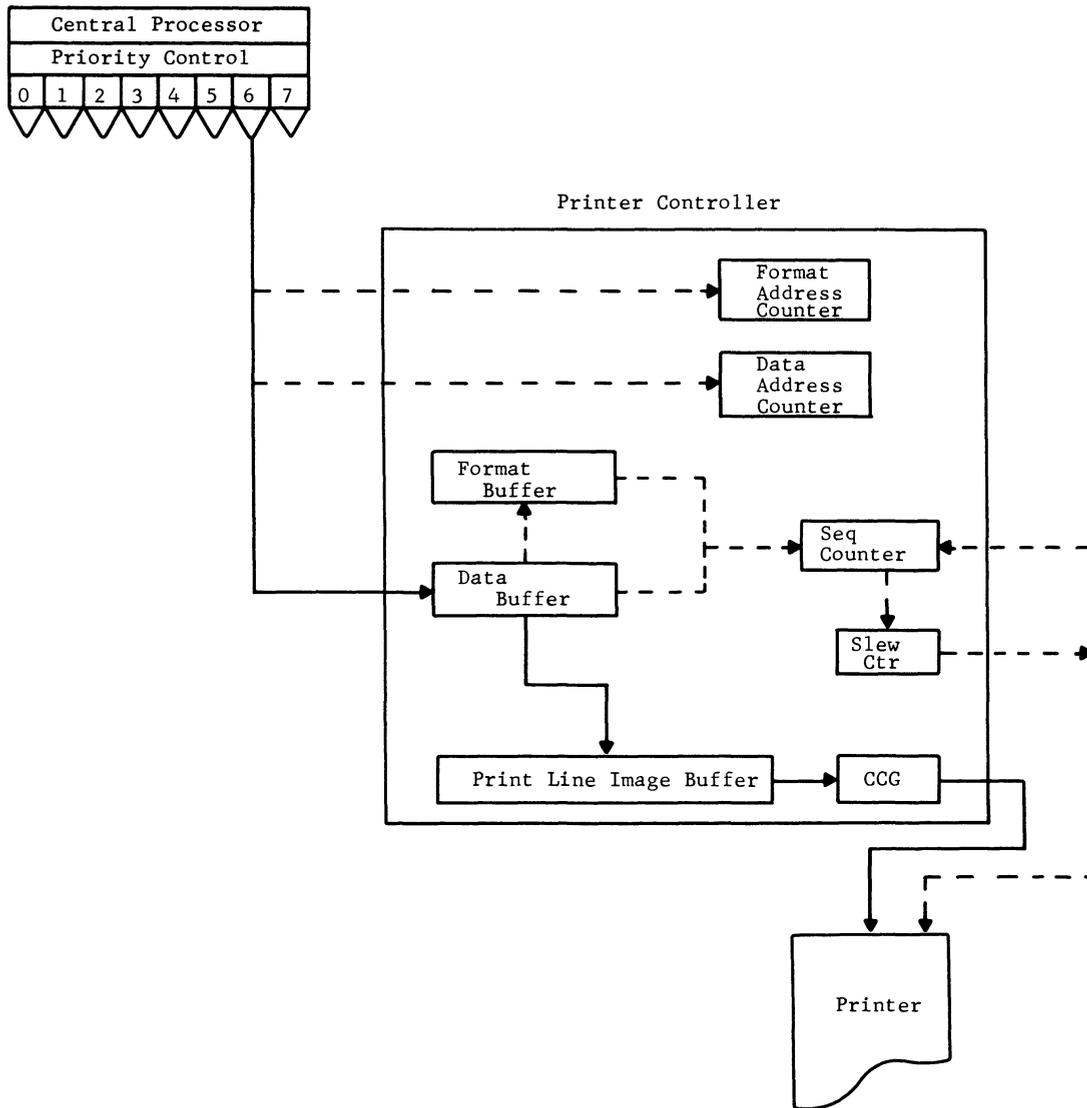


Figure 4. Printing Cycle, On-Line Operation

If the format character is a format control character, the printer controller takes the action specified by the format character--delete, zero suppress, etc.--upon the related data character and stores it in the print line image buffer.

If the format character is a printable character, it is stored in the print line image buffer.

When automatic format control for horizontal printing is not used for printing, the instructions received by the printer controller do not include format instructions. In this case, the printer controller requests and receives only data words, processing one character at a time.

PRINT LINE IMAGE BUFFER. The print line image buffer is a magnetic core memory buffer consisting of a matrix of 120 (columns) by 50 (characters). Each format and data word is checked for parity in the printer controller before a word is stored. After parity has been checked each character of print line data sets one core in one of the 120 columns, thereby indicating the character to be printed in that column (horizontal print position of the printer).

Printing Phase

As soon as the last data character has been processed, the printer begins to print the characters on paper, taking them from their places in the print line image buffer. When all words to be printed for a given print line have been processed, the operating cycle of the printer mechanism begins under control of the printer controller. As a character is removed from the print line image buffer, a hammer (corresponding to the character removed) strikes the character on the print wheel drum, causing the character to be imprinted on paper. This imprint is transferred to paper through an inked ribbon in a manner similar to the imprint transfer on a typewriter.

CHARACTER CODE GENERATOR (CCG). The character code generator (CCG) furnishes a 6-bit output which is always the BCD representation of the next character to come up on the print wheel of the printer mechanism. It is free-running and is always in synchronism with the printer mechanism print wheel.

SEQUENCING CONTROL. The sequencing control initiates the starting and stopping of the various functions of the printer controller, ensuring that these functions are performed at the right time and in the correct sequence.

SLEW CONTROL. The slew control initiates the slewing of paper at a time dictated by the sequencing control, and assures that the correct number of lines, as indicated by the print or slew instruction, are skipped.

Slewing Phase

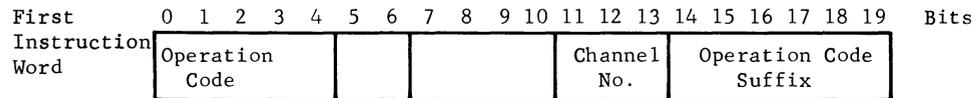
After all characters for a particular print line have been placed on paper, the paper is slewed the number of lines indicated by the instruction word. While the slew is in process, the printer subsystem is not considered busy, so at this time the central processor can provide the printer controller with new instruction words to begin another printing cycle.

If the instruction word received by the printer controller indicates only a slew operation, no format or data words are requested or received. Immediately after receiving the instruction for slew, the printer begins a slewing operation.

WORD FORMATS

Instruction and data words for the on-line printer are formatted as shown on the following page.

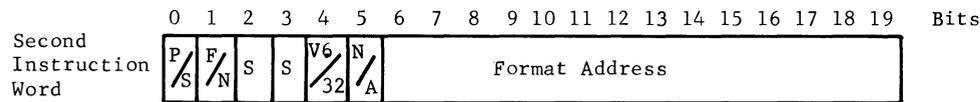
SEL Instruction Word



The SEL instruction word selects the printer controller by its channel number. Once selected, the controller goes busy and awaits the next two words from the central processor.

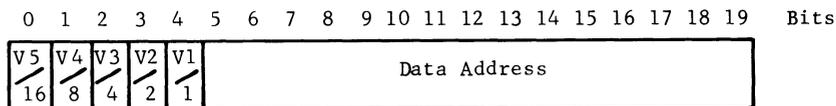
Printer Instruction Words

The two words sent to the controller following the SEL instruction word determine the operation to be performed by the printer. The bit configurations of the words determine the operation as follows:



The bit configuration of the second instruction word is as follows:

<u>Bit Position</u>	<u>Contents</u>	<u>Operation</u>
0	0	Slew operation only
	1	Print and slew operation
1	0	No horizontal format control of print line
	1	Horizontal format control of print line
2-3	1-1	Vertical slew the number of lines specified in the vertical slew bits (V6-V1)
	0-0	Vertical slew by VFU (tape channel) as specified in bits V6-V1
	1-0	VFU to channel 8
	0-1	VFU to channel 7
4	1	Vertical slew 32 lines or VFU to channel 6
5	1	Numbers only to be printed
	0	Alphanumerics to be printed
6-19		Address of first format word in memory

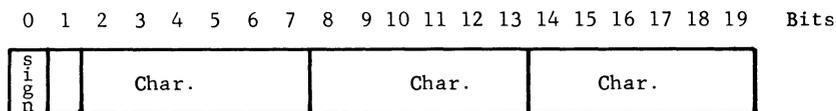


The bit configuration of the third instruction word is as follows:

<u>Bit Position</u>	<u>Contents</u>	<u>Operation</u>
0	1	Vertical slew 16 lines or VFU to channel 5
1	1	Vertical slew 8 lines or VFU to channel 4
2	1	Vertical slew 4 lines or VFU to channel 3
3	1	Vertical slew 2 lines or VFU to channel 2
4	1	Vertical slew 1 line or VFU to channel 1
5-19		Address of first data word in memory

Note: Although there are only 14 bits specified in the first instruction word for format address and 15 bits for the address of data in the second instruction word, the printer controller assumes that the most-significant (5th) bit of the format address will be the same as that specified for the data address.

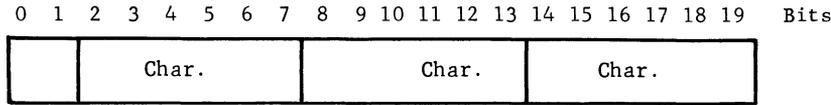
Data Words



Each data word is organized as follows:

<u>Bit Position</u>	<u>Contents</u>	<u>Operation</u>
0	0	Indicates that another data word is to follow
	1	Indicates this is the last data word to be printed
1		Not used
2-7	Octal for	1st BCD character to be printed
8-13	Octal for	2nd BCD character to be printed
14-19	Octal for	3rd BCD character to be printed

Format Words



Each format word is organized as follows:

Bit Position	Contents	Operation
0-1		Not used
2-7	Octal for	Format character 1
8-13	Octal for	Format character 2
14-19	Octal for	Format character 3

FORMAT CONTROL

The programmer must determine the format for the report to be printed and assign to memory of the central processor the bit configuration for both horizontal printing and vertical slewing of the form.

Vertical Formatting

Vertical spacing between lines of print for more than 1 line must be specified by the programmer during assembly of the user's program. There are two methods provided by the high-speed printer subsystem for vertical formatting (slewing), one by the countdown method which allows slewing of paper the number of lines specified in an instruction word (SLW) and the slew to channel method, which slews the paper the number of predetermined lines established in a tape channel--vertical format unit (VFU)--as specified in an instruction word (SLT).

SLEWING BY COUNTDOWN. Slewing by countdown allows the programmer to specify a specific number (0 to 63) of lines between printing lines. This method of slewing is normally used by a programmer when a form may require more than 8 different slewing formats (the VFU is limited to 8 formats) or when he does not feel that a new tape loop needs to be cut for the VFU. The number of lines (0-63) is specified as the operand of the Slew (SLW) instruction.

SLEWING BY VFU. Slewing by vertical format tape is accomplished by an 8-channel perforated tape loop. The vertical tape loop gives the programmer the ability to control vertical spacing on printed forms by slewing to a hole punched in a specified channel in the tape loop. The spacing of the holes in the channels determines the number of lines to be skipped during a slewing operation. Each of the 8 channels may contain a different pattern, so as many as eight vertical formats are available on each tape. The VFU channel is specified as the operand of the Slew Tape (SLT) instruction.

Horizontal Formatting

Horizontal positioning of characters is obtained by using automatic format control words. Data characters are positioned in a single print line based upon format characters stored in memory of the central processor. If the programmer does not use automatic formatting, each line of print must be formatted in memory as it is to be printed. The assembly of print lines in this manner means an unnecessary waste of memory, since space codes have to be inserted when an indented margin is desired. Spaces between words or numbers also have to be inserted. Dollar amounts usually do not carry the dollar sign (\$) until they are printed; therefore, they have to be a part of the print line assembly. These are some of the inconveniences that are overcome by using automatic formatting as provided by the high-speed printer subsystem.

When a print line format arrangement can be stored in memory once and then be used as often as needed to print lines of data in that same format--such as payrolls--any number of different printed forms can be used. The data may, within the limitations imposed by the editing control, also be stored in memory of the central processor.

AUTOMATIC FORMAT CONTROL

Using the automatic format control feature provided by the high-speed printer subsystem, the programmer specifies the format desired by the assignment of format control characters to assemble the print line. In the printer controller, when a data line is to be printed, format words are stored in the memory of the central processor in blocks of words the same as the print line data.

Each 6-bit character is interpreted as follows:

Printable characters and their octal equivalents are shown in Figure 5. All printable characters cause the typeline assembly counter to be incremented for the next sequential character to be considered.

Nonprintable characters are codes other than printable data characters or octal 35, causing blanks to appear in print columns corresponding to the positions in which encountered.

Control characters are those format characters which may or may not cause blanks (spaces) to be inserted in the print column.

In assembling a formatted print line, the printer controller reads one format word and one data word from memory of the central processor. The format word and its corresponding data word are operated upon by the printer controller in pairs; the characters within each word work on a one-for-one basis. That is, a control character in the format word acts on the corresponding

character of the data word, assuming that the format character is a control character. The sequential relationship of format and data characters is illustrated in the following example.

Example:

Assume that the contents of a format word is $F_1F_2F_3$ and a data word is $D_1D_2D_3$. They would be examined in pairs

F_1 to D_1
 F_2 to D_2
 F_3 to D_3

F_1 control character says do something special to the D_1 character, etc.

PRINTABLE CHARACTERS		PRINTABLE CHARACTERS	
<u>Numeric</u>	<u>Octal</u>	<u>Special</u>	<u>Octal</u>
0	00	#	13
1	01	@	14
2	02	-	15
3	03	=	16
4	04	+	20
5	05	.	33
6	06	-	40
7	07	\$	53
8	10	*	54
9	11	/	61
		,	73
		%	74
		[	75
		]	76
		NONPRINTABLE CHARACTERS	
		<u>Octal</u>	
		12	
		17	
		32	
		34	
		35	
		36	
		37	
		52	
		55	
		56	
		57	
		60	
		72	
		77	

PRINTABLE CHARACTERS	
<u>Numeric</u>	<u>Octal</u>
A	21
B	22
C	23
D	24
E	25
F	26
G	27
H	30
I	31
J	41
K	42
L	43
M	44
N	45
O	46
P	47
Q	50
R	51
S	62
T	63
U	64
V	65
W	66
X	67
Y	70
Z	71

Figure 5. Printable and Nonprintable Characters

The process of alternately reading a format word followed by a data word continues until a minus sign (1-bit in the sign position) is detected on a data word. This indicates the end of a print line, data words, and format words.

AUTOMATIC FORMAT CONTROL CHARACTERS

Control characters used by the programmer in loading the user's program are coded in octal form. A sample General Assembly Program coding follows.

	Symbol						Opr			Operand							X		
	1	2	3	4	5	6	8	9	10	12	13	14	15	16	17	18		19	20
1	F	O	R	M	A	T	O	C	T	0	3	5	3	5	5	7			
2										0	3	5	7	3	3	5			
3										0	3	5	3	3	3	5			
4																			

The five control characters are:

- Ignore Octal 35
- Ignore/Skip Octal 36
- Delete Octal 37
- Delete/Skip Octal 56
- Zero Suppress Octal 57 or 53

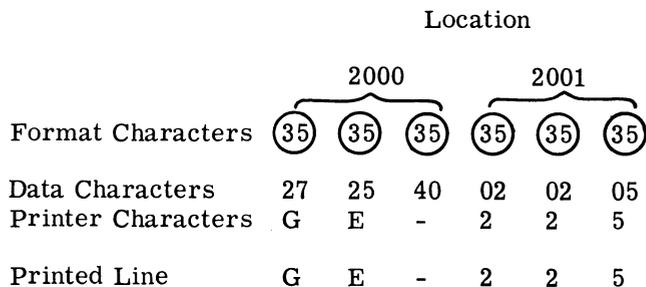
The function of each character, together with examples of its use, follows.

Ignore (octal 35)

When the format character is an Ignore, the data character in the data word is immediately considered for storage in the print line image buffer. The data character will occupy the print column that the format character would have occupied had it been printable.

Example:

The printer controller logic interprets an octal 35 as a no-action character. The associated data character will be printed if it is a printable character.



Example:

If the associated data character is not a printable character, a space (blank) will appear in the related position on the print line.

	Location					
	2000			2001		
Format Characters	(35)	(35)	(35)	(35)	(35)	(35)
Data Characters	27	25	12	02	02	05
Printer Characters	G	E		2	2	5
Printed Line	G	E		2	2	5

Ignore/Skip (octal 36)

When the format character is an Ignore/Skip the format character is deleted and a blank is inserted. The data character is then considered for storage in the print line buffer; however, it is not set to occupy the same position that the format character would have occupied; it is moved one position to the right.

Example:

The printer controller logic interprets an octal 36 as a no-action character and a space (blank) insertion. The associated data character will be printed in the next position to the right, if it is a printable character.

	Location					
	2000			2001		
Format Characters	35	35	(36)	35	35	35
Data Characters	27	25	40	02	02	05
Printer Characters	G	E	-	2	2	5
Printed Line	G	E	-	2	2	5

Example:

If the associated data character is not a printable character, two spaces (blanks) will appear in the related positions on the print line.

	Location					
	2000			2001		
Format Characters	35	35	(36)	35	35	35
Data Characters	27	25	12	02	02	05
Printer Characters	G	E		2	2	5
Printed Line	G	E		2	2	5

Delete (octal 37)

If the format character is a Delete, neither the format character nor data character is considered or stored in the print line image buffer; however, the next printable character is stored in its place. The next printable character can be in the format word or the data word.

Example:

The printer controller logic interprets an octal 37 as a Delete character. Neither the format nor data character is considered for storage and the next character is immediately read.

	Location						
	2000			2001			2002
Format Characters	35	35	37	40	35	35	35
Data Characters	27	25	60	21	02	02	05
Printer Characters	G	E		A	2	2	5
Printed Line	G	E	-	A	2	2	5

The format character following the Delete character is a printable character, therefore it is printed in the position that would have been occupied by the Delete.

Example:

When an octal 37 is the first character of a line of print, its associated data character is lost; the next printable character is printed.

	Location						
	2000			2001			2002
Format Characters	37	35	35	40	35	35	35
Data Characters	27	25	60	21	02	02	05
Printer Characters	G	E		A	2	2	5
Printed Line	E		-	A	2	2	5

Delete/Skip (octal 56)

If the format character is a Delete/Skip, the format and data character will be deleted and nothing will be printed in the position. A blank will be inserted.

Example:

The printer controller interprets an octal 56 as a deletion and a space (blank) insertion.

	Location						
	2000			2001			
Format Characters	35	35	40	02	56	35	
Data Characters	27	25	02	05	21	21	
Printer Characters	G	E	2	5	A	A	
Printed Line	G	E	-	2	2	5	A

The print line is established in the above example by the following interpretation:

F	F	F	F	F	F	
D	D	D	D	D	D	
G	E	-	2	2	5	A

Zero Suppress (octal 57 or 53)

Octal 57 is used to suppress a series of zeros in a data field from printing, and octal 53 is used to print a dollar sign and suppress zeros.

Once the zero suppression (octal 57) has been put into effect, the following sequence of events is initiated:

The related data character is not considered and, if it is a printable character, it is lost.

The next format character is considered and, if it is a printable character, it is stored in the print column corresponding to the zero suppress character.

Following the processing of the next format character, the printer controller inserts spaces in the print line columns for each zero data character, examining each format and data character until it detects either a period (octal 33) in a format word or a printable nonzero character in a data word, thus ending zero suppression.

Octal 53 in a format word is interpreted as a printable character and a Zero Suppress. Once zero suppression has been put into effect by an octal 53 (printable \$ sign), the following sequence of events is initiated:

A dollar (\$) sign is printed in the corresponding print column.

The related data character is considered and, if it is a printable nonzero character, it is stored in the next print column.

Following the printing of the dollar sign, the printer controller inserts spaces in the print line columns for each zero data character, examining each format and data character until it detects either a period (octal 33) in a format word or a printable nonzero character in a data word, thus ending zero suppression.

After zero suppression has been initiated by either octal 57 or 53 it has unique characteristics and can effectively be used when the programmer understands and uses it only in accordance with its proper application.

FIRST DATA CHARACTER--LOST. When octal 57 is detected, its related data character is not considered, and if a printable character, it is lost.

Example:

	2000			2001			2002	
	57	35	35	73	35	35	33	35
Format Characters	57	35	35	73	35	35	33	35
Data Characters	11	11	11	00	00	00	01	07
Printer Characters	9	9	9	0	0	0	1	7
Printed Line	9	9	,	0	0	0	.	1 7

FIRST DATA CHARACTER--PRINTED. When octal 53 is detected, a dollar sign (\$) is printed in its corresponding print column; and the related data character is printed in the next print column, if it is a printable character.

Example:

	2000			2001			2002		
	53	73	35	35	73	35	35	33	35
Format Characters	53	73	35	35	73	35	35	33	35
Data Characters	10	11	11	11	11	11	11	11	11
Printer Characters	8	9	9	9	9	9	9	9	9
Printed Line	\$	8	,	9	9	9	,	9	9 9 . 9 9

NEXT FORMAT CHARACTER--PRINTED. When octal 57 is detected, its related data character is not considered and the next format character is examined. If it is a printable character it is stored in the print column corresponding to the Zero Suppress.

Example:

	2000			2001			2002		
	57	13	35	35	35	35	35	35	35
Format Characters	57	13	35	35	35	35	35	35	35
Data Characters	00	00	00	00	04	05	06	06	07
Printer Characters	0	0	0	0	4	5	6	6	7
Printed Line	#			4	5	6	6	7	

FIRST PRINTABLE CHARACTER IS A PERIOD. When the first printable character is a period (octal 33) in a format word, spaces are inserted for each zero character until a period (octal 33) is detected.

Example:

	2000			2001			2002		
	57	35	35	35	33	35	35	35	35
Format Characters	57	35	35	35	33	35	35	35	35
Data Characters	21	00	00	00	11	11	11	02	03
Printer Characters	A	0	0	0	9	9	9	2	3
Printed Line				.	9	9	9	2	3

FIRST PRINTABLE NONZERO CHARACTER. When the first printable nonzero character is in a data word, spaces are inserted for each zero character until a nonzero character is detected in a data word.

Example:

	2000			2001			2002		
Format Characters	(57)	35	35	35	35	33	35	35	35
Data Characters	21	00	00	(04)	00	00	11	11	02
Printer Characters	A	0	0	(4)	0	0	9	9	2
Printed Line			4	0	.	0	9	9	2

COMMAS IN A FORMAT WORD. Commas are considered as space characters when zero suppression is in effect.

Example:

	2000			2001			2002				
Format Characters	(57)	(73)	35	35	(73)	35	35	33	35		
Data Characters	21	00	00	00	00	04	05	06	07		
Printer Characters	A	0	0	0	0	4	5	6	7		
Printed Line							4	5	.	6	7

COMMAS ARE PRINTABLE. Commas are printable when they follow a break in a Zero Suppress sequence.

Example:

	2000			2001			2002				
Format Characters	(57)	73	35	35	(73)	35	35	33	35		
Data Characters	21	00	01	02	03	04	05	06	07		
Printer Characters	A	0	1	2	3	4	5	6	7		
Printed Line			1	2	,	3	4	5	.	6	7

OCTAL 57 FOLLOWING OCTAL 57. Each Zero Suppress start is unique in that the start reinitiates the sequence of suppressing zeros whether or not zero suppression is currently in effect when the octal 57 is encountered. If zero suppression is in effect when the second octal 57 is encountered, the following format character, which normally could be printed prior to effecting this suppression, cannot be printed and only effects a space in the print column.

Example:

	2000			2001			2002		
Format Characters	(57)	(13)	35	(57)	(13)	35	35	35	35
Data Characters	00	00	05	00	00	00	03	02	01
Printer Characters	0	0	5	0	0	0	3	2	1
Printed Line	#		5	#			3	2	1

Example:

	Location								
	2000			2001			2002		
Format Characters	(57)	(13)	35	(57)	(13)	35	35	35	35
Data Characters	00	00	00	00	00	00	03	02	01
Printer Characters	0	0	0	0	0	0	3	2	1
Printed Line	#						3	2	1

OCTAL 53 FOLLOWING OCTAL 57. When octal 53 is encountered in a format word and zero suppression is currently in effect, zero suppression will be reinitiated; and the print column corresponding to octal 53 will be blank. The dollar sign will not be printed.

Example:

	Location								
	2000			2001			2002		
Format Characters	(57)	13	35	(53)	35	35	35	35	35
Data Characters	00	00	00	06	07	10	11	01	02
Printer Characters	0	0	0	6	7	8	9	1	2
Printed Line	#			6	7	8	9	1	2

OCTAL 53 WILL PRINT. A dollar sign will be printed when it is the next format character following an octal 57 or when it is the character initiating zero suppression.

Example:

	Location								
	2000			2001			2002		
Format Characters	57	(53)	35	35	33	35	35	35	35
Data Characters	21	00	00	00	00	01	02	03	04
Printer Characters	A	0	0	0	0	1	2	3	4
Printed Line	\$			.	0	1	2	3	4

OCTAL 53 AS A DATA CHARACTER. As a data character, octal 53 has no effect in suppressing zeros.

Example:

	Location								
	2000			2001			2002		
Format Characters	37	35	73	35	35	33	35	35	
Data Characters	00	(53)	00	00	00	11	11	11	
Printer Characters	0	\$	0	0	0	9	9	9	
Printed Line	\$	,	0	0	0	.	9	9	9

END OF PRINT LINE

To end a print line, a 1-bit (minus sign) must be placed in the sign bit position of the last data word for the print line. When the minus sign is encountered and after both the format word and data word characters have been considered, the print control sequence is ended, the printer mechanism starts printing the print line, and the printer controller is available to receive a new instruction.

When a print line uses the last available print column (120), the data word from which the last available print position is assigned must have a minus in the sign bit or the result of the print line may be completely erroneous. Format and/or data characters which would occupy positions beyond the last print column are discarded and are lost. For example, if the last word considered contains a character assigned to print column 120 and the sign bit has not been set, one of two erroneous conditions could be encountered: (1) print line characters can be garbled because the controller continues to request format and data words, or (2) an overlay of characters caused by the address counter running away.

When a print line does not use the last available print column (120), the last data word assigned to the print line must have a minus in the sign bit or the print line will be erroneous, because the printer control will keep attempting to completely fill the line from extraneous data.

OPERATING INSTRUCTIONS

In the following text, each instruction is introduced by a heading in the standard format shown in the example below. An explanatory key follows the example.

1
/

WRITE PRINT LINE				
WPL	M	X	26MMMM	
2	3	4	5	

1. Name of instruction (operation to be performed)
2. General Assembly Program mnemonic operation code
3. General Assembly Program Operand field symbol:
 - M indicates that the Operand field in this instruction is occupied by the address of a memory location (the address may be either actual or symbolic).
 - P indicates the priority control channel (0-7) to be addressed.
 - N indicates the number of lines for slewing.
 - K indicates the tape channel number for slewing.
4. General Assembly Program symbol X field:
 - X indicates that the address in the Operand field of the instruction may be automatically modified by using address modification words. Omission of this symbol indicates the instruction cannot be modified in this way.
5. Representation of the machine coding of the instruction in octal notation

SELECT

SEL	P	X	2500P20
-----	---	---	---------

This is the first word of a write or slew operation. It selects the printer controller connected to channel P for the operation indicated by an associated instruction.

Execution of the SEL instruction always sends the contents of the next two memory locations to the selected printer controller.

Execution of the SEL instruction also resets printer controller error conditions.

The format of the memory word for this instruction is as follows:

<u>Bit Position</u>	<u>Contents</u>
0-4	Operation code
5-6	Index
7-10	Must be zero
11-13	Channel number (0-7)
14-19	Suffix--operation code

WRITE PRINT LINE

WPL	M	N	26MMMMM
-----	---	---	---------

Print one line of data, no horizontal format control, starting at memory location M with 1 to 120 characters, and slew one line.

A WPL instruction cannot be address modified.

During assembly, the central processor automatically generates a one-line slew following the WPL instruction. If more than one line of slewing is desired or if special slewing (VFU) is desired, the programmer must set up a slew instruction for the vertical format. (See p. 30).

N indicates the data information is numeric only. If the X-field is left blank (absence of N), information is alphanumeric (BCD).

Example:

Print a line of data from memory location PRT (octal 1750) and slew 1 line. Printer controller is on priority control channel 6 of the central processor.

General Assembly Program coding

	Symbol						Opr				Operand								X
	1	2	3	4	5	6	8	9	10	12	13	14	15	16	17	18	19	20	
1							S	E	L	6									
2							W	P	L	P	R	T							
3							B	R	U	B	P	N							

Assembly:

<u>Memory</u>	<u>Contents</u>	<u>Coding</u>
01115	2500620	SEL 6
01116	2600000	WPL PRT
01117	0101750	Instruction word generated by General Assembly Program

Example:

Print a line of numeric data from memory location PRT (octal 1750) and slew one line. Printer controller is on channel 6.

General Assembly Program coding

14							B	R	U	*	-	1							
15							S	E	L	6									
16							W	P	L	P	R	T							N
17							B	R	U	B	P	N							

Assembly:

<u>Memory</u>	<u>Contents</u>	<u>Coding</u>
01115	2500620	SEL 6
01116	26①0000	WPL PRT
01117	0101750	Instruction word generated by General Assembly Program

indicates numeric data only to be printed

WRITE FORMAT LINE

WFL M 36MMMMM

Print one line of data using horizontal format control, starting at memory location M, 1 to 120 characters long, and slew one line.

A WFL instruction cannot be address modified.

During assembly, the central processor automatically generates a one line slew following the WFL instruction. If more than one line of slewing is desired or if a special slewing format (VFU) is desired, the programmer must set up octal instructions for vertical formatting. (See examples on page 30.)

This instruction must always be followed by a WPL instruction to specify the location of data in memory.

Example:

Print a line of data in horizontal format (stored location octal 2340) from memory location PRT (octal 1750), and slew 1 line.

General Assembly Program coding

	Symbol						Opr			Operand										X
	1	2	3	4	5	6	8	9	10	12	13	14	15	16	17	18	19	20		
1							S	E	L	6										
2							W	F	L	F	O	R	M	A	T					
3							W	P	L	P	R	T								
							B	C	S	P	N									

Assembly:

Memory	Contents	Coding
02120	2500620	SEL 6
02121	3602340	WFL FORMAT 2340 generated by General Assembly Program for the address of FORMAT words
02122	0101750	WPL PRT Generated instruction word for WPL PRT

SLEW PAPER N LINES

SLW	N	0600000
-----	---	---------

Slew paper N (0-63) lines.

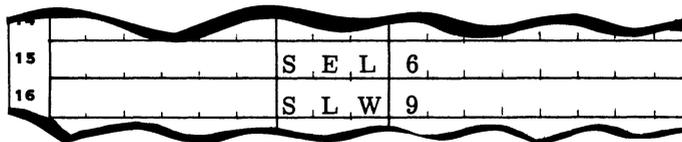
If the number of lines is greater than 31, the high-order bits will be in format word 1 and the low-order bits in format word 2.

Only 1 word of the SLW instruction is shown by the programmer, and the General Assembly Program automatically generates the other instruction word.

An SLW instruction cannot be address modified.

Example:

Slew paper 9 lines.



Assembly:

<u>Memory</u>	<u>Contents</u>	<u>Coding</u>
02144	2500620	SEL 6
02145	0600000	SLW 9
02146	1100000	

Word generated by General Assembly Program

Octal contents for SLW instructions:

0700000	SLW 32
0000000	
0600000	SLW 16
2000000	
0600000	SLW 8
1000000	
0600000	SLW 4
0400000	
0600000	SLW 2
0200000	
0600000	SLW 1
0100000	

TEST-AND-BRANCH INSTRUCTIONS

The following test-and-branch instructions test the printer controllers to determine whether a particular condition is true or false. If the condition tested is true, the central processor executes the next sequential instruction. If the condition tested is false, the central processor skips the next instruction and executes the second sequential instruction. The printer controller must be ready before any other branch condition is tested.

Each test-and-branch instruction is introduced by a heading in the standard format shown in the example below. An explanatory key follows the example.

BRANCH--PRINTER READY ¹					BRANCH--PRINTER NOT READY ¹				
BCS	BPR	P	2514P20		BCS	BPN	P	2516P20	
2	3	4	5		2	3	4	5	

1. Name of instruction
2. General Assembly Program mnemonic operation code
3. Operand field, the mnemonic code for the test to be performed
4. Channel number for the printer controller and the central processor priority control. In the General Assembly Program, this is coded in the symbol-X-field column.
5. Representation of the machine coding of the instruction in octal notation

BRANCH--PRINTER READY					BRANCH--PRINTER NOT READY				
BCS	BPR	P	2514P20		BCS	BPN	P	2516P20	

The printer controller is tested for a ready condition.

The printer controller is tested for a not ready condition.

Example:

Test the printer controller for ready status and, if ready, branch to symbolic memory location PRT.

Coding:

	Symbol					Opr					Operand										X
	1	2	3	4	5	6	8	9	10	12	13	14	15	16	17	18	19	20			
1							B	C	S		B	P	R						6		
2							B	R	U		P	R	T								
3																					
4																					
5																					

Assembly:

<u>Contents</u>	<u>Coding</u>
2514620	BCS BPR 6
2601750	BRU PRT

Example:

Test the printer controller for not ready status and, if ready, print a line of data from symbolic memory location OUTPUT. If not ready, delay.

Coding:

	<u>Symbol</u>						<u>Opr</u>				<u>Operand</u>										<u>X</u>
	1	2	3	4	5	6	8	9	10	12	13	14	15	16	17	18	19	20			
1							B	C	S	B	P	N									6
2							B	R	U	*	-	1									
3							S	E	L	6											
4							W	P	L	O	U	T	P	U	T						
5																					
6																					

Assembly:

<u>Memory</u>	<u>Contents</u>	<u>Coding</u>
01113	2516620	BCS BPN 6
01114	2601113	BRU *-1
01115	2500620	SEL 6
01116	2600000	WPL OUTPUT
01117	0101373	

BRANCH--PRINTER OUT OF PAPER

BRANCH--PRINTER NOT OUT OF PAPER

BCS	BOP	P	2514P22	BCS	BNP	P	2516P22
-----	-----	---	---------	-----	-----	---	---------

The printer controller is tested for the printer out-of-paper condition.

The printer controller is tested for the printer not-out-of-paper condition.

Example:

Test the printer controller for an out-of-paper condition. Branch to PAPER if condition exists.

Coding:

	<u>Symbol</u>						<u>Opr</u>				<u>Operand</u>										<u>X</u>
	1	2	3	4	5	6	8	9	10	12	13	14	15	16	17	18	19	20			
1							B	C	S	B	O	P									6
2							B	R	U	P	A	P	E	R							
3																					
4																					

Assembly:

<u>Contents</u>	<u>Coding</u>
2514622	BCS BOP 6
2603613	BRU PAPER

The out-of-paper condition is indicated when only a few inches of paper remain.

BRANCH--PARITY ERROR

BRANCH--NO PARITY ERROR

BCS	BER	P	2514P27	BCS	BNE	P	2516P27
-----	-----	---	---------	-----	-----	---	---------

The printer controller is tested for a parity error.

The printer controller is tested for no parity error.

Example:

Delay until the printer completes the printing of a line, then test for parity error condition. If any exists, branch to symbolic memory location PRT ERR.

Coding:

	Symbol						Opr			Operand										X	
	1	2	3	4	5	6	8	9	10	12	13	14	15	16	17	18	19	20			
1							B	C	S	B	P	N									6
2							B	R	U	*	-	1									
3							B	C	S	B	E	R									6
4							B	R	U	P	R	T	E	R	R						
5																					

Assembly:

Contents	Coding
2516620	BCS BPN 6
2601113	BRU *-1
2514627	BCS BER 6
2601492	BRU PRTERR

PROGRAMMING CONSIDERATIONS

Printing All Numerics

It is possible to program the reader to print only numeric characters, slew a maximum of three lines, and retain a printing speed of 900 lines per minute. When coding the WPL instruction, if N is indicated in the X-field on the General Assembly Program coding sheet, the program interprets this to indicate all numeric printing and will generate a 1 in bit position 5 of the first generated word.

Note: Alphabetic characters included as part of the print line data may or may not be printed, depending upon where on the print wheel the print cycle starts. In the print all numerics mode, the print cycle always ends when all numeric characters have been printed. All alphabetic characters in the print line may not have been printed.

Ignore and Ignore/Skip as Data Characters

In the process of examining a format word character, then a data word character, it is possible for an Ignore (octal 35) or an Ignore/Skip (octal 36) character to be encountered in the print line data (as well as in the format control data). If a data character is an Ignore, the next format character is immediately considered and nothing is printed for the Ignore character. If a data character is an Ignore/Skip character, a blank is printed and the next format character is considered.

Using Ignore and Ignore/Skip characters in the data line makes it possible for a print line format arrangement to be stored in memory once and be used as often as needed to print lines of data in that same format.

Example 1:

If a data character is an Ignore, the next format character is immediately considered and nothing is printed for that data character.

Format Characters	35	35	35	35	35	35
Data Characters	27	25	35	02	02	05
Printer Characters	G	E		2	2	5
Printed Line	G	E	2	2	5	

Example 2:

If a data character is an Ignore/Skip, a blank is printed and the next format character is considered.

Format Characters	35	35	35	35	35	35	35
Data Characters	27	25	36	40	02	02	05
Printer Characters	G	E		-	2	2	5
Printed Line	G	E		-	2	2	5

Nonformatted Printing

Each word stored in memory of the central processor contains three 6-bit BCD characters; therefore, it will take 40 stored words of information to print a full 120-column line. The sign bit of the stored data word containing the last character to be printed in the print line must be set. If the last character to be printed on the line happens to fall in bits 2-7 or 8-13, the unused characters in the word must contain an octal 35 or octal 60.

The print line data must be stored in sequence starting at the address given in the first command word.

Vertical Format Control Coding

A one-line slew is generated with either a WPL or WFL instruction to slew after printing a line. If it is desired to slew more than one line after printing, a separate slew instruction must be programmed. It is possible to combine printing and slewing of more than one line by coding the print line and loading it into the user's program in octal form.

Example:

Coding for printing from address 1350 and slewing 24 lines by the countdown method (see page 11).

10		S E L	6		
11	P R L I N E	O C T	2 6 0 0 0 0 0		
12		O C T	3 0 0 1 3 5 0		
13					

<u>Contents</u>	<u>Coding</u>
2500620	SEL 6
2600000 PRLINE	OCT 2600000
3001350	OCT 3001350

Example:

Coding for printing from address 2150 and slewing to tape channel 3 by VFU (see page 11).

15		S E L	6		
16	V P R L N	O C T	2 0 0 0 0 0 0		
17		O C T	0 4 0 2 1 5 0		
18					

<u>Contents</u>	<u>Coding</u>
2500620	SEL 6
2000000 VPRLN	OCT 2000000
0402150	OCT 0402150

TIMING CONSIDERATIONS

The following is the effective lines-per-minute print speed when a Print and Slew N Lines print command is given. Time shown is for alphanumeric data.

<u>Skip N lines after print</u>	<u>Lines/minute print speed</u>
1	915
2	735
3	663
4	618
5	580
10	451
15	366
20	308
25	268
30	240



3. OPERATING THE PRINTER SUBSYSTEM

PRINTER CONTROLLER

The printer controller consists of the electronic elements to perform the function of controlling the operation of the printer mechanism. It receives and interprets all instructions received from the central processor, accumulates and stores both format and data characters to be printed.

Three operations can be performed manually at the printer controller's control and indicator panel:

1. Slew to top of a page
2. Print out a central processor memory dump starting at memory location zero
3. Stop any print or slew function by means of the MANUAL CLEAR switch. (This is not an orderly halt and will destroy information.)

The control and indicator panel contains five indicator lights and six switches, illustrated in Figure 6.

Indicators

The indicators give the operator information about the controller and printer operations.

READY When this white indicator is illuminated, it indicates the subsystem is ready to be addressed from the central processor.

PARITY ALERT When this blue indicator is illuminated, it indicates that a parity error has been detected. The indicator remains lit until it is manually reset by the MANUAL CLEAR switch. (This error condition is recoverable, if programmed.)

PAPER ALERT When this blue indicator is illuminated, it indicates the status of the paper sensing mechanisms in the printer assembly. The indicator is activated by two sets of micro-switches on the printer to detect either the presence of paper or insufficient paper tension or broken paper form. Paper must be in the printer and sufficient tension applied vertically to extinguish the indicator.

OFF LINE When this white indicator is illuminated, it indicates the printer is disconnected from the central processor.

HAMMER FUSE When this red indicator is illuminated, it indicates the failure of one or more of the protective fuses on the hammer drive cards in the printer. The 120 hammers are logically controlled from 24 cards, each of which contains a protective fuse and the control for 5 hammers. Under certain conditions it is possible to overload the logic circuits controlling the hammers, thus blowing a fuse and making a group of five hammers inactive. This condition is detectable by the hammer fuse indicator or by examining the printout on the printer.

Switches

The switches on the control and indicator panel are as follows:

POWER ON This switch applies DC power to the entire printer subsystem.

POWER OFF This switch first removes power from the printer, and when the printer power supply is deactivated, from the controller.

ON LINE/OFF LINE When this two position switch is depressed for off-line operations, the OFF LINE indicator becomes lit, the READY indicator is turned off, and the printer cannot be selected for operation by the central processor. After switching back to ON LINE, the MANUAL CLEAR switch will condition the subsystem for ready.

SLEW TOP PAGE When this switch is depressed the printer begins to slew paper continuously until stopped by one of the three following conditions:

1. If the vertical format unit (VFU) has no tape in it and the photodiodes block is shielded from the light source, the paper slews until stopped by the operator's manual depression of the MANUAL CLEAR switch.
2. If the VFU has no tape in it and the light source is not shielded from the photodiodes, paper slews one line and stops of its own accord.
3. If the VFU has a tape loop punched in channel 8, paper slews until it senses a hole in channel 8 (Top of Page).

MEMORY DUMP Depressing this switch causes the printer to advance paper to VFU channel 8 and to print the contents of the central processor memory, starting with memory location zero. The printout consists of seven octal digits per memory word, and there are eight words per printed line. The memory dump does not halt when all locations have been printed, but will cycle back to location zero and repeat. The only way to halt the dump is by depressing MANUAL CLEAR.

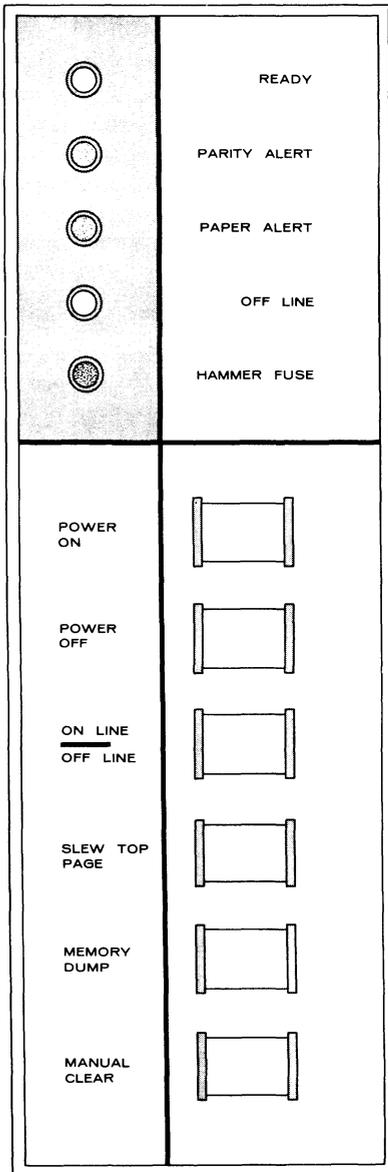


Figure 6. Control and Indicator Panel, Printer Controller

MANUAL CLEAR Depressing this switch stops paper movement and printing and clears the registers and buffers of the controller. This should not be used for an orderly halt.

PRINTER

The printer is an electromechanical device for rapidly printing either numeric or alphanumeric characters. The operator can control paper tension, print quality, and the position of the printed line by making adjustments to the following major assemblies.

Paper Feed Mechanism

The paper feed mechanism controls the flow of paper through the printer. It consists of electrically activated drive and brake clutches for the tractor feed assembly and the VFU.

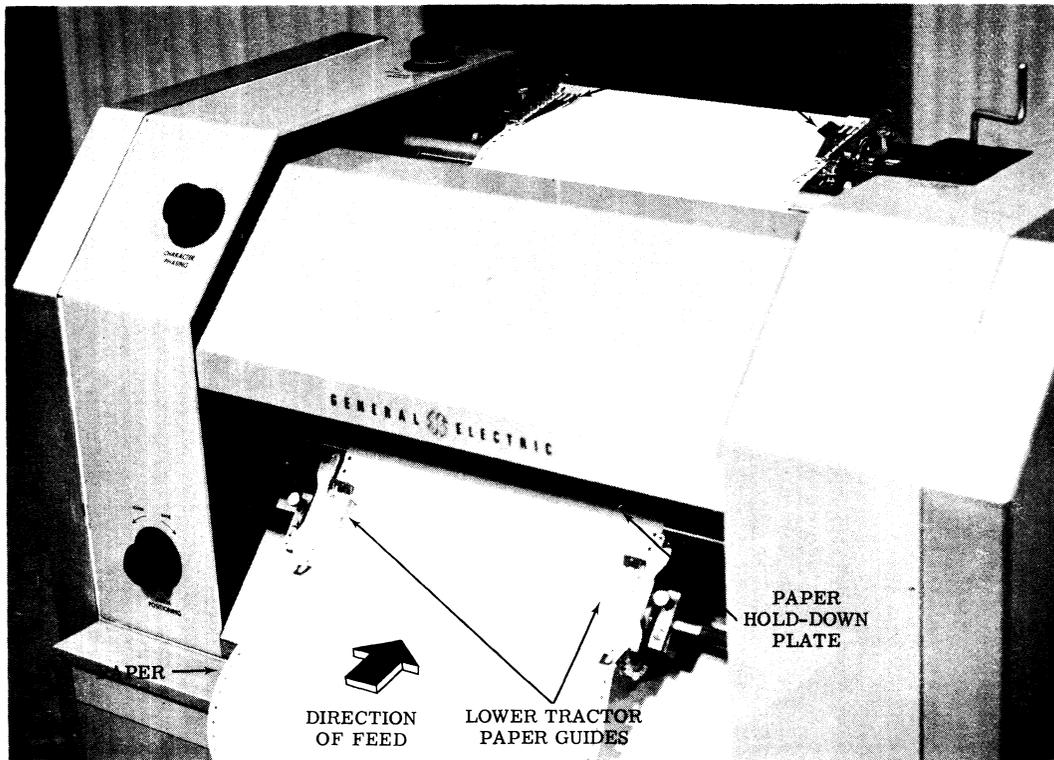


Figure 7. Tractor Feed Mechanism

TRACTOR FEED ASSEMBLY. The tractor feed assembly (see Figure 7) consists of an upper and lower set of paper sprocket and tractor guides. The sprockets drive the paper forward by engaging perforations in the continuous form paper, and holds the paper stationary during printout.

VERTICAL FORMAT UNIT MECHANISM. The vertical format unit (VFU) mechanism (see Figure 8) controls the feeding and sensing of a punched tape loop used to slew paper to a predetermined vertical format. The format wheel is geared to the paper feed shaft and turns an amount proportional to the advance of paper for the printing of each line. The turning of the format wheel feeds the format tape over a light source and eight format sensing photodiodes. When the punched format tape is inserted between the light source and the sensing photodiodes, each column of holes on the tape is aligned to pass above a sensing photodiode. The program uses the Slew to Tape (SLT) instruction to activate the VFU. The spacing of the holes in the channels (columns) of the format tape determine the number of lines to be skipped during printing. Each of the eight channels of holes in the format tape may contain a different print pattern, so as many as eight vertical formats may be available on each tape. The program instruction SLT determines which of the eight photodiode circuits is to be closed, thus which photodiode is to be activated. When the photodiode senses light and detects the proper hole, a signal is generated to halt the slew operation. Directions for making a VFU tape are given on page 40.

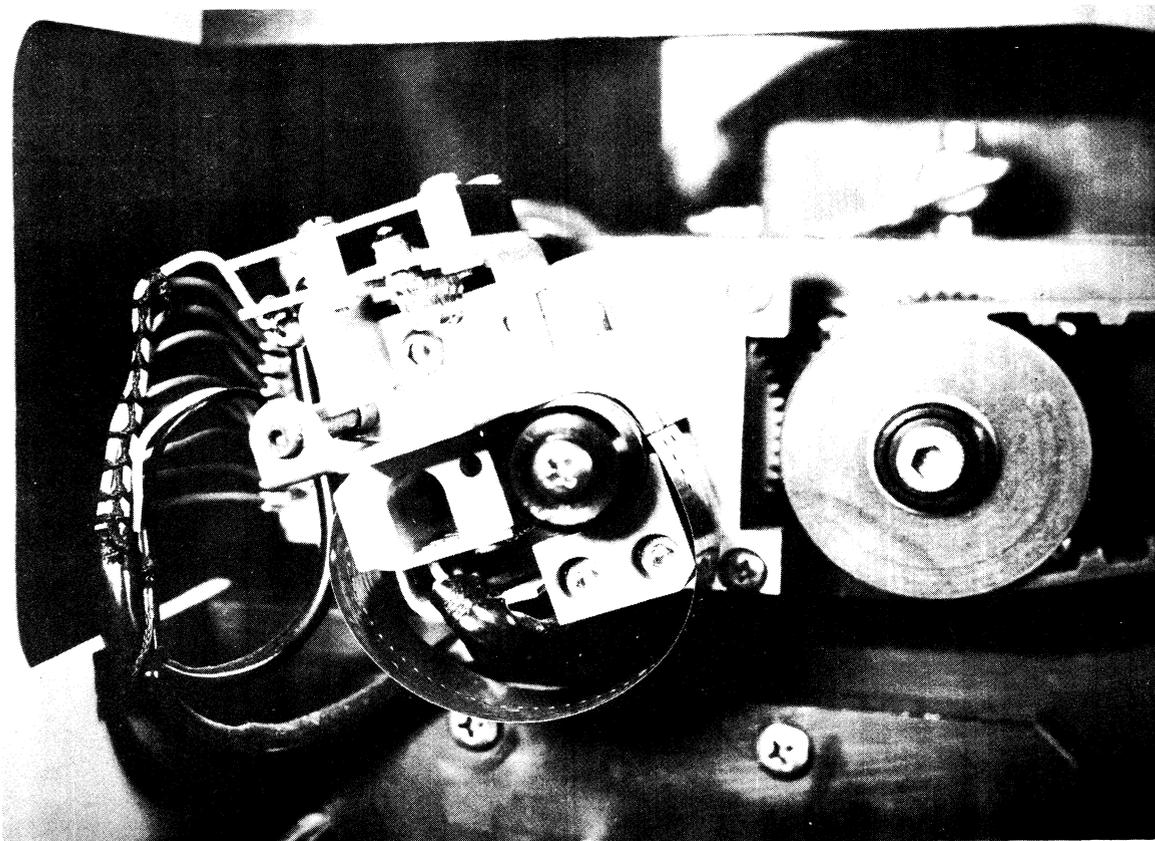


Figure 8. Vertical Format Unit (VFU) Mechanism

Ribbon Feed Mechanism

The ribbon feed mechanism controls the advancement of inked ribbon between the paper and the print wheel drum. It consists of an inner and an outer roll, driven one at a time by an electric motor through gears and magnetic clutches. One roll winds ribbon, while the other feeds ribbon; the rolls turn in opposite directions. The direction of ribbon flow is automatically reversed when the ribbon approaches the end on a roll.

Print Wheel Drum and Hammer Assembly

The print wheel drum is a long cylindrical roll which rotates. It contains 26 alphabetic, 10 numeric, and 14 special characters arranged in longitudinal rows around circumference. Each row contains just one character repeated 120 times across the length of the roller; since there is a row for each character, there are 50 rows. A unit of 120 self-contained hammers is located directly under the print roll, and the paper and the ribbon pass between the print roll and the hammer assembly.

As an example of print wheel operation, at the time the row of A's approaches the hammers, the controller scans the core buffer for all the A's for one line of print. At the proper time, and when paper motion has stopped, the controller sends out a series of signals to the printer which activate the hammers for printing the A's of the line. Next, timing calls for the printing of all

the B's on the line. When the print wheel has made one revolution, all characters in the line have been printed, and it is time for the paper to slew to the next line position, where the next revolution of the print wheel prints that line. The print wheel rotates continuously but the paper stops each time a line is printed. The print wheel is protected by a large cylindrical ribbon guide.

SYNCHRONIZING PULSE GENERATOR. The rotor of the synchronizing pulse generator is mounted on the print roll shaft. It provides accurately timed signals to the printer controller, indicating when a character row is in printing position.

Controls and Adjustments

The operator may control paper tension, print quality, and the position of the printed line by adjusting the following:

PAPER TENSION KNOB. The paper tension knob (see Figure 9) controls the distance between the corresponding sprockets on the upper and lower tractors of the tractor feed assembly to increase or decrease paper tension. Caution: If this knob is forced beyond its normal stops, it will become inoperative. The normal operating range is $\pm 1/2$ inch of form movement.

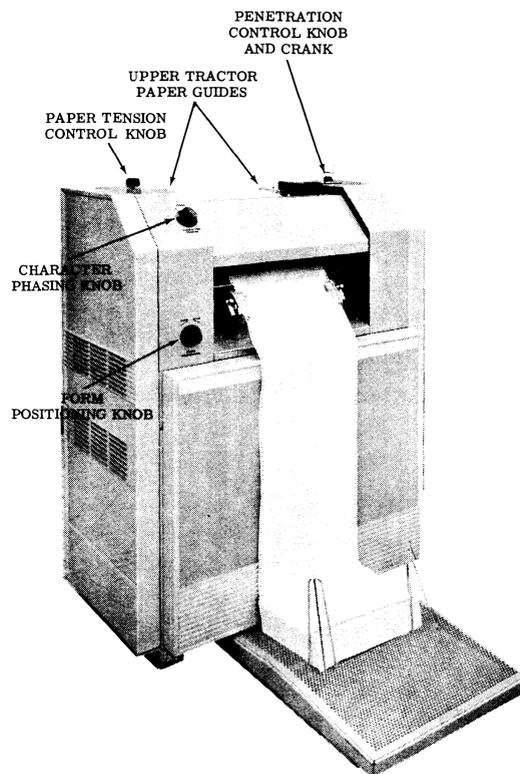
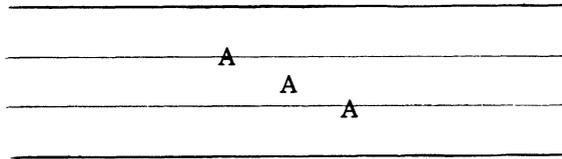


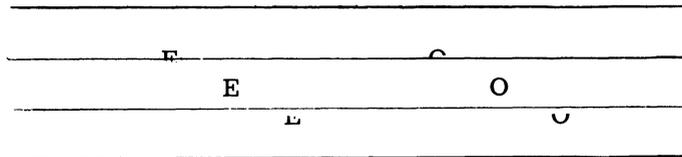
Figure 9. Controls and Adjustments

FORM POSITIONING KNOB. The form positioning knob (Figure 9) provides a means of raising or lowering the paper tractor sprockets of the tractor feed assembly to vary the vertical position of the print line. Turning the knob clockwise raises the paper in relation to the print hammers,

thus effectively lowering the print line on the paper. The following is an example of correct and incorrect positioning, and the type of variation which can be made with the form positioning knob. Only the center letter is correct. Improper positioning prints the whole letter improperly on the paper. Caution: If this knob is forced beyond its normal stops, it will become inoperative. The normal operating range is $\pm 1/2$ line of character movement. Increased adjustment is possible by moving the VFU loop.



CHARACTER PHASING KNOB. The character phasing knob controls the timing of the character synchronizing pulses from the printer. At the time of printing a line, the printer controller is synchronized with the print wheel rotation. Timing signals generated by the wheel are used for part of this synchronization. The generated signals control the exact time during which the selected hammers are activated. Because this synchronization system is partly mechanical, a certain amount of play is inevitable, so the character phasing knob is made available for operator adjustments. This knob normally needs adjustment only when there is a change from single copy to multiple copy paper. The following illustrates correct and incorrect positioning which can be adjusted with the character phasing knob. With incorrect positioning, characters lose either their tops or their bottoms, or, when completely out of adjustment, print the character either side of the one meant to be printed. For example, an A or C instead of a B.



PENETRATION CONTROL KNOB. The penetration control knob and crank adjusts the spacing between print hammers and the print wheel to vary the density of print and adjust for paper thickness and number of carbon copies. A maximum of five carbons may be used.

The knob is marked with 10 settings; lower numbered settings make print heavier, and higher settings (toward 10) make print lighter. The knob is turned by means of the crank behind it. A stop is built in to prevent the hammers from being brought too close to the print wheel. **Caution:** Do not force this control beyond its normal stop, as damage could possibly result to the printer.

Margin adjustments are made with each of the four paper drive tractors that can be moved to the right or left to be positioned properly on either edge of the paper. Loosening the tractor lock (see Figure 10) permits margin guide movement. The fine adjustment (after tightening the tractor lock) can be made with the adjustment wheel. Turning the adjustment wheel toward the operator moves the margin guide to the left; turning it away moves the guide to the right. Paper can be tightened by moving the guides on opposite sides of the paper away from each other, and paper can be made less taut by moving the guides toward each other.

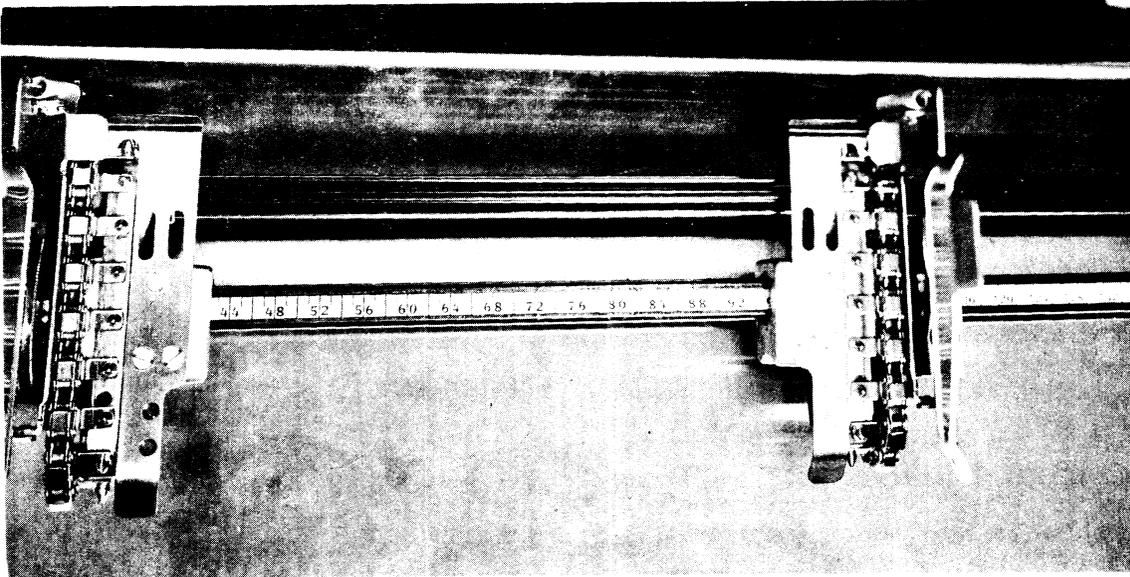


Figure 10. Paper Drive Tractors

SETUP PROCEDURE

Steps for preparing the printer subsystem for on-line operations are as follows (unless specified otherwise, controls and indicators referred to are on the printer controller's control and indicator panel):

1. Depress POWER ON switch to turn power on after cycling up power.
2. Depress the MANUAL CLEAR switch to clear the buffer in the printer controller.
3. Select and load proper VFU tape loop.
4. Depress the SLEW TOP PAGE switch to synchronize the VFU tape with the tractors and thereby position the VFU tape loop. Check ribbon movement.
5. Load paper and check that sufficient paper is available. Position paper on tractors so that printing will start in the correct position on the form.
6. Readjust the paper forms according to a predetermined mark for the top of page by removing the paper from the tractors and repositioning as needed. Fine adjustment then may be made with the FORM POSITIONING knob.
7. Adjust paper tension as necessary.
8. Select or check ON/OFF LINE mode.
9. If number of parts of forms is changed from last setup, check CHARACTER PHASING.
10. Check that all alert indicators are out.
11. Check that the READY indicator is on.
12. Depress the MANUAL CLEAR switch to ready the controller circuitry for data reception as indicated by the READY indicator being lit.

END OF PRINTING

1. Depress MANUAL CLEAR switch.
2. Depress POWER OFF switch.

SPECIAL PROCEDURES

VFU Loop Construction

To prepare a loop, obtain the vertical format directions from the program run book or other operating instructions for the program to be run. In making the loop follow these steps:

1. Count number of lines on the paper form to be used (66 on a normal 11-inch form).
2. Cut starting end of loop material on an angle at the midpoint between the sprocket holes.
3. Count out sprocket holes equal to the number of lines in step 1; then count three extra holes. The number of sprocket holes on the tape should equal the number of lines for the longest form plus three (for overlap at the splice). The number of lines on a form may be obtained by multiplying the length of the form (in inches) by the number of lines of paper feed per inch (6 in this case).

For example, an 11-inch form has 66 lines and therefore 69 sprocket holes. Since the tape must be long enough to loosely loop around the format light source, it may be necessary to multiply the number of sprocket holes for a short form by two or three before adding the three holes for overlap. For example, a 4-inch form cut to 3 form lengths has a tape length of $(4 \times 6 \times 3) + 3 = 75$ sprocket holes.

4. Cut loop material on an angle near the point found in step 3.
5. Punch desired VFU channel holes in the strip with the aluminum colored side face down on the punch block. Avoid punching any holes within 4 sprocket holes of either end. Position the tape so that the sprocket hole which is to represent the first line of print is over a punch guide hole (Figure 11). Note that the distance from the punch guide holes to the first sprocket pin is 8 sprocket holes on the tape and the distance from the first to the second and from the second to the third sprocket pin is also 8 sprocket holes.

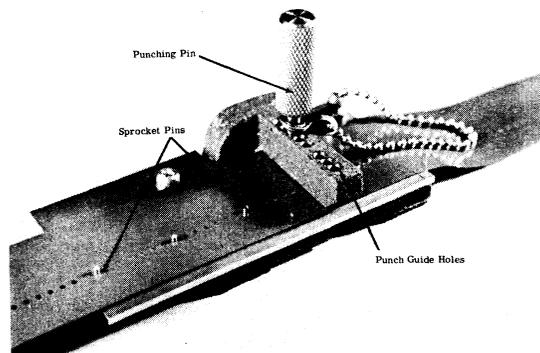


Figure 11. Hand Punch for a Vertical Format Loop

Place the punching pin in the hole corresponding to the channel to be used for controlling the slew to the top of the page and press the punch pin until it punctures the tape. It is customary to use channel 8 for controlling the slew to the top of the page. Channel 8 is on the edge of tape farthest from the sprocket holes, as illustrated in the tape sample (Figure 12). Carefully lift the tape off the sprocket pins and advance it through the hand punch until the next punching position is reached.

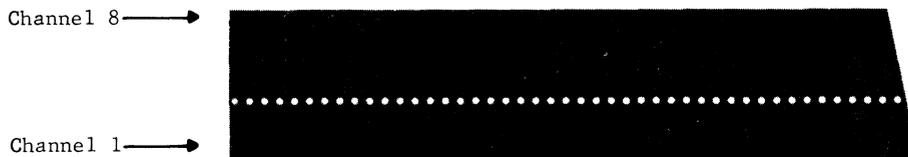


Figure 12. Tape for Vertical Format Loop

6. Repeat the hole-punching procedures in the line locations and channel positions specified in the program operating instructions. Small grease pencil markings made at strategic places on the tape may prevent losing hole count during tape advancement, but the markings must be removed after the tape is punched.
7. Using the punch block pegs to maintain alignment, form the loop (aluminum to the inside) by overlapping the two ends by three sprocket holes.
8. Sandwich a small piece of double coated Scotch Brand tape No. 665 between the overlapped tape. Trim the excess tape with razor blade. The VFU loop is ready to use immediately.

An alternate method of splicing tape is to glue the overlapped tape using Pliobond adhesive sparingly. Press down on the splice while in alignment on the punch block pegs. Remove tape from pegs and clean off excess glue; care should be exercised to prevent glue from filling the holes. Cure the tape for 12 to 24 hours before using.

Loading VFU Loop

The VFU tape loop may contain all or part of the vertical format of print out. The format control unit is located on the left-hand side of the printer near the back. A sprocket wheel drives the tape (see Figure 13). The plate or mounting block is hinged and has a retractor knob extending below the sprocket. By turning the knob, the pressure plate can be moved up and away from the sprocket, allowing the format tape to be slipped on or off.

1. Raise the tape pressure plate away from the sprocket hub using the retractor knob.
2. Place paper tape loop over the vertical format unit. The tape is placed over the sprocket wheel with the wider section (5 channels) nearest the printer frame.
3. Fit the tape sprocket holes onto the sprocket wheel. If the tape is minimum length (capacity for one 11-inch page--66 lines) it will fit comfortably over the sprocket wheel and the tape guides above the wheel. If the tape is longer the slack will fall loosely below the sprocket wheel. The channels are in numeric sequence with number one channel being farthest from the printer frame.
4. Lower the pressure plate into place in contact with the paper tape loop.

If no tape is installed in the VFU, return the pressure plate to the operating position so that light shines on the photodiodes to prevent paper runaway if printing is accidentally started.

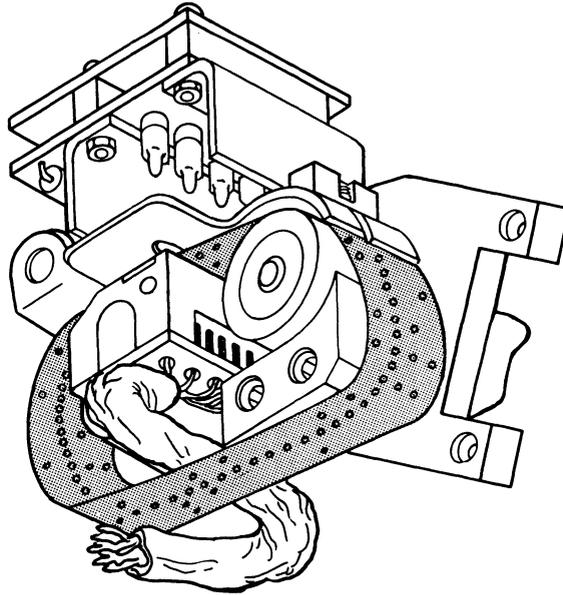


Figure 13. Vertical Format Loop

Loading Paper

In each of the paper tractors is a paper adjustment thumb screw or lever which allows the tractors to be moved laterally (along the line of print). Loosening the screw or lever allows the tractors to be adjusted to the right or left as situation may require. A fine adjustment may be made by turning the serrated vertical wheel on each tractor (see Figure 14).

1. Lower the hammer mounting plate by turning the PENETRATION CONTROL crank counterclockwise four or five turns. This backs off the hammer mounting plate sufficiently to allow paper to be passed easily between the print roll and the hammer mounting plate.
2. Line up the left-hand tractors to the desired position by referencing the column numbers on the tractor mounting shaft. Tighten down the adjustment screws.
3. Insert the paper in the machine by passing it over the lower tractors, between the hammer mounting plate and the print roll and between the upper tractors and the transparent plastic scale. Clamp the paper in the left-hand tractors.
4. Line up the right-hand tractors to fit the size paper being used.
5. Crank the hammer mounting plate into the printing position with the PENETRATION CONTROL crank. The paper is ready for printing.
6. If the horizontal positioning is not exact, steps two and four must be repeated until proper positioning is accomplished.

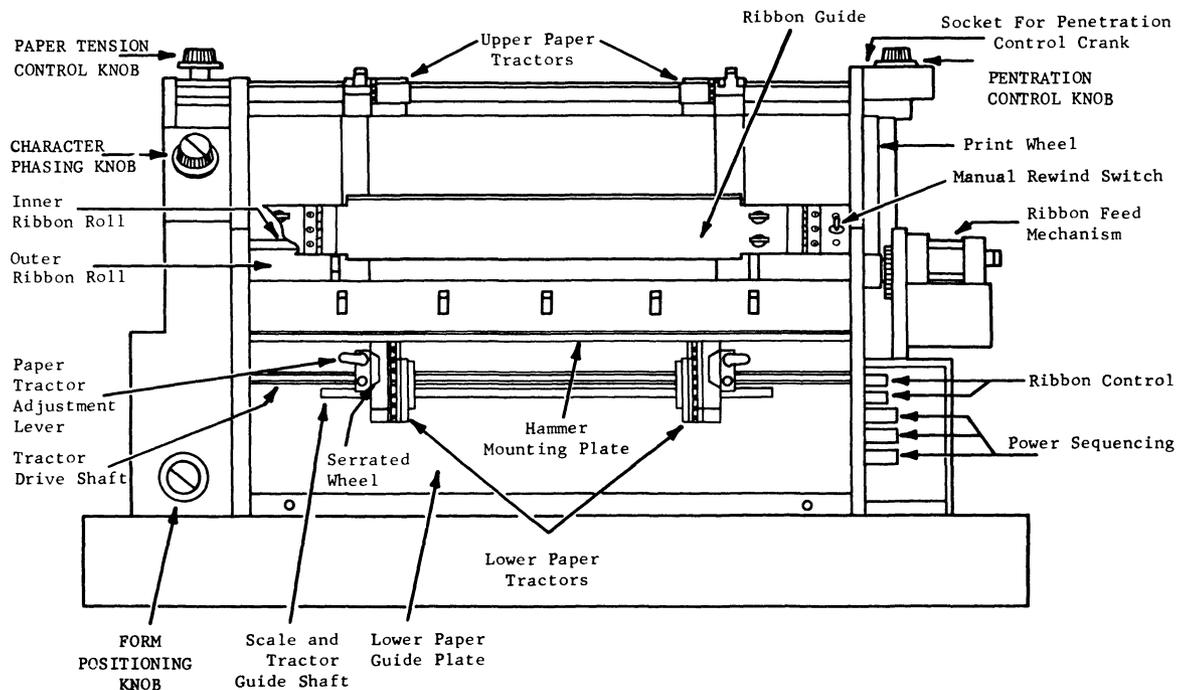


Figure 14. Printer Assembly

7. Turn the PAPER TENSION CONTROL knob clockwise to increase tension on the paper between upper and lower tractors. This tension should be such that there is a slight elongation of the holes at both upper and lower tractors. Excessive elongation is undesirable as paper tearing is likely. This step may be accomplished effectively only after the hammer mounting plate is in position for printing.

ADJUSTING VERTICAL POSITION. When adjusting the vertical position of paper do not force the FORM POSITIONING knob beyond the stops.

1. Paper can be adjusted within plus or minus 1/2 a line during printing to position printed copy exactly on lines of form.
2. To lower paper, turn FORM POSITIONING knob clockwise. To raise paper, turn the knob counterclockwise. Several turns of the knob are required to move the paper a distance of one-half line. By this means the printing may be placed exactly on the form lines.

Caution: Do not force knob beyond the normal stop limits.

INSTALLING PRINTED FORMS. This procedure consists of adjusting the vertical format tape and paper tractors so that a line of printing will fall on a desired line on the printed form.

1. Depress SLEW TOP PAGE switch. This causes the tractors to advance to the proper position for the form and stops the vertical format tape in the starting position.

2. If the locating mark is already printed on the form, place this mark on the tear strip (six inches above the first line to be printed). Familiarity with the form may allow counting the sprocket holes extending above the tractors or in relation to the tractors.
3. Open the tractors and place paper form on tractors so that locating mark aligns with black line on either of the upper tractors or the correct relation of the upper sprocket holes to the tractors is obtained.
4. For final adjustment of preprinted lines with respect to printed copy, make vertical adjustment of paper, as necessary.

Caution: It is not recommended that the printer be operated with single part paper of less than 20 pound weight (0.004 inch minimum thickness) nor with multiple part paper of less than a total of 0.004 inch thickness.

The PAPER TENSION knob has a total turn capacity of 12 complete turns from stop-to-stop. The FORM POSITIONING knob has a capacity of 16 turns stop-to-stop. Set these knobs midway in their range for best operation. Do not attempt to force them beyond their normal stop positions or damage to the controls may result.

A check is made by the printer for presence of paper. When an out-of-paper condition is detected, the printer stops upon completion of the form being printed.

Changing the Printer Ribbon

The ribbon feed assembly is mounted on the upper front portion of the printer (Figure 15). It provides means of moving the ribbon between print wheel and paper. Reversal of ribbon travel is effected automatically as the ribbon on either roll becomes exhausted (see Figure 14).

The assembly consists basically of a supporting frame, upper and lower ribbon rolls, drive motor and two clutch-brakes. The drive motor is a speed reducer motor with an output speed of 23 rpm. Gear ratio from motor pinion to ribbon rolls is such that the ribbon moves at approximately 40 inches per minute.

Each ribbon roll is driven by a clutch-brake. The clutches function alternately, one always driving and the other acting as a brake. Alternate energization and de-energization of the clutch relays depends upon the action of two microswitches which are controlled by respective ribbon roll diameters via two sensing paddles. The switches are so arranged that as minimum diameter of either ribbon roll is reached, clutch circuit connections are reversed and the clutches exchange functions.

The ribbon for the printer is supplied on a hollow mandril (Figure 14) and has a cardboard leader on each end. The leader is secured to the mandril with masking tape, and the ribbon mandrils are supported on each end by metal hubs. The left hubs are spring-loaded to allow removal and installation; each of the right hubs has a pin protruding to fit into slots in the ends of the mandrils. These hubs provide the drive for the ribbon. Between the right hubs are two ribbon-sensing feet (Figure 16). These feet and associated switches are the means by which the printer determines when to reverse ribbon direction.

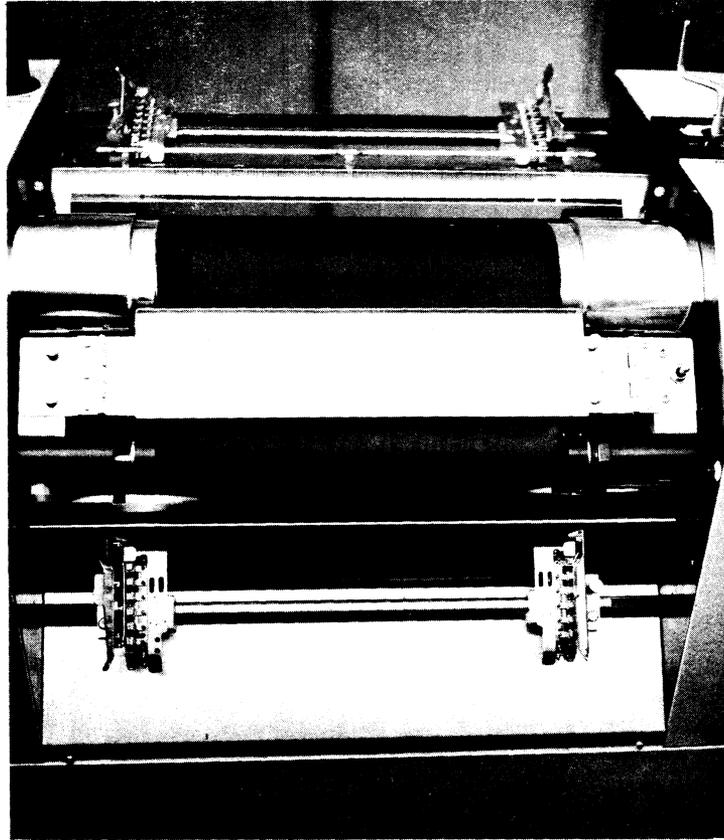


Figure 15. Printer Ribbon Assembly

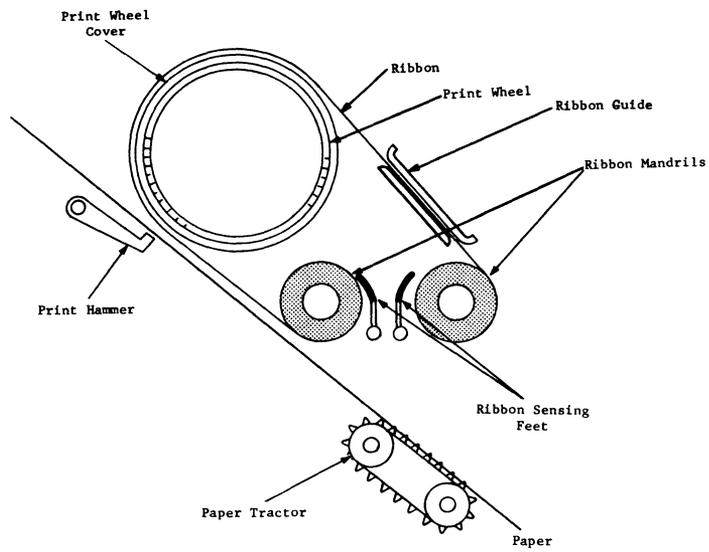


Figure 16. Printer Mechanism, Side View

REMOVING A RIBBON. Remove the worn ribbon from the printer as follows (unless specified otherwise, controls and indicators referred to are on the control and indicator panel of the printer controller):

1. Remove the sloping center panel from the front of the printer mechanism.
2. Release the hinged cover plates on the upper and lower tractor paper guides and remove the paper.
3. Turn the printer **PENETRATION CONTROL** crank counterclockwise approximately 10 turns to lower the hammer mounting plate.
4. Release the two thumbscrews on the ribbon guide.
5. Swing hinged section of ribbon guide to the left to a near vertical position.
6. Use the toggle switch on the righthand side of the ribbon guide to wind all the ribbon onto one mandril.
7. When one mandril is clear of ribbon, remove the leader by pulling the masking tape loose. Continue to wind until the leader is wound around the ribbon.
8. With the ribbon completely removed from one mandril, grasp the outer mandril at both ends and push it to the left. The spring-loaded left hub allows the mandril to travel far enough to clear the right hub. The mandril can now be removed by pulling the right end out to clear its hub. Caution: Do not place excessive pressure on the ribbon-sensing feet when removing and installing ribbon mandrils.
9. Repeat the procedure in step 8 to remove the inside mandril. The ribbon may be on either mandril.

INSTALLING A NEW RIBBON. Install the new ribbon using essentially the reverse procedure for ribbon removal, observing the following:

1. Place the new ribbon on the inside left hub and push to the left until there is enough clearance to place the ribbon mandril over the right hub, being careful not to put excess pressure on the ribbon-sensing feet. The drive pin on the right hub must engage the slot in the end of the mandril.
2. Feed the ribbon leader under the print wheel unit. Pull the ribbon up and over the print wheel cover.
3. Install the empty mandril on the other hub as in step 1.
4. Thread the ribbon through the ribbon guide.
5. Affix the ribbon leader to the empty mandril with masking tape, making sure that the ribbon is centered and will drive straight.
6. Use rewind switch to start ribbon.
7. Lower upper ribbon guide plate and tighten thumbscrews.
8. Observe the movement of the ribbon-sensing feet and be sure they are not caught under the ribbon.

9. Observe the ribbon winding to see that it is operating properly.
10. Turn the printer PENETRATION CONTROL crank clockwise until it is snug to return the print wheel to its normal position.
11. Reinstall the sloping center panel on the front of the printer mechanism.

Memory Dump (Manual)

A complete memory dump may be obtained at any point in a program to provide an octal representation of all information in computer memory, beginning at location zero. Quite often, a service routine is used to obtain the memory dump, but the routine itself is read into the lower 100 or 200 memory locations. Information in those locations must be obtained by the manual dump method or else it will be lost.

There is an advantage in using a service routine instead of the manual dump, for the routine adds the notation of the memory location after every eighth word. The steps in manually obtaining a dump are as follows (switches referred to are on the control and indicator panel of the printer controller):

1. Depress the MEMORY DUMP switch to start the printout.
2. Depress the MANUAL CLEAR switch when the printout has reached the place where you want to stop it. The printout never stops by itself, and repeats the whole memory dump over and over if not stopped by the operator.
3. If you are using a service routine, finish the dump with the routine.

OPERATOR RESPONSIBILITIES

The printer subsystem requires only minor maintenance during normal operations, in addition to changing paper forms and replacing the printer ribbon. The following operations should be performed at specified intervals of printer operation to ensure the continued top performance of which this printer is capable.

Cleaning

1. Turn all power off on the equipment.
2. Open access doors and vacuum out all paper residue from the printer mechanism. Lower the hammer mounting plate and vacuum, then reverse the vacuum to remove residue from the hammers.
3. Clean all machine covers for a neat appearance.
4. Clean VFU assembly using dry Kimwipes brand disposable wipers.
5. Operationally check printer performance.
6. List discrepancies and present list to Service Engineer.

Operator Checklist

The high-speed printer can fail to operate properly or cause a program halt should the operator neglect to:

1. Turn on the printer by depressing the POWER ON switch on the printer controller panel.
2. Install correctly punched VFU tape for slewing paper.
3. Load paper correctly, with supply set squarely in front of printer.
4. Set margin adjustments.
5. Adjust tension of paper.
6. Turn up pressure plate; adjust penetration control, if necessary.
7. Adjust CHARACTER PHASING knob, when necessary.
8. Adjust FORM POSITIONING knob.
9. Check for correct controller selector channel connection in controller cabinet.
10. Put printer on line before starting program.
11. Depress MANUAL CLEAR before attempting any manual operations and after putting on line.

A summary chart of possible error conditions, their possible causes, and the operator's corrective action is shown in Appendix D, page 55.

APPENDIX A PRINTER PROGRAM LIBRARY ROUTINES

Dynamic Universal Memory Print (DUMP)--DUMP provides a convenient means of examining the state of any addressable registers and testable alarms or conditions, as well as any memory locations before the execution of any instruction while the program is being executed CD225B2.015

Register and Partial Memory Dump (SEE)--Dumps on the printer the contents of all index registers, A and Q registers, the overflow indicator, and any portion of memory, during the operation of a program. CD225B2.016

High-Speed Octal/BCD Memory Print (HSMP)--Dumps memory both in octal and BCD form on the on-line, high-speed printer. Duplicate lines are edited CD225B2.020R

Tape to Printer 1--Lists tapes written in any mode on the printer in one of two formats CD225B3.001R

Print Assembly Listing Tape (PAT)--Provides a means of obtaining multiple assembly listings in the same format as the General Assembly Program II output by reading and printing the assembly output listing tape (tape 5) CD225B3.002R

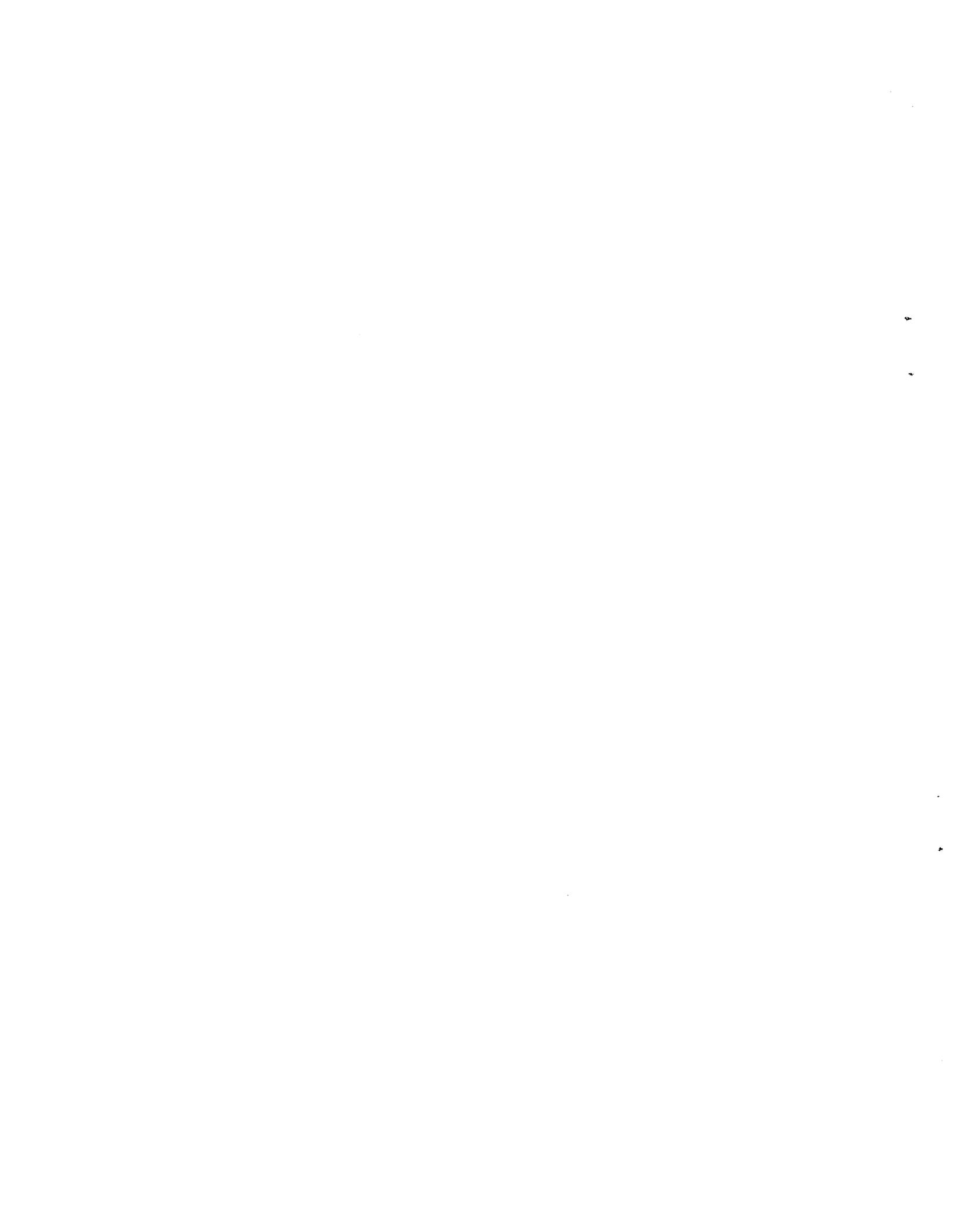
Decimal Card to Printer List--Lists a deck of decimal cards on the high-speed printer CD225B6.002R

General Purpose Output (OUT)--Sets up a line of information for output to the printer, punch, magnetic tape, or all three CD225E1.005

General Purpose Output (OUT)-AAU--Sets up information for output to the on-line punch and/or to the on-line printer CD225E1.006

Peripheral Package (PIP)--Monitored by a control subroutine which may transfer control to: card-to-tape, tape-to-printer/BCD card punch, and/or tape-to-binary card punch modules CD225E1.009

Mass Random Access to Printer--Sequentially dumps on the high-speed printer prescribed areas of DSU onto formatted hard copy in octal or decimal notation CD225E8.001



APPENDIX B FORTRAN CHARACTERS

<u>Card Codes</u>	<u>Octal (in Memory)</u>	<u>Standard Character Set</u>	<u>FORTRAN Character Set*</u>
12	20	+	+
11	40	- (minus)	- (minus)
0-1	61	/	/
3-8	13	#	=
4-8	14	@	- (dash)
5-8	15	_ (underline)	~ (tilde)
6-8	16	=	#
7-8	17	space	%
12-3-8	33	.	.
12-4-8	34	space)
11-3-8	53	\$	\$
11-4-8	54	* (asterisk)	* (asterisk)
0-3-8	73	,	,
0-4-8	74	%	(
0-5-8	75	(	space
0-6-8	76	)	space

*The FORTRAN character set is used to print IBM FORTRAN tapes. It is NOT required for G.E. FORTRAN.

PRINTER (STANDARD) CHARACTERS

CHARACTER	HIGH SPEED PRINTER SYMBOLS	CONSOLE TYPEWRITER CHARACTER OR ACTION	PAPER TAPE CHARACTER (8 CHANNEL)	HOLLERITH CODE (PUNCH IN ROWS)	BCD MEMORY (OCTAL)**	BCD MAGNETIC TAPE (OCTAL)	400 - 600 CHARACTER SET
0	0	0	Space	0	00	12	0
1	1	1	1	1	01	01	1
2	2	2	2	2	02	02	2
3	3	3	3	3	03	03	3
4	4	4	4	4	04	04	4
5	5	5	5	5	05	05	5
6	6	6	6	6	06	06	6
7	7	7	7	7	07	07	7
8	8	8	8	8	10	10	8
9	9	9	9	9	11	11	9
A	A	A	/	12-1	21	61	A
B	B	B	S	12-2	22	62	B
C	C	C	T	12-3	23	63	C
D	D	D	U	12-4	24	64	D
E	E	E	V	12-5	25	65	E
F	F	F	W	12-6	26	66	F
G	G	G	X	12-7	27	67	G
H	H	H	Y	12-8	30	70	H
I	I	I	Z	12-9	31	71	I
J	J	J	J	11-1	41	41	J
K	K	K	K	11-2	42	42	K
L	L	L	L	11-3	43	43	L
M	M	M	M	11-4	44	44	M
N	N	N	N	11-5	45	45	N
O	O	O	O	11-6	46	46	O
P	P	P	P	11-7	47	47	P
Q	Q	Q	Q	11-8	50	50	Q
R	R	R	R	11-9	51	51	R
S	S	S	B	0-2	62	22	S
T	T	T	C	0-3	63	23	T
U	U	U	D	0-4	64	24	U
V	V	V	E	0-5	65	25	V
W	W	W	F	0-6	66	26	W
X	X	X	G	0-7	67	27	X
Y	Y	Y	H	0-8	70	30	Y
Z	Z	Z	I	0-9	71	31	Z
+	+		0	12	20	60	**
-	-	-	-	11	40	40	**
Space	Blank	Blank	&	Blank	60	20	**
/	/		A	0-1	61	21	/
				2-8	12	12	~
#	#	/	Stop	3-8	13	13	#
@	@			4-8	14	14	@
(Underline)	—			5-8	15	15	:
=	=			6-8	16	16	>
				7-8	17		^
				12-2-8	32*	72	
+0				12-0	32*		**
.	.	.		12-3-8	33	73	.
*				12-4-8	34	74	*
				12-5-8	35	75	(
			Tab	12-6-8	36	76	<
		Carriage Return		12-7-8	37	77	|
-0				11-0	52*	52	**
				11-2-8	52*	52	
\$	\$	\$	\$	11-3-8	53	53	\$
*	*			11-4-8	54	54	*
				11-5-8	55	55)
				11-6-8	56	56	;
				11-7-8	57	57	'
		Print Red		0-2-8	72	32	→
,	,			0-3-8	73	33	,
%	%			0-4-8	74	34	%
(	[	Print Black		0-5-8	75	35	=
)	]	Tab		0-6-8	76	36	"
			Delete	0-7-8	77	37	^

APPENDIX C LIST OF INSTRUCTIONS

The abbreviations used in the mnemonics of the Operand field and X-field of the General Assembly Program are as follows:

M Memory Location
 N Slew N Lines
 P Channel Number (Priority Control)
 K VFU Channel Number

<u>Opr</u>	<u>Operand</u>	<u>X</u>	<u>Octal</u>	<u>Result</u>	<u>Microseconds Timing</u>		
					215	200/225	235
SEL	P	X	2500P20	Select controller	72	36	36
SLT	K		0K00000	Slew: VFU tape	72	36	36
SLW	N		0600000	Slew: Countdown	72	36	36
WFL	M		36MMMMM	Print formatted line	72	36	36
WPL	M	N	26MMMMM	Print line	72	36	36
BCS	BER	P	2514P27	Branch--Parity error	72	36	24-36
BCS	BNE	P	2516P27	Branch--No Parity error	72	36	24-36
BCS	BNP	P	2516P22	Branch--Not out of paper	72	36	24-36
BCS	BOP	P	2514P22	Branch--Out of paper	72	36	24-36
BCS	BPN	P	2516P20	Branch--Not ready	72	36	24-36
BCS	BPR	P	2514P20	Branch--Ready	72	36	24-36

APPENDIX D

SUMMARY OF CONTROLS AND INDICATORS

Location	Control or Indicator	Function
PRINTER CONTROLLER	POWER ON switch	Turns power on for the printer subsystem
	POWER OFF switch	Turns power off for the printer and printer controller
	ON LINE/OFF LINE switch	Selects mode of operation. Also used as an operator halt switch.
	SLEW TOP PAGE switch	Moves paper to top of next page under manual control
	MEMORY DUMP switch	Starts continuous sequential printout of entire contents of memory of central processor in octal notation
	MANUAL CLEAR switch	Halts printing operation, clears printer buffer, and resets all printer control circuits
	READY (white) indicator	Indicates when printer is ready to accept information
	PARITY ALERT (blue) indicator	Indicates when parity error is detected
	PAPER ALERT (blue) indicator	Indicates when end of paper or insufficient paper tension is detected
	OFF LINE (white) indicator	Indicates off-line mode
	HAMMER FUSE (red) indicator	Indicates when a fuse in one of the print hammer circuits has burned out
PRINTER	PAPER TENSION knob	Controls horizontal distance between sprockets (both upper and lower tractors) to increase or decrease paper tension
	PENETRATION CONTROL knob and crank	Provides fine adjustment of spacing between print hammers and print wheel to vary the density of printing and accommodate different paper thicknesses
	CHARACTER PHASING knob	Controls timing of print hammers relative to print wheel to ensure uniform printing of each character
	FORM POSITIONING knob	Controls tractor sprocket adjustment to provide fine vertical adjustment of printed line on paper

PRINTER SUBSYSTEM OPERATOR CHECKLIST

Condition	Possible Cause	Corrective Action
PRINTER Printer operates but no printing appears (after loading paper)	Hammer bed not raised	Turn penetration control crank to raise hammer bed; go to programmer and/or run book to determine recovery procedure.
	Ribbon torn	Replace ribbon; go to programmer and/or run book to determine recovery procedure.
Printer slews paper, but not to top of page, when SLEW TOP PAGE switch is pressed	Failure of operator to slew to top of page before loading paper	Press SLEW TOP PAGE switch, then readjust paper (top of page to top tractor).
Print line is too heavy or cuts paper	Penetration control too tight for number of sheets being printed	Decrease pressure by turning PENETRATION CONTROL toward 10 (clockwise).
Print line is too dim	Penetration control adjusted too loosely for number of pages being printed	Increase pressure by turning PENETRATION CONTROL knob toward 1 (counterclockwise).
	Ribbon worn	Replace ribbon.
	Ribbon not advancing	Inspect for off-track bunching. Ask Service Engineer to correct malfunctioning ribbon mechanism.
Print line is too high or too low on paper	FORM POSITIONING knob out of adjustment	Turn FORM POSITIONING knob toward LOWER to lower print line on paper, toward RAISE to raise line.
Top or bottom of print line is blurred or parts of two lines are printed at once	Characters out of phase	Adjust print line by using CHARACTER PHASING knob. Turn toward LOSPEED to regain bottom of characters, toward HISPEED to regain top of letters.
Printer prints lines of "garbage"	Characters one complete line out of phase. (When buffer holds all B's, it can print all A's or all C's.)	Use memory dump of all zeros or ask Service Engineer to set up a known character on test panel of controller, then adjust, using CHARACTER PHASING knob (see preceding).
One or more letters or numbers are repeatedly too light or their tops or bottoms fade out.	Individual hammer or hammers out of adjustment	Ask Service Engineer to align hammers for characters which print unevenly.
	Improper paper tension	Adjust paper tension
Printer slews paper continuously when SLEW TOP PAGE switch is pressed	Photodiode assembly blocked out. Loop not seated	Press SLEW TOP PAGE switch and adjust top of page to top tractor, inspect and correct.
	No holes punched in VFU tape, or no hole in channel 8 of VFU tape	Install correctly punched VFU tape.

Condition	Possible Cause	Corrective Action
PRINTER (cont.) Printer slews one line when SLEW TOP PAGE switch is pressed	VFU tape broken or off sprocket	Repair or replace tape as needed; if off sprocket, check for mutilated holes or glue in holes.
Tractors tear sprocket holes in paper	Paper too tight	Adjust tension to allow slight looseness (both directions if necessary).
Paper tears or separates at perforated lines	Poor quality or aged paper	Use fresh supply of good quality paper.
	Paper tension out of adjustment	Adjust vertical and horizontal tension as necessary.
Paper wrinkles or separates at perforated lines	Supply stack of paper not set squarely in front of tractors on printer	Place paper stack so it feeds squarely.
	Lower tractors not aligned with upper tractors	Align tractors so paper feed is straight and smooth.
PRINTER CONTROLLER Printer does not respond to manual commands; blower is operating	Power not on	Depress POWER ON and MANUAL CLEAR switches on the controller panel at the same time.
PARITY ALERT light comes on	A parity error has been detected in data to be printed	Notify programmer; note conditions in operator's log.
PAPER ALERT light comes on	Out of paper, improper paper tension, or broken form in the printer	Load paper in printer and/or adjust paper tension.
HAMMER FUSE light comes on; five character positions from a print line are dropped; printer goes not ready	Blown fuse in a print hammer circuit	Call Service Engineer; note approximate location of missing characters to help Engineer locate blown fuse.
CENTRAL PROCESSOR CONSOLE INDICATORS ECHO ALARM comes on; printer does not operate	Power off to printer controller	Turn power on to controller and go to the nearest restart point as determined by the run book.
	Nonexistent controller selector channel addressed, or no connector installed in printer controller	Ask supervisor to install or correct channel, restart with manual BRU TO P-1, press AUTO and START switches.
	Busy controller selected by program	Return program to originator with appropriate notes; note in operator's log.
Program hangs in a loop on a printer-not-ready branch instruction	Out of paper or improper paper tension	Load or adjust paper; put printer on line; press AUTO and START switches on central processor console.
	Printer off line	Put printer on line; press AUTO and START switches on central processor console.
	Hammer fuse blown	Call Service Engineer
	Another peripheral has the same channel number as the printer	Have the supervisor check peripheral channels.

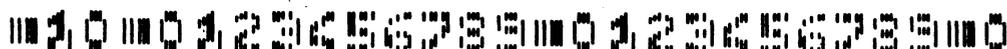


APPENDIX E COC-5 OPTION

An Optical Reader option kit (BFR225) is available for use on a GE-200 Series system which contains both the S12D Reader/Sorter and the high-speed, on-line printer.

When installed, the COC-5 modifications permit users to print and re-enter information on deposit slips, bills, stubs and other records without the need for special additional peripherals. No character loss results from the modification of the printer, as it has additional capacity on the drum to accommodate the COC-5 characters.

The new font consists of ten numeric characters and a special character for formatting and field definition. The suffix "5" is derived from the fact that five vertical bars are used to construct each character, as shown in the illustration below.



Each line printed can be either all COC-5 or all gothic, but never both. There are no changes to the method of preparing data for printing in gothic font. The method of printing in COC-5 font is identical with that used for gothic printing, with the following exceptions:

1. An octal 52 must appear in the first data character (bit positions 2-7). Also the first format character (which corresponds to the octal 52 in the first data character) is ignored.
2. A formatted/nonformatted line of COC-5 font can be printed under alphanumeric control. A Print Numeric Only command in conjunction with a print COC-5 code is illegal. Should this occur, the line will be printed in gothic font and no alert will occur.
3. All format characters applicable to printing in gothic font will function in the same way, when used with COC-5 font, with the exception of the format dollar sign (octal 53) and format zero suppress (octal 57). Should these codes be used, the line of data will be printed in gothic font under alphanumeric control. No alert will occur. Four special control characters are available for use with COC-5 font:
 - a. Format/data ignore octal 35
 - b. Format/data ignore/skip octal 36
 - c. Format delete octal 37
 - d. Format delete/skip octal 56

4. The octal codes which should be used when printing COC-5 characters are:

<u>Octal</u>	<u>COC-5</u>
00	0
01	1
02	2
03	3
04	4
05	5
06	6
07	7
10	8
11	9
13	cue symbol
60	space

5. When printing COC-5 font, the following codes are undefined. If detected during the printing of what is intended to be a COC-5 line, the data will be printed in gothic font under alphanumeric control and no alert will occur.

- a. 26 alpha characters
- b. 14 special characters
- c. Octal 12, 17, 32, 34, 55, 72, and 77
- d. Octal 52 in any position other than the first data character.

PAPER REQUIREMENTS

Paper Types

<u>ITEM</u>	<u>PAPER</u>	<u>NO. OF PARTS</u>	<u>WEIGHT*</u>	<u>REMARKS</u>
1	Register Bond	1	20 lbs. 24 lbs.	Minimum Maximum
2	Ledger Stock	1	32 lbs. 20 lbs.	Maximum Minimum
3	Punch Card Stock	1	99 lbs.**	0.0070 inch thick 0.0004 inch thick

*Pounds shown based on weight of 500 sheets measuring 16 x 22 inches.

**Pounds shown based on weight of 500 measuring 24 x 36 inches.

Paper Characteristics

SIZE

Minimum 0.003 thick x 2 1/2" wide x 5 1/4" long.
Maximum 0.0074 thick x 3 3/4" wide x 9" long.

GURLEY STIFFNESS

A minimum of 100 in the direction of machine processing. (Corresponds to a taber V-5 = 2.5.)

TAB CARD HOLES

Maximum of 110 punches per document.

SMOOTHNESS

300 ml/minute maximum, as measured on Bendtsen Tester.

REFLECTANCE

80% minimum, 95% maximum, as measured on Kidder Press Model 081. "Optical Character Tester" using infrared sensor (peaks at 9000A).

CLEANLINESS

5 PPM maximum, as defined in TAPPI Test 437.

RECOMMENDATIONS FOR ACHIEVING PRINTED IMAGE REQUIREMENTS

Recommended Ribbon

The ribbon defined by G.E. Drawing 43C164186P43133 satisfies the ribbon requirements of low inking, minimum ink spread, print clarity, and life in excess of 100,000 printed lines. It is recommended that this ribbon be used exclusively in all applications of COC-5 printing.

Printer Considerations

The printer alignment factors needing attention are (in order of decreasing importance):

Alignment Factor	Poor Print Symptom
Hammer face horizontal positioning	Missing fifth bar on character
Hammer cocking	Ghosting
Column to column penetration setting	Variation in printed character densities
Overall penetration setting	Overall darkness or lightness
Phasing Setting	Portion of next character on segment printed above or below desired character

Overall Penetration Adjustment

Correct overall penetration is necessary to obtain good COC-5 performance. The operator should set the overall penetration control so that:

- a. There is sufficient white space between narrow spaced bars.
- b. There are no strong ghost bars.
- c. Vertical slurring of vertical bars is not objectionable.

Phasing Adjustment

Use Phasing Control while printing E's in all positions (with specified paper and ribbon) to obtain equal print density on top and bottom horizontal bars.

Document Handler Operation to Obtain Optimum Reading Performance

PLUGBOARD WIRING

- On-Line
- a) Wire the plugboard to turn off the COC-5 reader (special turn-off) on the special symbol count representing the left-most COC-5 hyphen symbol on the document.
 - b) Do not use missing digit detection override if it is desired to minimize the number of missorts (i.e., sorting on the wrong digit position).
- Off-Line
- a) Check cue count for COC-5 special symbols to avoid sorting in the wrong field on the document.
 - b) Do not use missing digit detection override if it is desired to minimize the number of missorts (i.e., sorting on the wrong digit position).

DOCUMENT ALIGNMENT IN FEEDER

Jog or otherwise pack the documents such that each document will be properly registered (down and left) in the feeder. Print line orientation is face in, printed line down.

DOCUMENT REVIEW SHEET

TITLE: <u>GE-200 Series High-Speed On-Line Printer</u>
CPB #: <u>321B</u>

FROM:

Name: _____

Position: _____

Address: _____

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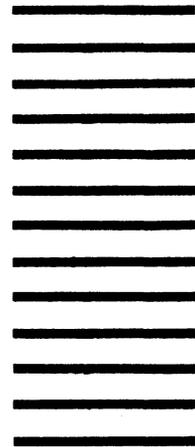
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