

X. HIGH-SPEED PRINTER SUBSYSTEM

GENERAL DESCRIPTION

The high-speed printer subsystem (Figure X-1) consists of a printer mechanism and a printer controller which operates through the controller selector. The main function of the printer is to print out the results of computer computations. It does this at the rate of 900 lines per minute single spaced and 675 lines per minute double spaced. The printer operates mainly under computer control, but, as will be described later, there are a few operations which can be performed manually at the operator control panel on the printer controller. Since the output from the central processor is buffered through the controller, the high-speed printer can print simultaneously with other functions of the computer.

Printer Controller

The printer controller is housed in an equipment rack and consists of the electronic elements to perform the following functions:

1. Receive and interpret instructions from the central processor's memory (via the controller selector).
2. Accumulate and store characters to be printed.
3. Accumulate and react to format control data.
4. Control the operation of the printer mechanism.

Controller Operation. The printer system is activated by the central processor to perform a print or a slew operation. This requires the central processor to provide three instruction words. These three words give the information required by the printer to begin operation. For example, the three instruction words pertaining to writing a print line contain memory locations from which format and data words are to

be extracted and the number of lines of paper to be moved upon completion of the printing of one line of information. As the controller receives each instruction word, it checks its parity and indicates any error by a light on the controller's control and indicator panel.

After receiving three instruction words, the printer requests that it be supplied with the first word containing format information, (if automatic format control was specified) and the first word containing data to be printed. Each of these words has 21 bits, including parity.

After receiving the first format and data words, the printer controller examines these, 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 a character is an automatic format control character (there are six of these) or a printable character. If it is printable, it is stored in a storage area within the printer controller known as the core buffer. If the character is a control character, the printer controller takes the action specified by the character. After the first words of both format and data have been processed, the printer requests the next two words. Format and data words are processed in this manner until a 1 is detected in the sign bit position of a data word signifying that the end of the print line has been reached. The maximum print-line size is 120 characters. As soon as the last data character has been processed, the printer begins to print the characters on paper, taking them from their place of storage in the core buffer.

Controller and Printer Operation. When all words to be printed for a given print line have been processed and the core buffer is filled to capacity, the print cycle begins under control of the controller. As a character is removed from the core buffer, a hammer of the printer (corresponding to the character removed) strikes the paper and print wheel, causing the character on the wheel to place its imprint on paper. This imprint is transferred to paper through an inked

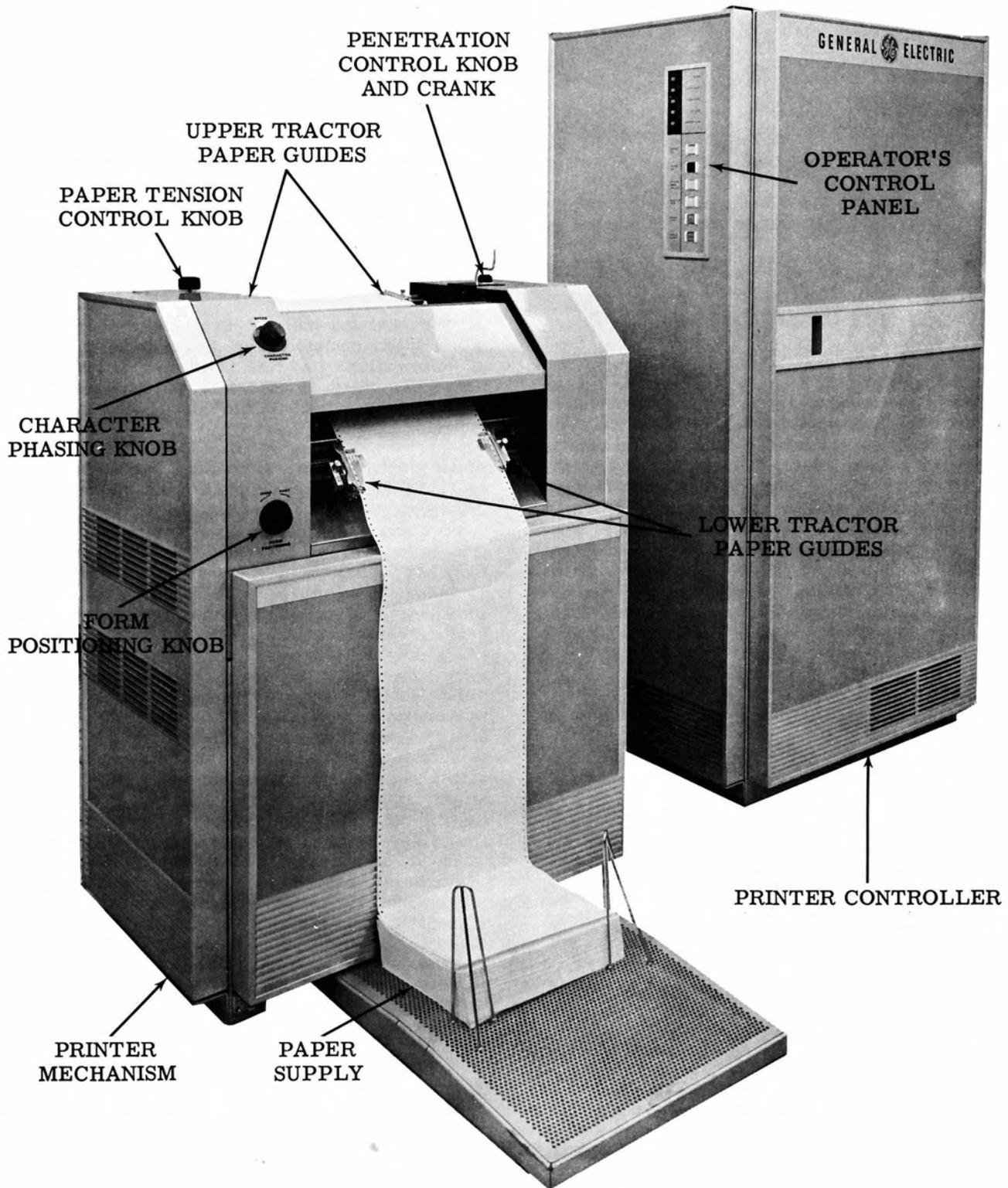


Figure X-1. High-Speed Printer Subsystem

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ribbon in a manner similar to the imprint transfer on a typewriter. After all characters to be placed on a particular print line have been placed on paper, the paper is slewed as dictated by the initial command words. While the slew is in process, the printer system is not considered busy, so at this time the central processor can provide the printer with new command words to begin another operating cycle.

When the automatic format feature is not used in printing, the three instruction words received by the controller do not include format instructions. In this case, the printer controller requests and receives only data words, which it processes one character at a time.

When the instruction words received by the controller indicate only a slew operation, no format or data words are requested or received. Immediately after receiving the command words for the slew, the printer begins to slew.

When the printer is selected for a test and Branch instruction, the operating cycle is very short. It consists of receiving a Branch Quiz signal from the central processor and immediately supplying the processor with responses to all quizable conditions. The central processor determines from the responses what action it must take.

The operator should memorize the following two branch instructions and their octal representation: (P is controller-selector plug number.)

Instruction	Mnemonic Code	Octal Code
Branch on Printer Ready	BCS BPR	2514P20
Branch on Printer Not Ready	BCS BPN	2516P20

Format Control. Horizontal format is controlled by use of automatic format control words as already described. Vertical format control is obtained by either of two methods of slewing. By the 'count-down' method, the paper slews the number of lines specified by the binary count in bit positions VFU1 through VFU6 in the printer command words. By the 'slew to channel' method, the printer slews until the next hole is detected in the channel of the vertical format tape specified by the printer command words.

Manual Operations of the Controller and Printer. Three operations can be performed manually at the printer controller's control and indicator panel:

1. Slew to top of page.

2. Print out a computer memory dump starting at memory location zero.
3. Stop any print or slew function by means of the **MANUAL CLEAR** pushbutton.

Control and Indicator Panel of the Printer Controller.

This panel contains five indicator lights and six switches, illustrated in Figure X-2. The indicators give the operator the following information about the controller and printer operations:

READY. This indicates when the system is ready to be addressed from the central processor.

PARITY ALERT. This indicates when a parity error is detected. The indicator remains lit until it is manually reset by the **MANUAL CLEAR** button. (This error condition is recoverable, if programmed.)

PAPER ALERT. This indicates the status of the paper sensing devices in the printer mechanism. The indicator is activated by two sets of microswitches located on the printer to detect (1) paper present or (2) insufficient paper tension. Either set of switches, when not depressed, can activate the **PAPER ALERT** indicator. Paper must be in the printer and sufficient tension applied vertically to extinguish the indicator.

OFF LINE. This indicates when the high-speed printer is disconnected from the central processor.

HAMMER FUSE. This indicates the failure of one or more of the protective fuses on a hammer drive card 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 make a group of five hammers inactive. This condition is detectable by the hammer fuse indicator or by examining the printout on the printer.

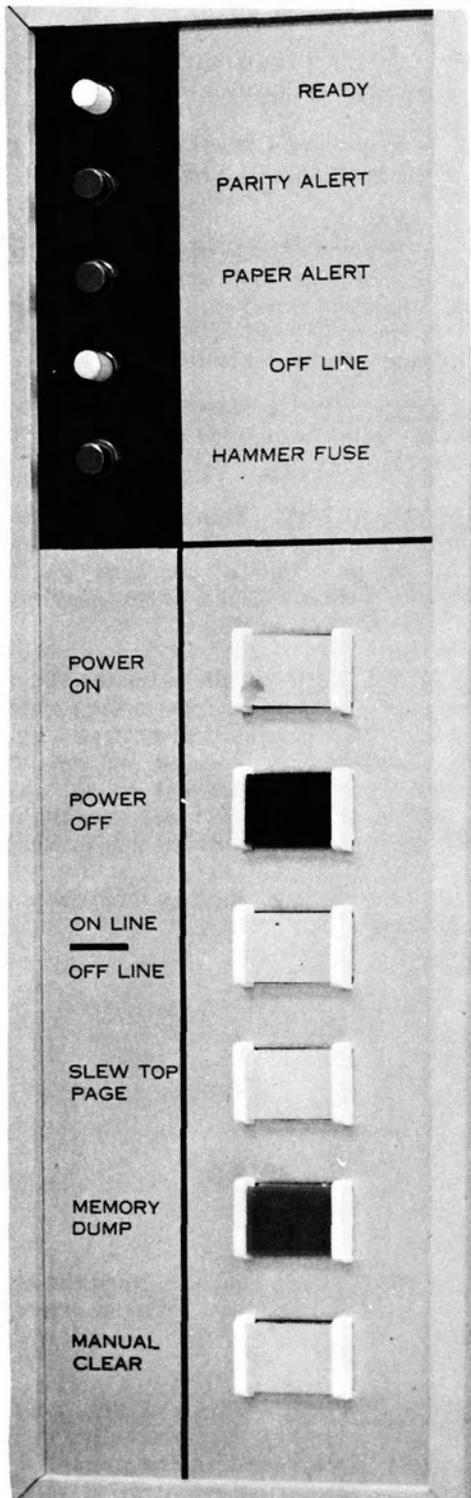


Figure X-2. Printer Controller Control and Indicator Panel

Switches on the control panel permit the operator to apply power to the printer system and perform certain manual operations. The switches are:

POWER ON. This applies DC power to the entire printer system.

POWER OFF. This first removes power from the printer, and when the printer's power supply is deactivated, it removes power 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 can only be made ready by depressing MANUAL CLEAR.

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 VFU unit has no tape in it and the format brushes are not making contact with the brush block, the paper will slew until stopped by the operator's manual depression of MANUAL CLEAR.
2. If the VFU unit has no tape in it and the format brushes are making contact with the brush block, paper will slew one line and stop of its own accord.
3. If the VFU unit does have tape in it, paper will slew to a hole in channel eight of the tape.

MEMORY DUMP. Depressing this switch causes the printer to print the contents of the central processor's 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 will 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.

MANUAL CLEAR. Depressing this switch stops paper movement and printing, and clears the internal registers and buffers of the controller.

Maintenance Control Panel. The controller also has a maintenance control panel which is located inside the front door of the printer controller and is accessible to maintenance personnel only. This control panel is used to monitor system operations and as an aid in correcting system malfunctions.

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Printer

The high-speed printer is an electromechanical device for rapidly printing data in response to electrical signals from the printer controller. The signals actuate individual print hammers, (similar to the hammers on a typewriter except that printer hammers are blank). The printer hammers strike engraved characters on a continuously rotating print wheel. As the print wheel rotates, rows of characters are brought into position over the row of hammers. Actuating of a hammer is timed to occur as the required character turns into printing position. Inked ribbon and paper pass between the print wheel and the hammers.

The printer consists of the following major assemblies:

Paper Feed Mechanism. The paper feed mechanism controls the flow of paper through the printer. It consists of the paper feed engine with electrically actuated drive and brake clutches, the tractor feed assembly, and the vertical format control unit. Power from the paper feed engine is transmitted through the tractor feed assembly to the sprockets in the four paper tractors, shown in Figure X-3.

The sprockets drive the paper forward by engaging perforations in the paper, and hold the paper stationary during printout of a line of data.

Ribbon Feed Mechanism. The ribbon feed mechanism controls the advancement of inked ribbon between the paper and the print wheel. 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 and the rolls turn in opposite directions. The direction of ribbon flow is automatically reversed when the ribbon approaches the end on a roll.

Synchronizing Pulse Generator. The rotor of the synchronizing pulse generator is mounted on the print roll shaft. It provides accurately timed signals to the computer, indicating when a character row is in printing position.

Vertical Format Unit (VFU) Mechanism. (See Figure X-4) A 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 a punched format tape between the wheel and eight format sensing brushes. When

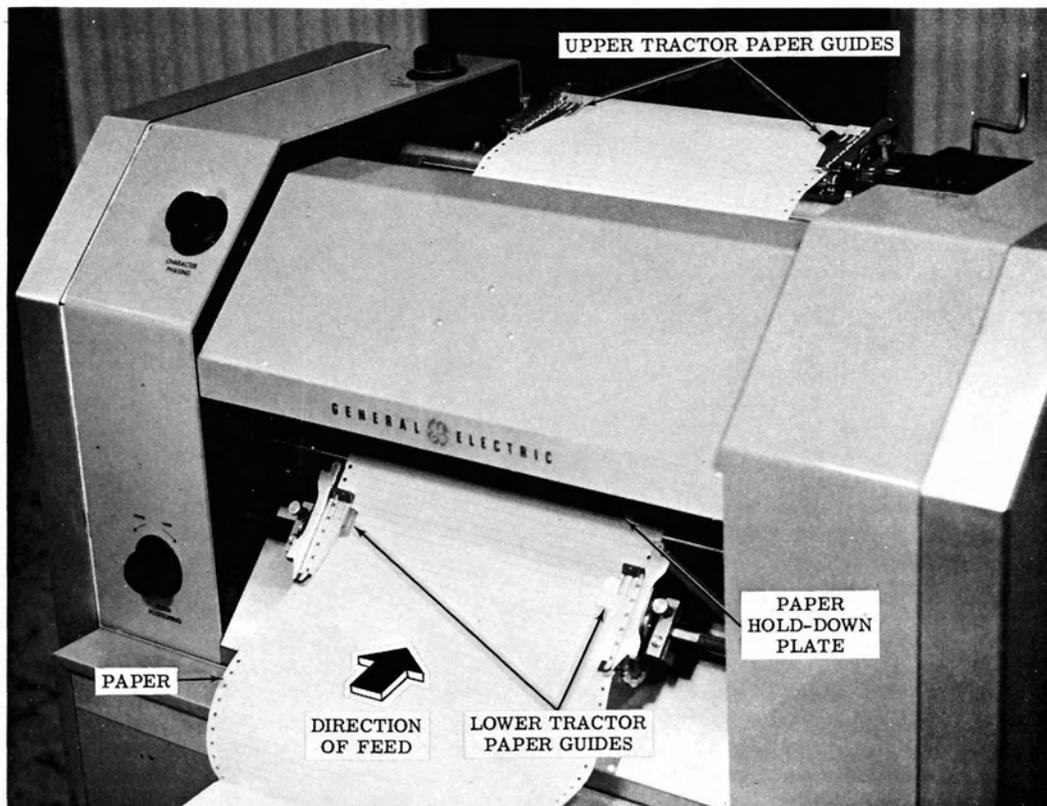


Figure X-3. Routing Paper Through the Printer

the punched format tape is inserted between the drum and the sensing brushes, each column of holes on the tape is aligned to pass beneath a sensing brush. When the program uses the VFU tape method (also called the slew to channel method), it uses the command Slew to Tape (SLT). The spacing of the holes in the channels 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 determines which of eight brush circuits is to be closed, thus which brush is to be activated. When the activated brush senses a hole in the format tape, the circuit is completed and a signal is generated to halt the slew operation. Directions for making a VFU tape are given under the Special Procedures section which follows.

Print Wheel and Hammer Assembly. The print wheel is a long cylindrical roll which rotates at either 600 or 900 RPM. It contains 26 alphabetic, 10 numeric, and 14 special characters arranged in longitudinal rows around the 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.

Printer 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. This knob controls the distance between the corresponding sprockets on the upper and lower tractors to increase or decrease paper tension. CAUTION: If this knob

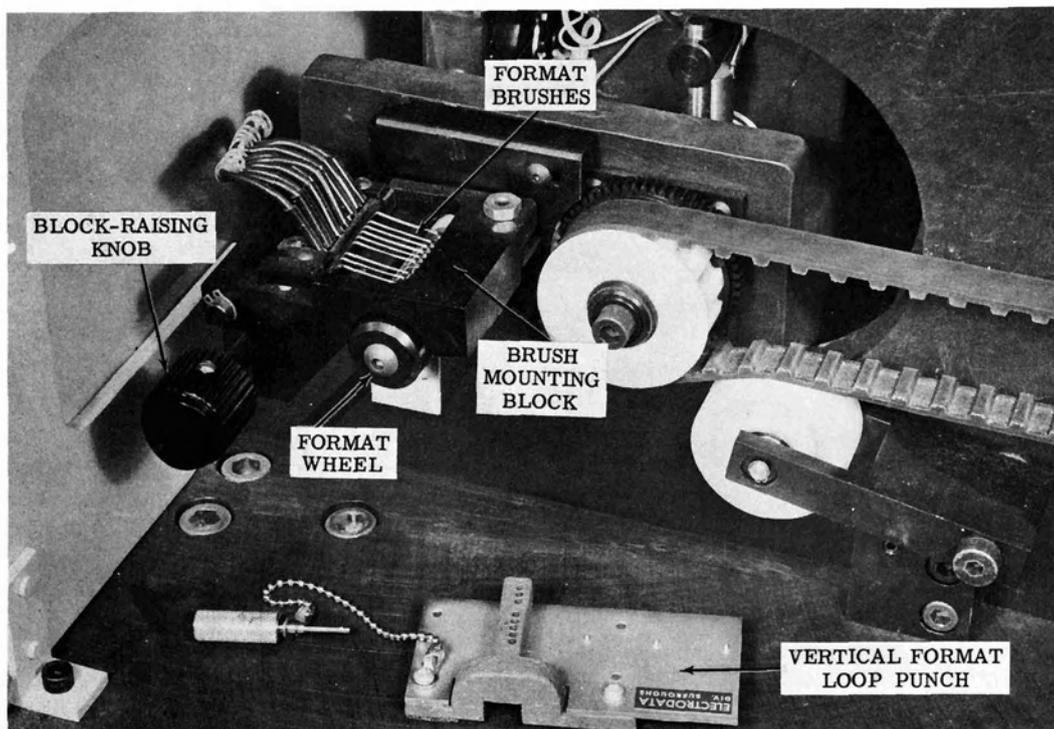


Figure X-4. Vertical Format Control Unit

is forced beyond its normal stops, it will become inoperative.

Margin Adjustments. Each of the four paper drive tractors (Figure X-5) can be moved to the right or left to be positioned properly on either edge of the paper. Loosening the tractor lock permits margin guide movement. The fine adjustment (after tightening the tractor lock) can be made with the vernier adjustment wheel. Turning the vernier 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 taught by moving the guides toward each other.

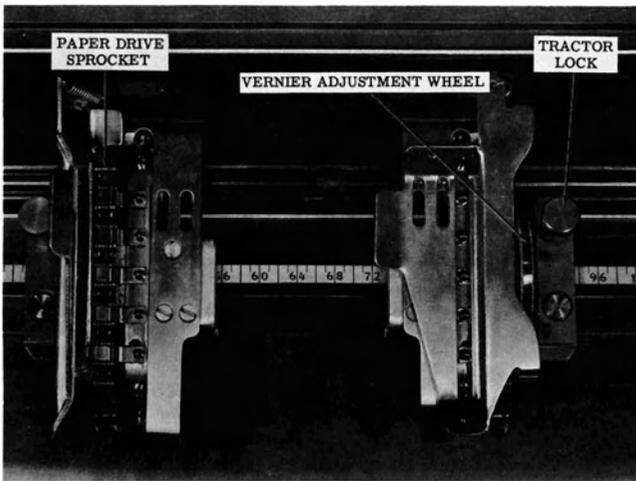
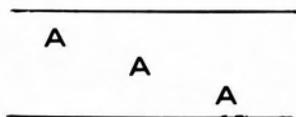
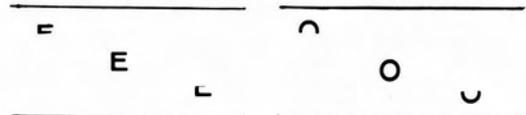


Figure X-5. Paper Drive Tractors

FORM POSITIONING knob. This knob provides a means of raising or lowering the paper tractor sprockets 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 placed on the paper. CAUTION: If this knob is forced beyond its normal stops, it will become inoperative.



CHARACTER PHASING knob. This 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 of speed between 600 and 900 lines per minute, or 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 and crank. This 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. The printer adjustments just described (except margin adjustments) can be made during printing, and should be made by the operator to provide sharp copy.

Speed Changes. Speed changes are made by the service engineer.

SETUP PROCEDURE

The steps for preparing the printer subsystem for on-line operation are as follows: (Refer to Table XII for a summary of controls and indicators. Unless specified otherwise, controls and indicators referred to are on the printer controller's control and indicator panel.)

1. Depress the POWER ON switch to turn power on.

2. Depress the **MANUAL CLEAR** switch to clear the buffer in the printer controller.
3. Install the VFU tape in the VFU mechanism of the printer. Steps for this installation are:
 - a. Remove the access panel from the left side of the printer.
 - b. Raise the brush mounting block by rotating the block-raising knob. (See Figure X-4).
 - c. Place the tape loop so it is threaded between the format wheel and the tape guide; holes are on the side of the tape closest to the operator; and the teeth on the format wheel engage the sprocket holes in the tape.
 - d. Lower the brush mounting block by turning the block-raising knob and replace the access panel.
4. Depress the **SLEW TOP PAGE** switch to synchronize the VFU tape with the tractors and thereby position the VFU tape loop.
5. Load paper in the printer as follows: (Refer to Figures X-1, X-3, and X-5. Unless specified otherwise, controls referred to are on the printer.)
 - a. Lower the hammer assembly by turning the penetration control crank counterclockwise four or five turns.
 - b. If the paper to be used is of different width from the present tractor settings, determine the margin setting for the left hand tractors from the program run book. Set the inside edge of the left tractors (both lower and upper) to the margin setting called for. In order to move the tractors horizontally along the tractor guide shaft, it is necessary to loosen the tractor locks. After both tractors have been set to their proper scales, tighten the locks. Move both right hand tractors to the far right side of their guide shafts.
 - c. Open all four tractor covers.
 - d. Align the stack of paper in front of the printer so that the side of the paper which has perforations is on the right side (your right as you face the printer). Pick up the paper from the stack and fold back the first sheet at the perforation so that a double thickness is obtained.
 - e. Feed the paper through the paper hold-down plate. Holding the paper with the left hand, reach behind the ribbon guide and pull the paper up past the hammer assembly.
 - f. Align the left edge of the paper with the upper left tractor such that the edge of the paper is approximately a quarter of an inch below the top of the rear lip of the tractor. This will correctly position the paper at a slew to top of page. Engage the perforated holes of the paper with the sprocket teeth. Close the tractor cover.
 - g. Using the paper width as a guide, adjust the upper right tractor so that the sprocket teeth engage the perforated holes of the paper, then close the cover. Tighten the tractor locks. At this point the paper should not be either too tight or too loose. The coarse adjustment should allow about a quarter of an inch of play when the paper is tapped.
 - h. Raise the hammer assembly by turning the penetration control crank clockwise.
 - i. Follow the same procedure for engaging the paper with the lower tractors. It may be necessary at this time to make a coarse adjustment with the paper tension control knob if the perforated holes of the paper do not exactly vertically match the lower tractor sprocket teeth.
 - j. Fine adjustments for horizontal paper tension can be made by the vernier adjustment wheels located on each tractor.
 - k. Final vertical tension adjustment should be made so that the tractor sprocket teeth are slightly elongating the perforated holes in the paper when the paper is being drawn through the printer system by the paper drive mechanism.
 - l. Depress the **SLEW TOP PAGE** switch on the controller's control and indicator panel twice.
 - m. Depress the **MEMORY DUMP** switch on the controller's control and indicator panel to get a sample printout to check the density of the printing. Depress

- the **MANUAL CLEAR** switch to halt the printing action.
- n. Adjust the **PENETRATION CONTROL** knob if necessary by turning it clockwise to make the printing appear darker or by turning it counterclockwise to make the printing appear lighter.
 - o. If the lines of print must be aligned with preprinted ruled lines on the paper, adjust the alignment by turning the **FORM POSITIONING** knob clockwise to raise the paper relative to the printed line or counterclockwise to lower the paper. This knob is used only for fine adjustment since it will move the paper within a range of only one line of print. If a larger adjustment should be necessary, center the **FORM POSITIONING** knob, then reposition the paper on the tractor sprocket teeth.
 - p. It may be necessary to adjust the character phasing knob, since the range of this adjustment is such that the printer could print the wrong character. If there is any doubt about whether the character phasing knob is set correctly, the following steps should be taken:
 - (1) Clear memory to zeros by a memory reset service routine.
 - (2) Take a manual memory dump on the printer. Zeros should be printed out.
 - (3) The print roll is constructed in such a way that one side of the zero row is a row of ones and the other is nothing at all, so an out of phase condition could result in a page of ones or an empty page, or portions of either the tops or bottoms of 1's. Adjust the character phasing knob to cause the printout to be all 0's.
- 6. If the **OFF LINE** light is illuminated, depress the **ON LINE/OFF LINE** pushbutton to put the high-speed printer in the on-line mode and extinguish the **OFF LINE** light.
 - 7. Depress the **MANUAL CLEAR** switch to ready the controller circuitry for data reception as indicated by the **READY** light being lit.

TABLE XII.
SUMMARY OF CONTROLS AND INDICATORS
FOR THE HIGH-SPEED PRINTER SUBSYSTEM

Location	Control or Indicator	Function
Printer controller's control and indicator panel	POWER ON switch	Turns power on for the high-speed printer.
	POWER OFF switch	Turns power off for high-speed printer and printer-controller.
	ON LINE/OFF LINE switch	Selects on-line or off-line mode of operation.
	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 from central processor in octal notation.
	MANUAL CLEAR switch	Halts any printing operation, clears printer buffer, and resets all printer control circuits.
	READY light	Indicates when high-speed printer is ready to accept information from central processor.
	PARITY ALERT light	Indicates when parity error is detected.
	PAPER ALERT light	Indicates when end of paper or insufficient paper tension is detected.
	OFF LINE light	Indicates when high-speed printer is in off-line mode (disconnected from central processor)
HAMMER FUSE light	Indicates when a fuse in one of the print hammer circuits has 'blown'.	

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TABLE XII (CONT.)

Location	Control or Indicator	Function
Printer mechanism	PAPER TENSION knob	Controls distance between corresponding sprockets on upper and lower tractors to increase or decrease paper tension.
	PENETRATION CONTROL knob and crank	Provides fine adjustment of the spacing between print hammers and print wheel to vary the density of printing and accommodate different paper thickness.
	CHARACTER PHASING knob	Controls timing of print hammers relative to print wheel to assure uniform printing of each character.
	FORM POSITIONING knob	Controls tractor sprocket adjustment to provide fine vertical adjustment of printed line on paper.

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SPECIAL PROCEDURES

Preparation of a Vertical Format Loop

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

1. Determine the length of tape required. 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 would have 66 lines, therefore 69 sprocket holes. Since the tape must be long enough to loosely loop around the format drum, 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 2-inch form cut to 3 form lengths would have a tape length of $2 \times 6 \times 3$ plus 3 = 39 sprocket holes.
2. Cut the tape from the supply spool furnished with the high-speed printer (plastic coated metallic foil tape) at the length just determined. Always cut the tape at the midpoint between the holes.
3. Place the tape in the hand punch (Figure X-6) with the aluminum-colored side of the loop material down. Position the tape so that the sprocket hole which is to represent the first line of print is over a punch guide hole. It may be of help to 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. 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 that channel 8 be used for controlling the slew to the top of the page. Channel 8 is on the edge of tape farthest from the sprocket holes, as indicated in the tape sample, Figure X-7. Carefully lift the tape off the sprocket pins and advance it through the hand punch until the next punching position is reached.

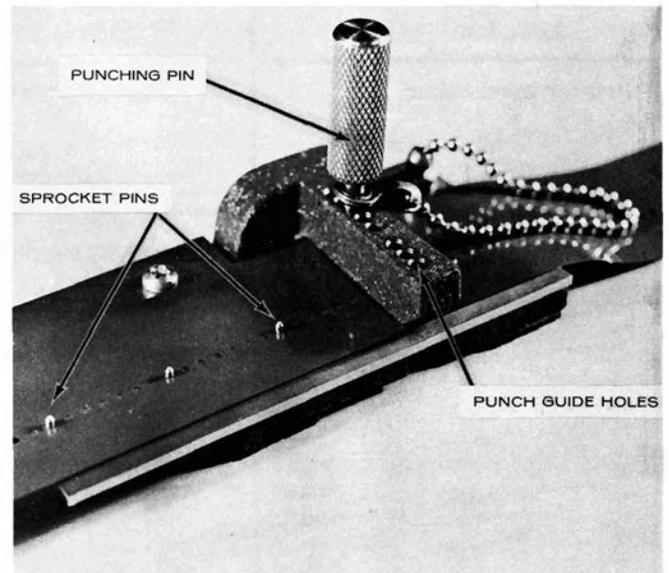


Figure X-6. Hand Punch for a Vertical Format Loop

4. Repeat the hole-punching procedure 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.
5. If one or more sprocket holes have been punched adjacent to the first sprocket hole, holes should be punched in corresponding rows adjacent to the first of the 'overlap' sprocket hole of the tape for an 11-inch form.
6. Form the loop with the aluminum-colored side on the inside. Place the tail end of the tape over the beginning area so the sprocket holes overlap. It will be easier to align the holes in the tape at the overlap if a pair of overlapped holes is placed over the center sprocket of the hand punch with, for example, the hole adjacent to the 67th sprocket hole on the pin first.
7. Glue the overlapped ends together. Apply a thin coat of plibond cement across the width of the tape adjacent (in this example) to the 67th sprocket holes. Hold the tape firm against the flat portion of the hand punch, and bring the other end of the tape with the first sprocket hole around so that it may be placed on top so that the same sprocket pin engages the corresponding hole in the beginning of the tape. Align all holes punched adjacent to the ones engaged by the

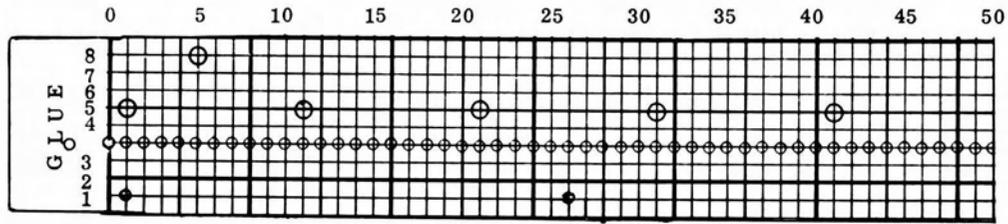


Figure X-7. Sample Tape for Vertical Format Loop

pin so that they complement each other perfectly. Care should be exercised to prevent excess glue from filling the holes. Any type of vertical format loop can be punched to control top-of-page slew for as many as eight different form lengths. However, the loop must be cut for the longest form and the other forms must be some even multiple of the longest form.

8. Install the vertical format loop on the format wheel, as illustrated in Figure X-8.

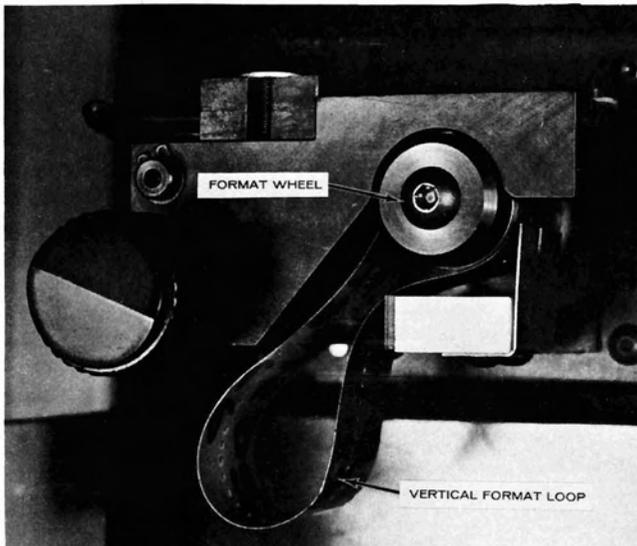


Figure X-8. Vertical Format Loop

Changing the Printer Ribbon

The ribbon for the high-speed printer is supplied on a hollow mandril and has a cardboard leader on each end (See Figure X-9). 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; the right hubs have pins (one each) 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 X-10). These feet and associated switches are the means by which the printer determines when to reverse ribbon direction.

Remove the worn ribbon from the printer as follows: (Unless specified otherwise, controls and indicators referred to are on the controller's control and indicator panel.)

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's PENETRATION CONTROL crank counterclockwise approximately 10 turns to lower the print wheel.
4. Depress the ON LINE/OFF LINE switch to put the high-speed printer in the off-line mode as indicated by the illumination of the OFF LINE light.
5. Depress the MEMORY DUMP switch. This action will start the ribbon winding.
6. Observe the ribbon movement to determine when it is nearly wound on one mandril. When the direction of ribbon winding changes, depress the MANUAL CLEAR switch to halt the printout.
7. Depress the POWER OFF switch. CAUTION: Turning off power to the printer is necessary before continuing ribbon changing to prevent rubbing one's fingers against the moving print wheel.
8. Manually wind the remaining ribbon onto the fullest mandril by turning the mandril by hand.
9. When one mandril is clear of ribbon, remove

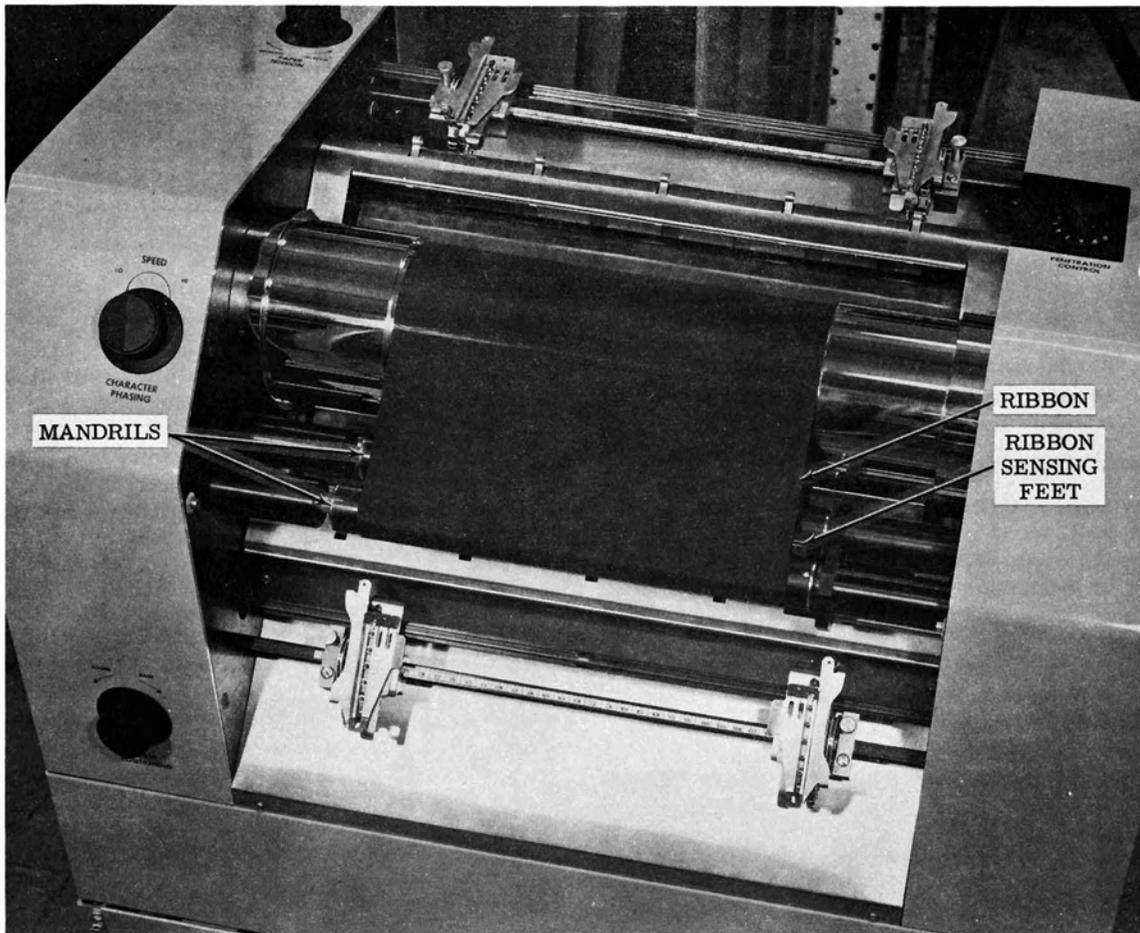


Figure X-9. Installation of Printer Ribbon

the leader by pulling the masking tape loose. Continue to wind until the leader is wound around the ribbon.

10. 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 will allow 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 should be exercised so excessive pressure is not put on the ribbon sensing feet when removing and installing ribbon mandrils.
11. Repeat the procedure in step 10 to remove the inside mandril. (The ribbon may be on either mandril.)

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 per step 1.
4. Affix the ribbon leader to the empty mandril with masking tape, assuring that the ribbon is centered and will drive straight.
5. Turn the outer mandril by hand until there is inked ribbon wound on it. Check again to make sure that the ribbon feeds straight.

6. Depress the POWER ON switch.
7. Observe the movement of the ribbon sensing feet and be sure they are not caught under the ribbon.
8. Depress the MEMORY DUMP switch. This action will cause the ribbon to begin winding.
9. Observe the ribbon's winding to see that it is operating properly.
10. Depress the MANUAL CLEAR switch to halt the ribbon movement.
11. Turn the printer's PENETRATION CONTROL crank clockwise until it is snug to return the print wheel to its normal position.
12. Reinstall the sloping center panel on the front of the printer mechanism.

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 printer controller control and indicator panel.)

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 will never stop by itself, and will repeat 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.

ERRORS AND OPERATOR CORRECTIVE ACTION

Operator Checklist

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

1. Turn power on printer controller panel power on.
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, when necessary.
8. Adjust form positioning knob.
9. Check for correct controller-selector plug 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.

Table II summarizes error conditions, their possible causes, and operator corrective action.

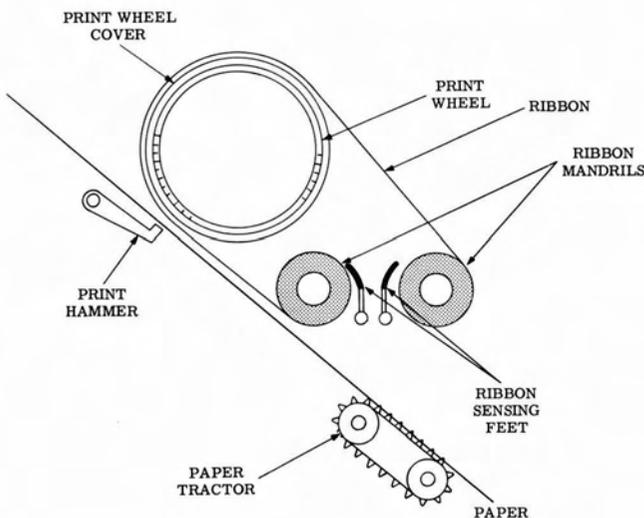


Figure X-10. Printer Mechanism, Side View

Memory Dump (Manual)

The 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 (described in section XVI of this manual) is used to obtain the memory dump, but the routine itself is read into the lower 100 or 200 memory locations. Information in those lower locations must be obtained by the manual dump method or else it will be lost.

TABLE XIII.
PRINTER SUBSYSTEM ERROR CONDITIONS

Error Condition	Possible Cause	Corrective Action
PRINTER INDICATIONS Printer operates, but no printing appears (after loading paper)	Pressure plate not raised	Turn penetration control crank to raise pressure plate; 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	Operator failed to slew to top of page before loading paper	Press SLEW TOP PAGE switch, then readjust paper (top of page to top tractor)
Printer slews paper continuously when SLEW TOP PAGE switch is pressed	Brush position knob on VFU tape assembly is up (brush fingers not contacting)	Lower the brush knob until brush fingers contact; press SLEW TOP PAGE switch, and adjust top of page to top tractor.
	No holes punched in VFU tape, or no hole in channel 8 of VFU tape	Install correctly punched VFU tape.
Printer slews one line when SLEW TOP PAGE switch is pressed	VFU tape has broken or come off of 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.

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TABLE XIII. (CONT.)

Error Condition	Possible Cause	Corrective Action
Paper wrinkles or separates at perforated lines. (cont.)		
	Lower tractors not aligned with upper tractors.	Align tractors so paper feed is straight and smooth.
CONSOLE INDICATORS ECHO ALARM light 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 plug has been addressed, or no plug installed in printer controller	Ask service engineer to install correct plug; restart with manual BRU to P-1, press AUTO and START switches.
	Busy controller was 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 instruction	Out of paper or improper paper tension	Load or adjust paper; put printer on on-line; press AUTO and START switches.
	Printer off line	Put printer on line; press AUTO and START switches.
	Hammer fuse blown	Call service engineer
	Another peripheral has the same plug as the printer	Have service engineer check peripheral plugs.
PRINTER CONTROLLER INDICATORS Printer does not respond to manual commands; blower is operating	Power is not on	Depress POWER ON switch on controller panel.
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 or improper paper tension	Load paper in printer and/or adjust paper tension.

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TABLE XIII (CONT.)

Error Condition	Possible Cause	Corrective Action
HAMMER FUSE light comes on; five characters from a print line are dropped; printer goes not ready	Fuse in a print hammer circuit has blown	Call service engineer; note approximate location of missing characters to help engineer locate blown fuse.
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 is worn	Replace ribbon.
	Ribbon not advancing	Ask service engineer to correct malfunctioning ribbon mechanism.
Print line too high or too low on paper	FORM POSITIONING knob needs 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 Printer prints lines of 'garbage'	Characters are out of phase	Adjust print line by using CHARACTER PHASING knob; turn toward LO SPEED to regain bottom of characters, toward HI SPEED to regain top of letters.
	Characters can be one complete line out of phase (when buffer holds all B's, it can print all As or all Cs)	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 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.