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IBM 1130 Computing System Input/Output Units

This publication describes the input/output devices available for attachment to the IBM 1130 Computing System.

The text is primarily intended as a machine operator reference. Each input/output unit is individually introduced. Descriptions of control keys and indicator lights, special features, setup procedures, and principles of operation are included. Throughput timings and data record media specifications are given where applicable.

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CONTENTS

INTRODUCTION

The IBM 1130 Computing System offers the user a variety of input/output (I/O) devices. This manual describes the devices listed below.

IBM 1054 Paper Tape Reader
IBM 1055 Paper Tape Punch
IBM 1132 Printer
IBM 1442 Card Read-Punch, Models 6 and 7
IBM 1627 Plotter, Models 1 and 2

To fully understand the material presented herein, the reader should have a knowledge of the IBM 1130 Computing System as described in the publication IBM 1130 Computing System, Principles of Operation (Form A26-5881).

INPUT/OUTPUT DEVICES - GENERAL

System input/output devices involve the transfer of information to or from the central processing unit (CPU). External documents, such as punched cards and paper tape, are used to transfer information from input devices to the CPU. Information transferred to output devices from the CPU can be represented in printed, graphic, punched card, and paper tape format.

All I/O devices are under control of the CPU program. I/O instructions in the program initiate all operations. The operations are terminated by completion of the data transfer or by operator intervention at the I/O device. I/O interrupts enable the CPU to provide appropriate programmed responses to conditions that occur in the I/O device. Priority sequences are assigned to allow the most efficient use of all I/O devices.

Each data transfer rate is determined by the speed of the I/O device.

IBM 1130 Computing System

The IBM 1054 Paper Tape Reader and the IBM 1055 Paper Tape Punch provide paper tape input/output for the system to which they are attached. These units are capable of reading or punching eight channel chad (fully punched holes) paper tape or chad edge-punched documents (special feature). Reading and punching of all paper tape codes is possible because the code translation is done by the program. The transfer of information to or from tape is illustrated in Figure 1. Both the 1054 and 1055 operate at a speed of 14.8 characters per second.

Individual characteristics of the two units are described in the following sections.

DOCUMENT SPECIFICATIONS

Tape

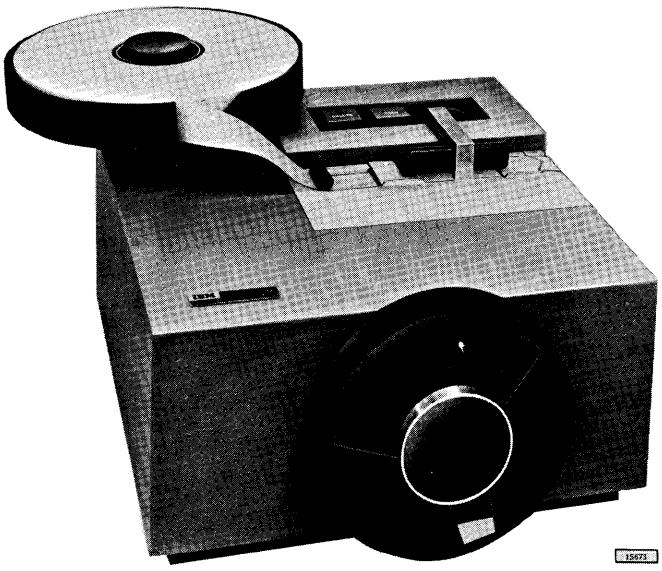
The system is capable of using paper tape, Mylar* laminated paper tape, and Mylar coated aluminum tape. Figure 2 shows the tape specifications.

Standard hole size and spacing is required for all code and feed-hole punching.

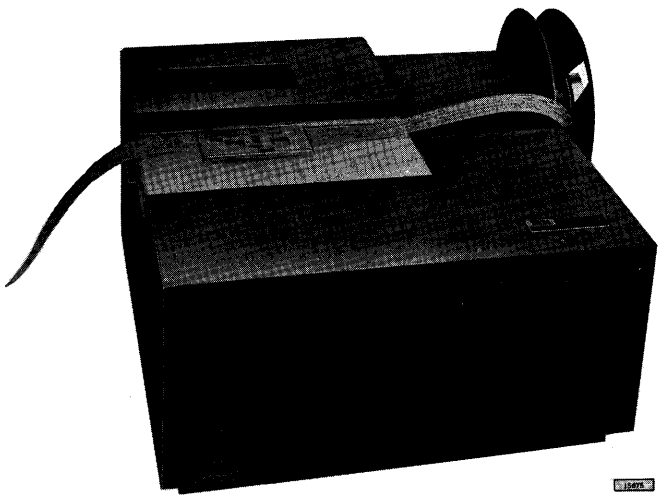
Tape Splicing

The general rules to follow when splicing tape are:

1. All splicing should be done in non-data portions of the tape whenever possible.
2. Either a butt-joint or lap-joint type splice is acceptable. The thickness at the splice must however, not exceed .010". Any splicing material used for a butt-joint splice must be flexible and should be attached to the top of the tape.
3. Width of the splice must not exceed the width of the tape.
4. The leading edge of any lap-joint splice must be opposite to the normal direction of feeding.
5. No staples or other types of fasteners can be used for splicing. Also, any excess glue on the surface of the tape must be completely removed.
6. When lapping punched tape columns, more than one punched column should be lapped.



IBM 1055 Paper Tape Punch



IBM 1054 Paper Tape Reader

*Trademark of E.I. duPont deNemours Company

NOTE: The illustrations in this manual have a code number in the lower corner. This is a publishing control number and is unrelated to the subject matter.

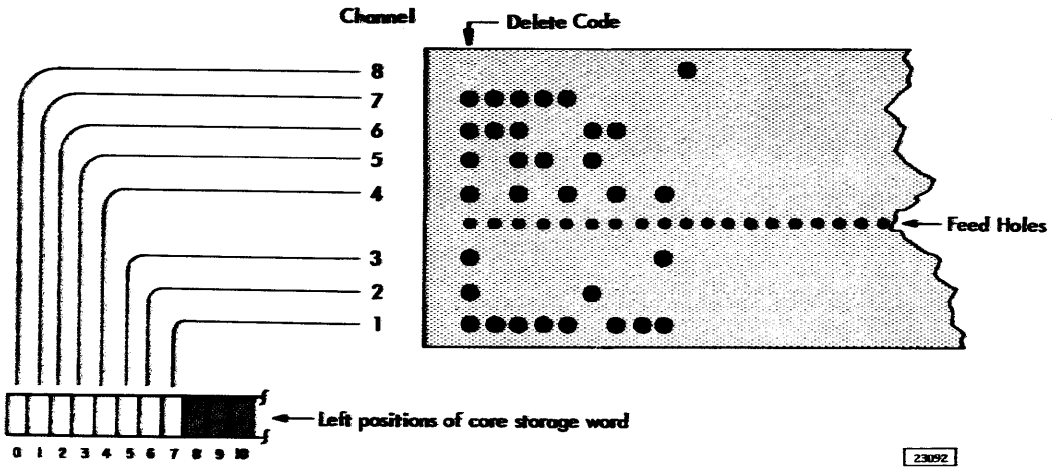


Figure 1. Bit Transfer – Core Storage/Tape Code

Edge-Punched Documents (Special Feature)

Edge-Punched documents can be of paper or ledger card stock. The following specifications apply to all edge-punched document types.

Thickness:	Minimum – .004"
	Maximum – .010", including folds
Length (single documents):	Minimum – 4.0 inches
	Maximum – 16.0 inches
Width:	Maximum – 12.0 inches (not to exceed length)
Hole size and spacing:	Same as for paper tape (see Figure 2)

The length of continuously-fed fanfold documents must be evenly divisible by .100 inch for proper registration. The first pre-punched feed hole must be .05 inch from the leading edge of the document, the first character punched must be at least .60 inch from the leading edge, and the last character must be 1.20 inches from the trailing edge.

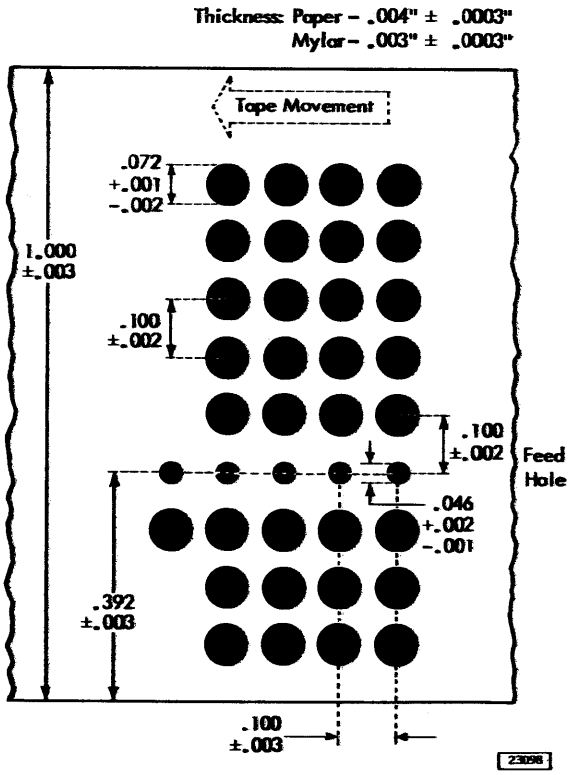


Figure 2. Tape Specifications

IBM 1054 PAPER TAPE READER

The reading of tape by the 1054 is accomplished by sensing pins. Reading is interrupted by the program, an end of tape condition, or a tape feed failure. The tape can be moved manually either forward or backward without being read.

Interlocks

Tape Presence Contact. This contact stops the reader when the end of the tape is reached. A minimum of 12 positions must follow the last punched character code to prevent a reader stop before all data has been read.

Tape Tension Lever. The tension lever (Figure 3) causes the reader to stop (prevents the reader from accepting control commands) when a strain is placed on the tape so it cannot feed. If the taut tape condition is relieved, the reader can restart upon receiving a control command.

Special Features

Center-Roll Feed Reel and Take-Up Reel. This special feature permits the tape to be read in the same order in which it was punched by feeding from the center of the punched tape roll. It also provides a power-driven take-up reel for the rewinding of tape after it has been read. The center-roll-feed tray and the take-up reel are 6 inches in diameter.

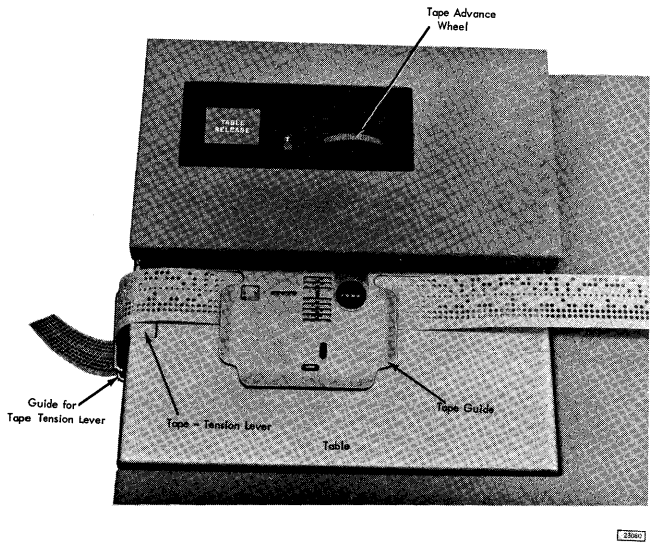


Figure 3. IBM 1054 Controls

Edge-Punch Read. This feature permits edge-punched (chad type) documents to be read by the paper tape reader.

OPERATOR CONTROLS (Figure 3)

The following manually operated controls on the 1054 are used for tape or document insertion and movement.

Table Release Button. Pressing this button causes the tape guide to raise, permitting the insertion or removal of punched tape.

Tape Advance Wheel. This wheel permits the operator to move the tape manually in either direction without the device reading the tape.

T/D (Tape/Document) Lever. This two-position lever (used only with Edge-Punched Read special feature) must be set to T to permit the 1054 to read 1-inch tape, or to D to permit the 1054 to read edge-punched cards and ledger stock.

OPERATOR PROCEDURES

Inserting Tape in Reader (Figure 4)

The procedure to place the tape in the tape reader and to check for proper alignment is:

1. Press the table-release button to raise the table.
2. Insert the tape under the tape guide (and also under the guide adjacent to the tape-tension lever) with the tape leader over the sensing pins. These pins are indicated by the red line on the tape guide. The tape should be inserted with the tape leader to the right and the three-track section of the tape toward the back of the reader. (The tape contains three punching tracks on one side of the feed holes and five punching tracks on the other side.)
3. Reposition the table by pressing the table down and check that the feed holes are over the feed pins.
4. Operate the tape-advance wheel to manually position the first coded column over the sensing pins (as indicated by the red line on the tape guide).

NOTE: The procedure for the insertion of edge-punched documents is the same as for tape, except that the T/D lever is positioned with the D (for documents) visible.

5. Thread the leader end of the tape through the guides, and insert it in the take-up reel slot (when Take-up Reel special feature is used) so that the counterclockwise rotation of the reel will properly wind the tape. This reel is a split-reel type with the front removable for easy insertion and removal of the tape.

NOTE: To place a reel of punched tape into the center feed reel for reading by the tape reader, position the roll with the three-hole edge up. The inside (leading) end of the tape must be twisted 90° so that the three-hole edge is toward the back of the reader and inserted under the sensing pins. Be sure that the tape feed holes are aligned with the feed wheels.

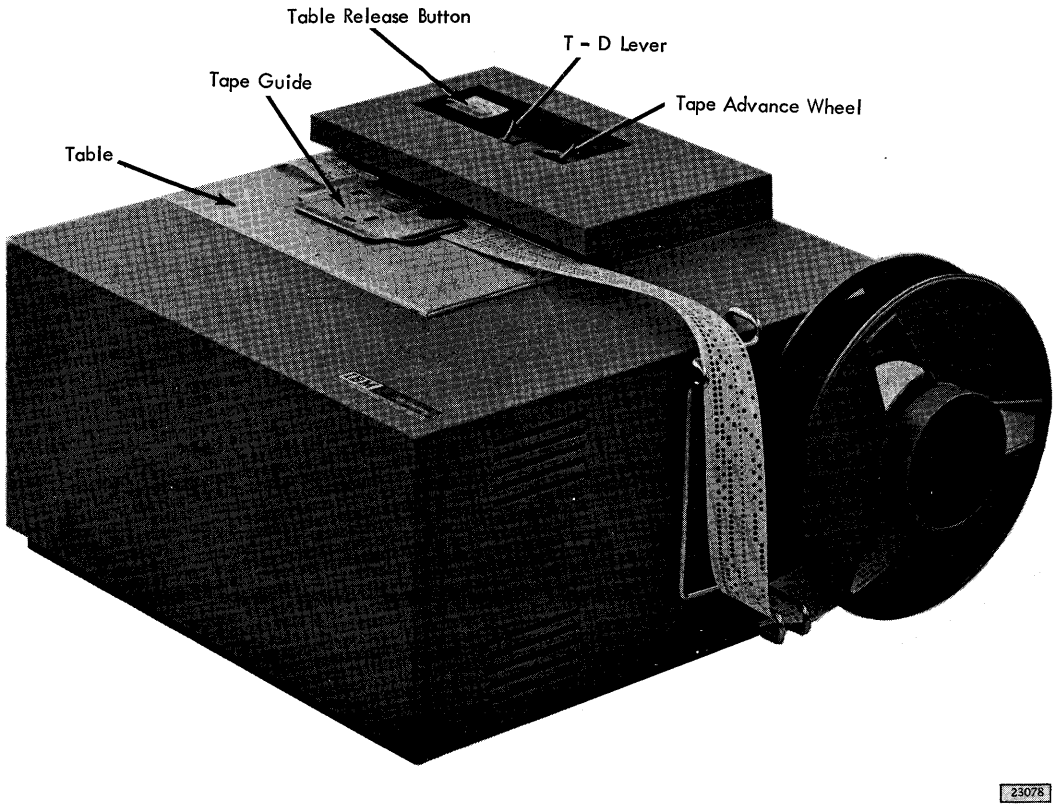


Figure 4. IBM 1054 - Tape Insertion

IBM 1055 PAPER TAPE PUNCH

The 1055 Paper Tape Punch is capable of punching chad paper tape or edge-punched documents having pre-punched feed holes. The feed holes are automatically punched in the tape when character codes are punched or when the Feed key is used by the operator. The delete and blank codes are the only codes that can be punched by the operator. All other punching is under control of the CPU program.

Interlocks

Tape Presence Contact. This interlock occurs when the punch runs out of tape.

Tape Tension Lever. If a strain is placed on the tape as it feeds from the spool, the tension lever interrupts the program control of the punch mechanism.

Special Features

Tape Take-Up Reel. Available as a special feature is the 6 inch power driven take-up reel for winding the tape after it has been punched.

Edge Punching. This special feature permits documents with pre-punched feed holes to be fed and punched (chad type) by the paper tape punch.

OPERATOR CONTROLS (Figure 5)

Delete Key. Pressing this key causes the tape punch to advance the tape one position and punch a delete code and a feed hole. Delete codes can be punched continuously by simultaneously pressing and holding down the delete and feed buttons.

Feed Key. Pressing this key causes the tape punch to advance the tape by punching feed holes. Holes are continuously punched by holding the button in the operative position.

Tape Advance Wheel. This wheel permits the operator to feed the tape in either direction through the punch mechanism..

NOTE: If tape is moved forward, exercise care because no feed holes will be punched.

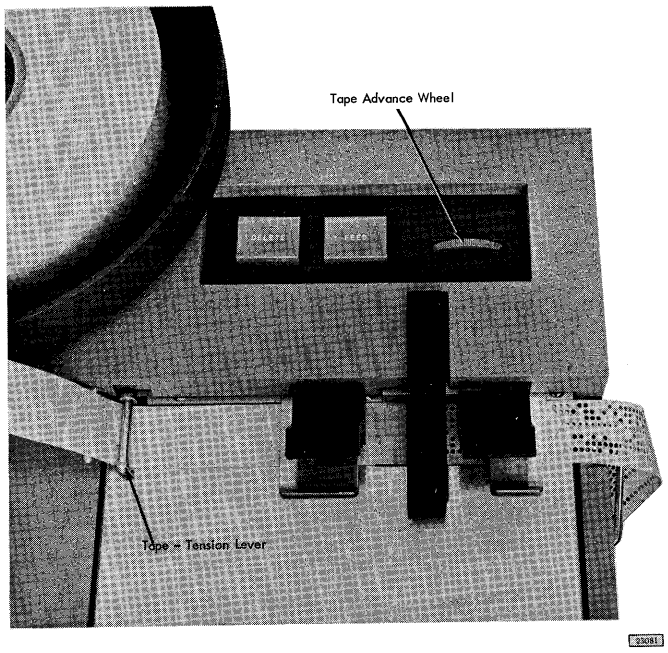


Figure 5. IBM 1055 Controls

Document Pressure Lever. This lever, when in the raised position, permits feed hole punching in tape. When using documents with pre-punched feed holes, this lever is placed in the lowered position.

OPERATOR PROCEDURES

Inserting Tape (Figure 6)

Place a blank reel of tape in the tape supply pan and thread the tape through the guides. The proper tape insertion procedure is:

1. Move the document pressure lever to the left so that it is ineffective for tape operations.
2. Pivot the tape pressure lever up.
3. Take the leading end of the tape from the supply pan and thread the tape with the outer surface of the tape up.
4. The tape should pass under the tape-tension lever, the die, and the tear guide.
5. The tape is then threaded around the guides on the side of the unit and inserted in the take-up reel slot to permit counterclockwise

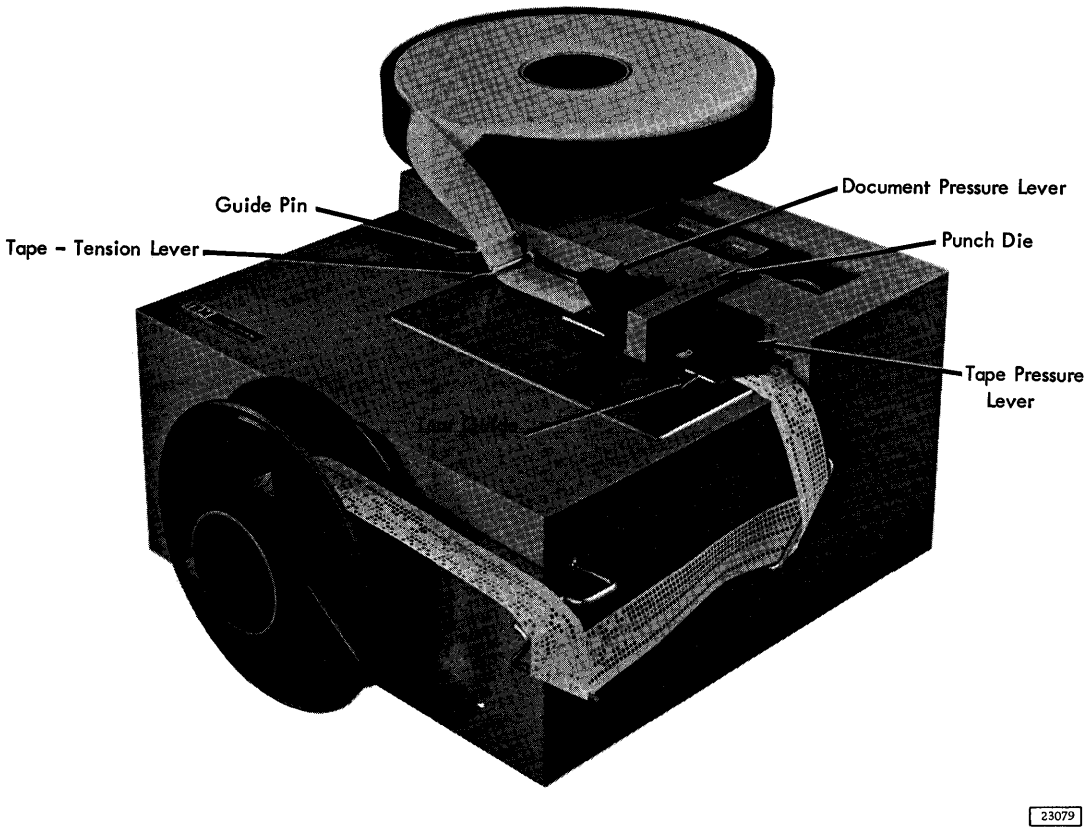


Figure 6. IBM 1055 - Tape Insertion

winding of the tape (when take-up reel special feature is used).

NOTE: The tape reel is the split-reel type to permit easy insertion and removal of the tape.

6. Lower the tape-pressure lever.
7. Press the Feed key to punch several inches of tape with feed holes. This permits self-aligning of the tape for proper punching registration.

Inserting Edge-Punch Documents

The procedure for inserting edge-punched documents is:

1. Move the document pressure lever to the right and pivot up so that the document can be inserted.
2. Insert document from the left toward the right with the top edge of the document against the registration rail and the right edge of the document under the die and firmly against the stop.
3. Lower the tape and document pressure levers onto the document. All feed holes in the document must be pre-punched because no feed holes are punched by the tape punch while in document mode.

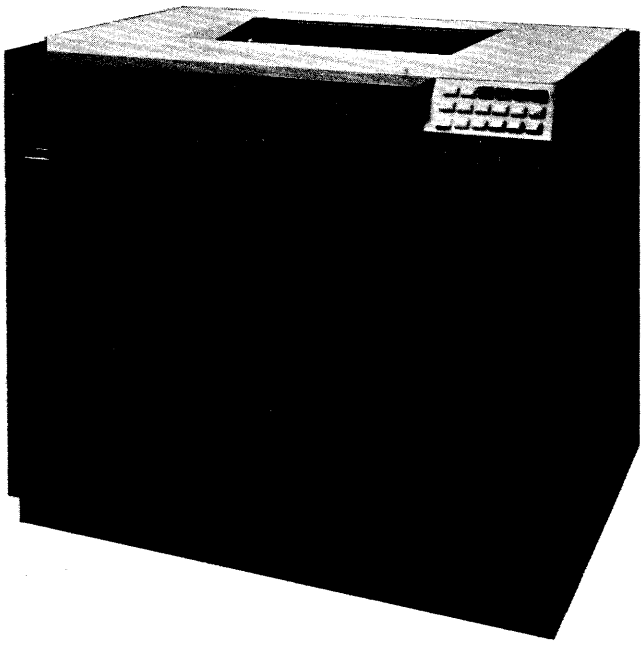
The IBM 1132 Printer is an on-line data processing system output unit. The 1132 is equipped with a tape-controlled carriage for transporting continuous paper forms. Alphameric data is printed at the rate of 80 lines per minute while consecutive all-numeric lines of data are printed at the rate of 110 lines per minute. The print line is 120 characters in length. Printing and carriage operations are under control of the program.

PRINTER FUNCTIONS

The 1132 contains 120 continuously rotating print-wheels within a 12-inch printing line. Each print-wheel contains 48 characters: 26 alphabetic, 10 numeric, and the following 12 special characters:

& - / . $, * ( ) ' + =

When the program calls for printing, the printer sends to the CPU an extended binary-coded representation of the character (same as the CPU internal code for that character) in position to be printed.



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IBM 1132 Printer

This code is compared by a program subroutine with all 120 characters in the output record to determine which printwheels will be fired at that time.

Vertical form spacing of six or eight lines to the inch is manually selected by the operator. Selective spacing and skipping between printed lines is controlled by the program and the carriage tape channels 1 through 6, 9, and 12.

Space and skip instructions may be executed at any point in the central processing unit stored program prior to a print (write) instruction or they may start 16 idle scan cycles after the last graphic is printed.

OPERATING CONTROLS

Lights

The following lights (Figure 7) give the operator a visual indication of the operating condition of the 1132.

Power On. This light indicates that electrical power is supplied to the 1132.

Ready. This light indicates that the 1132 is ready to accept instructions from the CPU. The following conditions must be satisfied before the Ready light will come on:

1. Forms in printing position.
2. Electrical power on.
3. Start key pressed after items 1 and 2 are satisfied.

Print Scan Check. This light indicates that the program scan of the output record for a particular character was incomplete at the time the character was in position to print. The light is automatically reset by the CPU when the condition is sensed.

Form Check. This light turns on when approximately 14 inches of paper remain to be printed. When the Form Check light goes on, the printer Ready light is turned off.

Keys

The following keys (Figure 7) provide switch control of various printer and carriage operations.

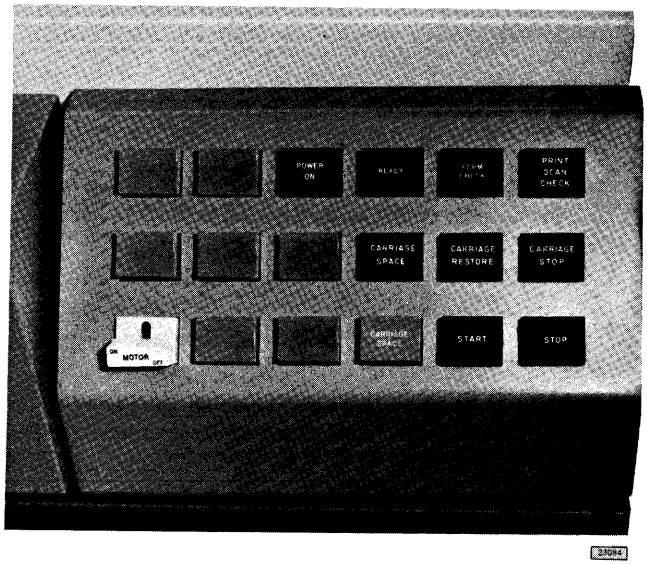


Figure 7. Operator Control Keys and Lights

Start. Pressing this key, when power is on and forms are in position, turns on the Ready light. This action makes the 1132 ready to accept instructions from the CPU.

Stop. Pressing this key terminates the ready status of the 1132.

Carriage Restore. Pressing this key positions the carriage at Channel 1. If the carriage platen feed clutch is disengaged, the form will not move. If the clutch is engaged, the form and carriage control tape move synchronously. This key is operative only when the printer is not in a ready status.

Carriage Space. This key allows the operator to advance the form one space at a time. This key is operative only when the printer is not in the ready status.

Carriage Stop. Pressing this key stops carriage operation.

Motor Switch. This switch turns the printwheel drive motor off so the ribbon can be changed.

Manual Controls

These controls (Figures 8 and 9) allow the operator to insert and register forms, to adjust for forms thickness, and to select print spacing at 6 or 8 lines to the inch.

Platen Clutch Knob. This knob disconnects the platen from the drive motor so that the platen may be positioned independently of the carriage tape mechanism.

Platen Space Knob. Rotating this knob moves the form vertically line by line. The platen clutch must be disengaged.

Platen Space Knob Vernier. Rotating the vernier moves the form vertically less than one line space. Turning the knob in a clockwise direction causes the printing to occur higher on the form. Counterclockwise movement of the knob advances the platen and lowers the printing on the form. In either case, the carriage tape is not affected and adjustments can be made while the platen is engaged and while the machine is in operation.

Forms Thickness Lever. This lever moves the entire carriage and platen away from its normal position in relation to the printwheels. This provides additional clearance between the platen and the printwheels when forms of increased thickness are used.

Platen Pressure Release Lever. Operating this lever toward the rear of the carriage releases the pressure holding a form to the platen. It is used when inserting new forms or when repositioning a form. The pressure release lever should always be in the released position when the forms tractor is being used.

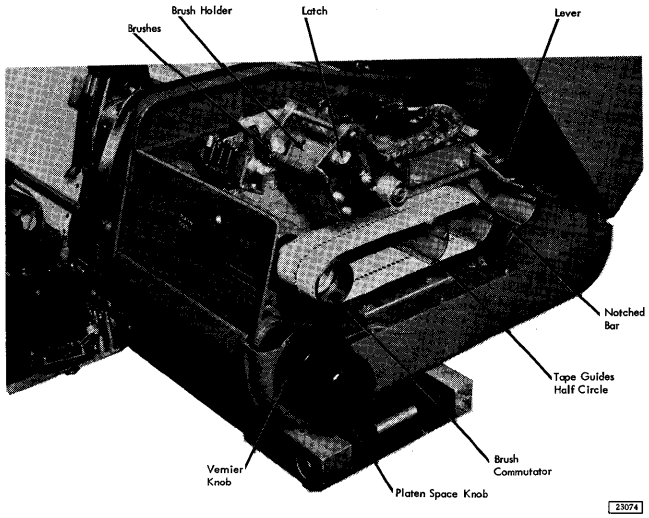


Figure 8. Inserting Tape in Carriage

Lateral Adjustment Handwheel. Turning this handwheel moves the carriage horizontally.

Lines Per Inch Adjustment. This mechanism, located on the right side of the forms tractor, allows the operator to select vertical spacing of 6 or 8 lines to the inch (Figure 10).

Carriage Control Tape

The control tape (Figure 11) has 12 columnar positions indicated by vertical lines. These positions are called channels. As viewed from the front of the machine, they are numbered 1 through 12 from left to right. Brush 1 rests on channel 1, brush 2 on channel 2, and so on. A maximum of 132 lines can be used for control of a form, although for convenience the tape blanks are slightly longer. Horizontal lines are spaced 6 to the inch for the entire length of the tape. Round holes in the center of the tape are pre-punched for the pin feed drive in the tape sensing mechanism.

Tape Channels

Tape channels are punched to control various functions:

1. Channels 1 through 6 are used to stop the form (skip to) as designated by the program. Channel 1 is normally punched for the first printing line of a form. When the Carriage Restore key is operated, the carriage will automatically seek channel 1 as a home position.
2. Channels 9 and 12 are normally used to sense the location of the form for the purpose of overflow. These two channels may be used for the same purpose as channels 1 through 6.
3. Channels 7, 8, 10, and 11 are not used.

A small compact punch (Figure 12) is provided for punching the tape.

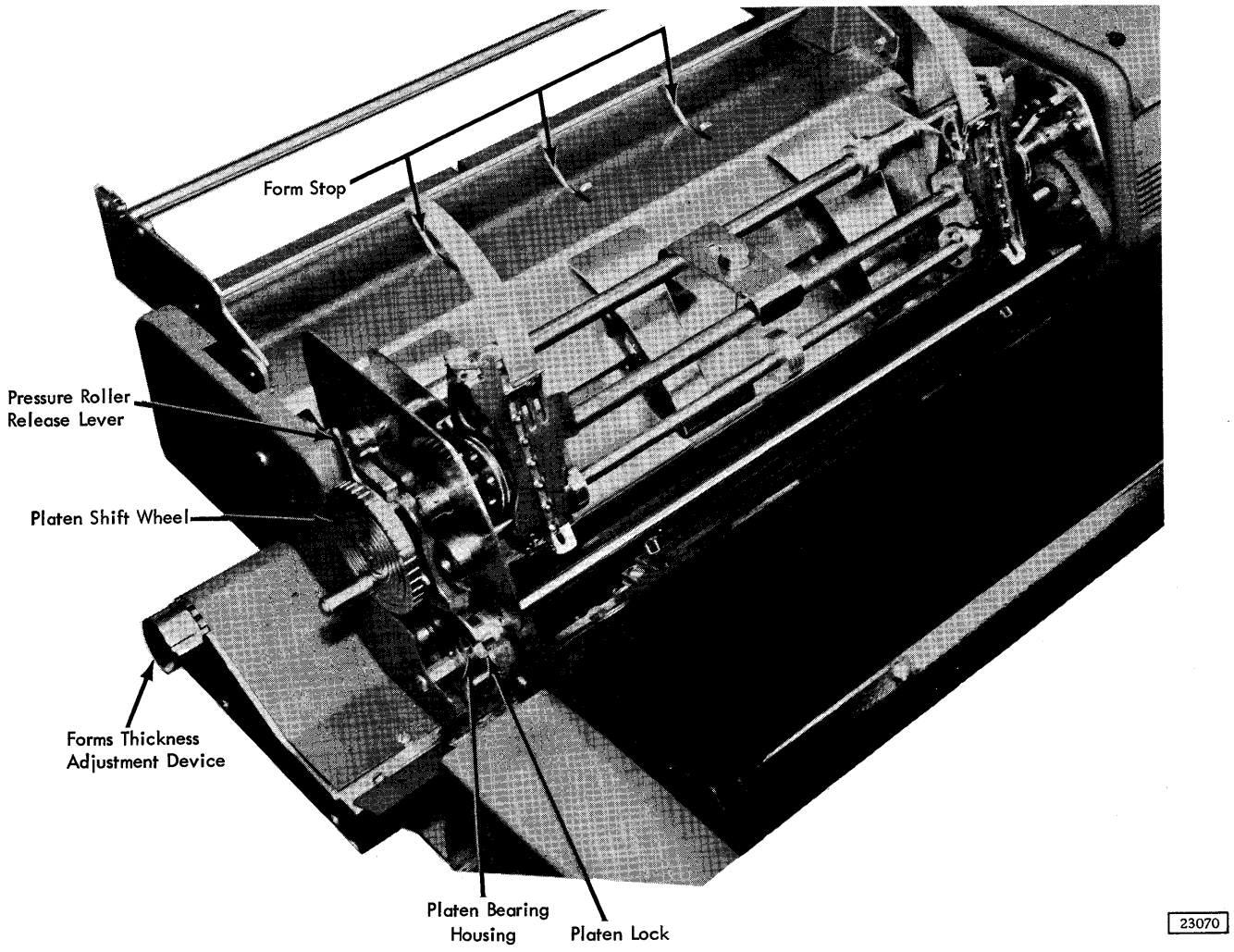


Figure 9. Left Side of Carriage

OPERATOR PROCEDURES

Carriage Control Tape Preparation and Punching

The tape blank is first marked in the channels in which the holes are to be punched for 6-lines-per-inch spacing. This can easily be done by laying the tape beside the left edge of the form, with the top line (immediately under the glue portion) even with the top edge of the form. A mark is then made in the first channel on the line that corresponds to the first printing line of the form. Additional marks are made in the appropriate channels for each of the stops and/or indicator channels.

The control tape for 8 lines-per-inch spacing is punched as it would be for normal 6 lines-per-inch spacing. Each line on the tape always equals one line on the form regardless of whether the latter be 6 or 8 lines per inch. Using an ordinary ruler, to prepare 8 lines to the inch tape, the ruler will show where to punch the holes in the tape, not by inches, but by lines. For example, if the first line is to be printed 1-6/8" from the top of the form, the hole in the tape should be punched in channel 1 line 14, of the tape (Figure 13). Every 1/8 inch on the form represents one line on the tape.

Normal spacing is 6 lines per inch. Variations that must be considered for 8 lines-per-inch spacing are illustrated in Table 1.

The marking for one form should be repeated as many times as the usable length of the tape allows. When the tape serves to control several forms in one revolution through the sensing mechanism, the life of the tape is increased. Mark the line corresponding to the bottom edge of the last form and cut it after the tape is punched.

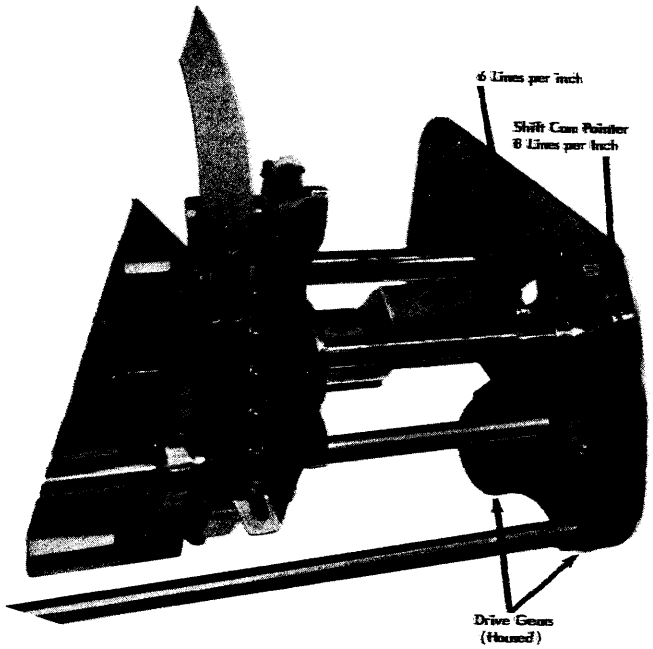


Figure 10. Forms Tractor Shift Cam Assembly

The tape is inserted in the punch by aligning the line to be punched with the guide line on the punch and placing the center feed holes of the tape over the pins projecting from the base. The dial is then turned until the arrow points to the number of the channel to be punched. By pressing on the top of the punch, toward the back, a rectangular hole will be cut at the intersection of a vertical and horizontal line in the required channel of the tape.

Table 1. Lines-Per-Inch Spacing Chart

	6 LINES PER INCH		8 LINES PER INCH	
	Corr. Tape Lines	Distance on Form	Corr. Tape Lines	Distance on From
Maximum Length of Form	132 Lines	22 Inches	132 Lines	16-1/2 Inches
Length of Form Compared with Length of Tape	———	Same	———	Form is 3/4 as long as one tape revolution
Distance to Move First Printing Line Back from Indicator to Print	14 Lines	2-1/3 Inches	19 Lines	Approximately 2-1/3 Inches*

* Vernier adjustment may be necessary

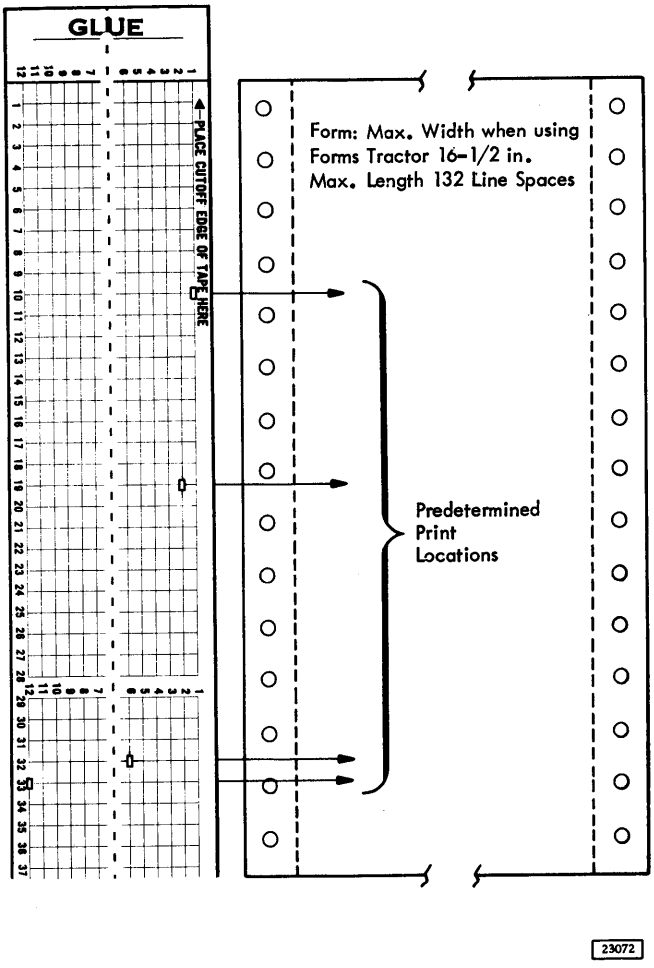


Figure 11. Control Tape Punching for Predetermined Printing Locations

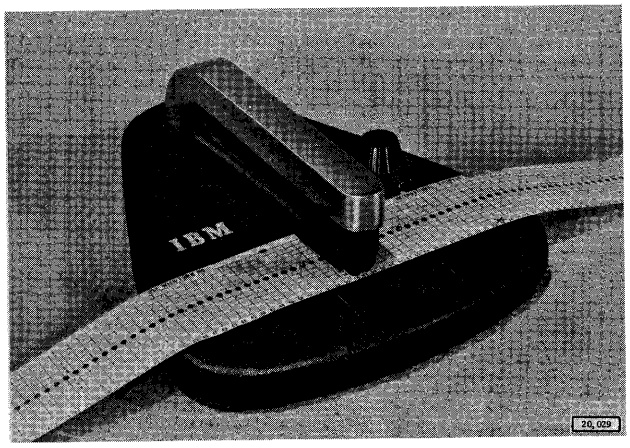


Figure 12. Tape Punch

The tape can be punched with holes in more than one channel on the same line. This is advantageous in cases where several skip conditions require stopping on the same line of the form.

After the tape is punched, it is cut and looped into a belt. The bottom end is glued to the top section, marked "Glue," so that the bottom edge coincides with the top line. Before the tape is glued, the glaze on the tape should be removed with an ink eraser to ensure a strong bond between the two tape surfaces. The center feed holes should coincide when the two ends of the tape are glued together.

The last hole punched in the tape should be not less than four lines from the cut edge, as approximately the last half inch of the tape overlaps the glue section when the two ends are spliced. If it is necessary to punch a hole lower than four lines from the bottom of the form, the tape should be placed with the top line (immediately under the glue portion) four lines lower than the top edge of the form before marking the channels. To compensate for the loss, the tape should then be cut four lines lower than the bottom edge of the form.

Inserting Control Tape in Carriage

Carriage control tapes are easily changed (Figure 8) and can be used repeatedly. The following installation procedure is recommended.

1. Tilt back the carriage cover to gain access to the tape reading mechanism.
2. Disengage the platen clutch.
3. Raise the brush holder by moving, to the left, the latch located on the side of the brush holder.
4. Holding the tape so that the printed captions can be read, loop one end over the pin feed drive wheel so that the pins engage the center drive holes. Lock the brush holder down.
5. Place the opposite end of the loop over the nearest half-circle guide piece. The excess slack is removed from the tape by tilting the lever that engages the notched bar and moving it to the rear of the carriage. The tape should be just tight enough so that it gives slightly when the top and bottom portions of the loop are pressed together. It should not fit too tightly or the pin feed holes will be damaged.
6. Press the Restore key to bring the tape to its home position.
7. Turn the Platen Clutch Knob back to the engaged position. The carriage is ready to operate.

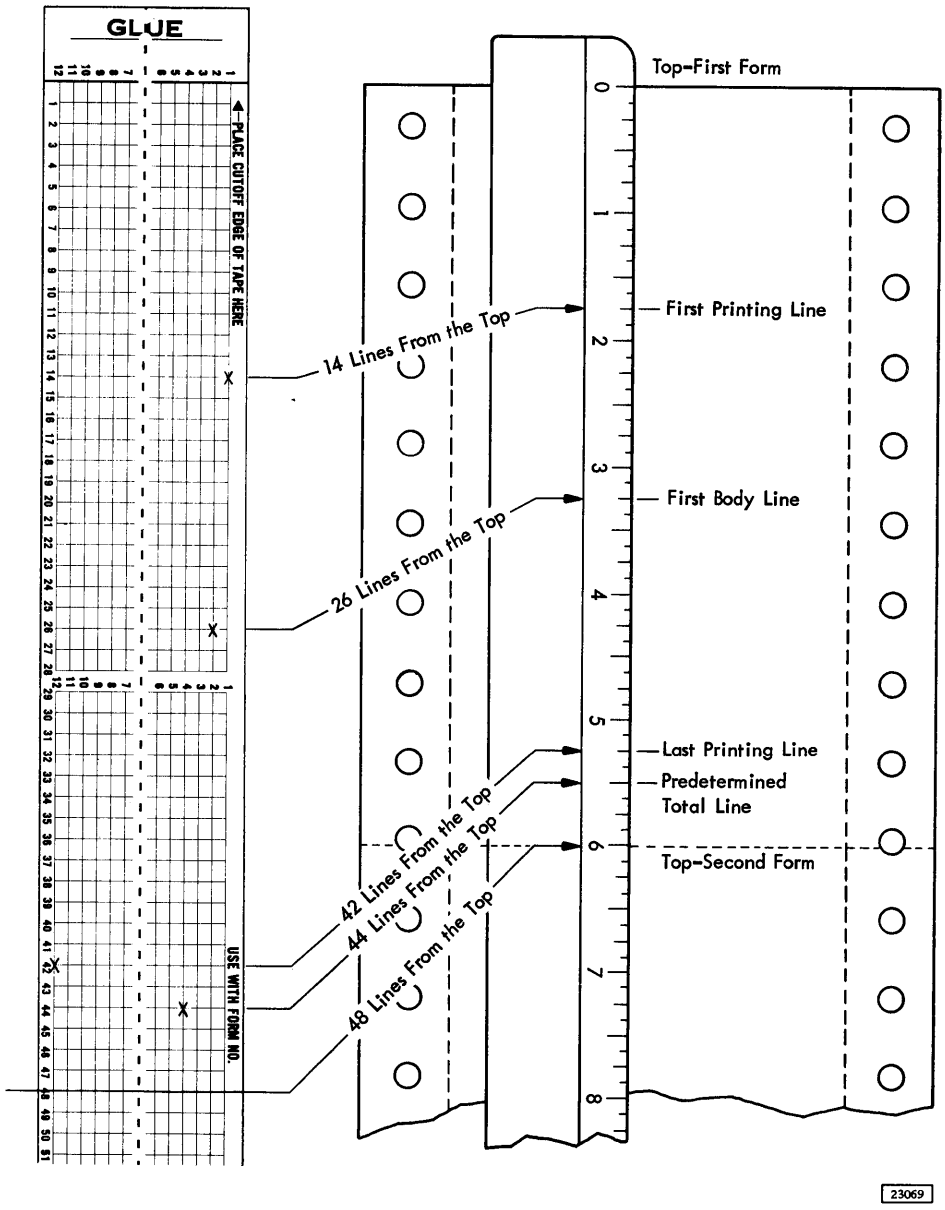


Figure 13. Determining Control-Tape Punching for Eight Lines Per-Inch Spacing

Installing Forms Tractor

The removable Forms Tractor (Figure 14) is easily inserted in the carriage.

1. Position the paper guides (on the bed of the carriage) to the far left and right sides of the carriage.
2. Hook the rear pins of the tractor in position and lower the front of the tractor until its drive gear engages the gear on the right end of the platen.
3. Position the shift cam pointer to the desired setting (6 or 8 lines per inch) between the scribed lines marked on the side frame. If the pointer cannot be positioned between the lines, a tooth-on-tooth condition exists between the platen gear and the forms tractor drive gear. In this case, move the shift cam to release the pressure on the drive gear and turn the platen slightly (platen clutch disengaged) to allow the teeth to engage fully.

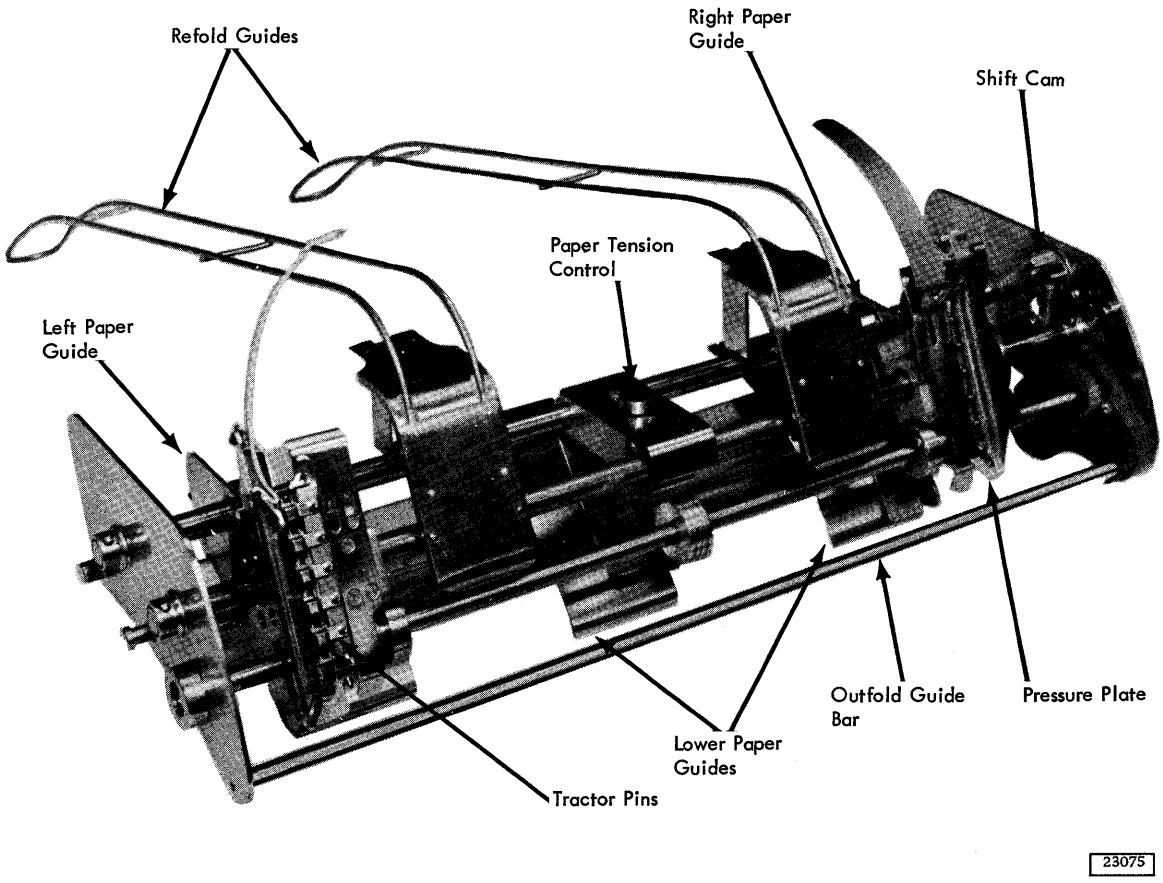


Figure 14. IBM Forms Tractor

Inserting Forms

1. Disengage the platen clutch. Turn the platen knob to make sure the platen and the forms tractor move freely.
2. If the form is less than 7 inches wide, the center paper guide and paper-tension device can be removed (Figure 15). The paper tension device is adjustable and exerts a slight pressure on the paper as it feeds through the forms tractor.
3. Loosen the left and right locking rings and move the lower paper guide to the left of the first printing position. Tighten the left locking ring.
4. Pass the form under the forms stop arms, over the lower paper guides, under the round rod, and then into the pressure rolls and platen. The right paper guide can now be positioned. Allow a slight clearance so the form slides freely between both guides. Tighten the right locking ring.
5. Remove the spring loaded outfold guide bar (Figure 14). Pull the pressure roll release lever forward and turn the platen knob until the end of the form can be grasped.
6. Pivot the right and left hinged pressure plates away from the tractor pins.
7. While holding the edge of the form, operate the pressure release lever to free the form and then position the form pin feed holes over the feed pins.
8. Return the pin feed pressure plates to their lowered position and replace the outfold guide bar. The outfold guide bar aids the feeding of forms.
9. With the platen knob, set the form so that the first printing line of the form is even with the first printing line indicator mark on the lower part of the pin feed pressure plates. Turn the form back fourteen spaces if spacing is set for 6 lines per inch or nineteen spaces if set for 8 lines per inch. Finer adjustments can be made by use of the vernier knob.

10. After inserting the control tape, restore the carriage (Carriage Restore key) and then engage the platen clutch.

Tractor Adjustments

The tractor adjustment wheels (Figure 15) can be turned to provide a 1/8 inch lateral movement of the tractors. These wheels make the tractor pins line up exactly with the center of the marginal holes in the paper after the paper guides have been set.

Ribbon Replacement

The ribbon feeds from one spool to the other by repeated steps, each step moving the ribbon approximately one inch. The ribbon feeds continuously while the printwheel drive motor is running. The direction of feeding is reversed when the metal eyelet near the end of the ribbon on either spool strikes the ribbon reversing lever.

When a new ribbon is installed, it is important that the leading end of the ribbon be firmly hooked onto the empty spool so that the metal eyelet is somewhere between the spool and the ribbon reversing

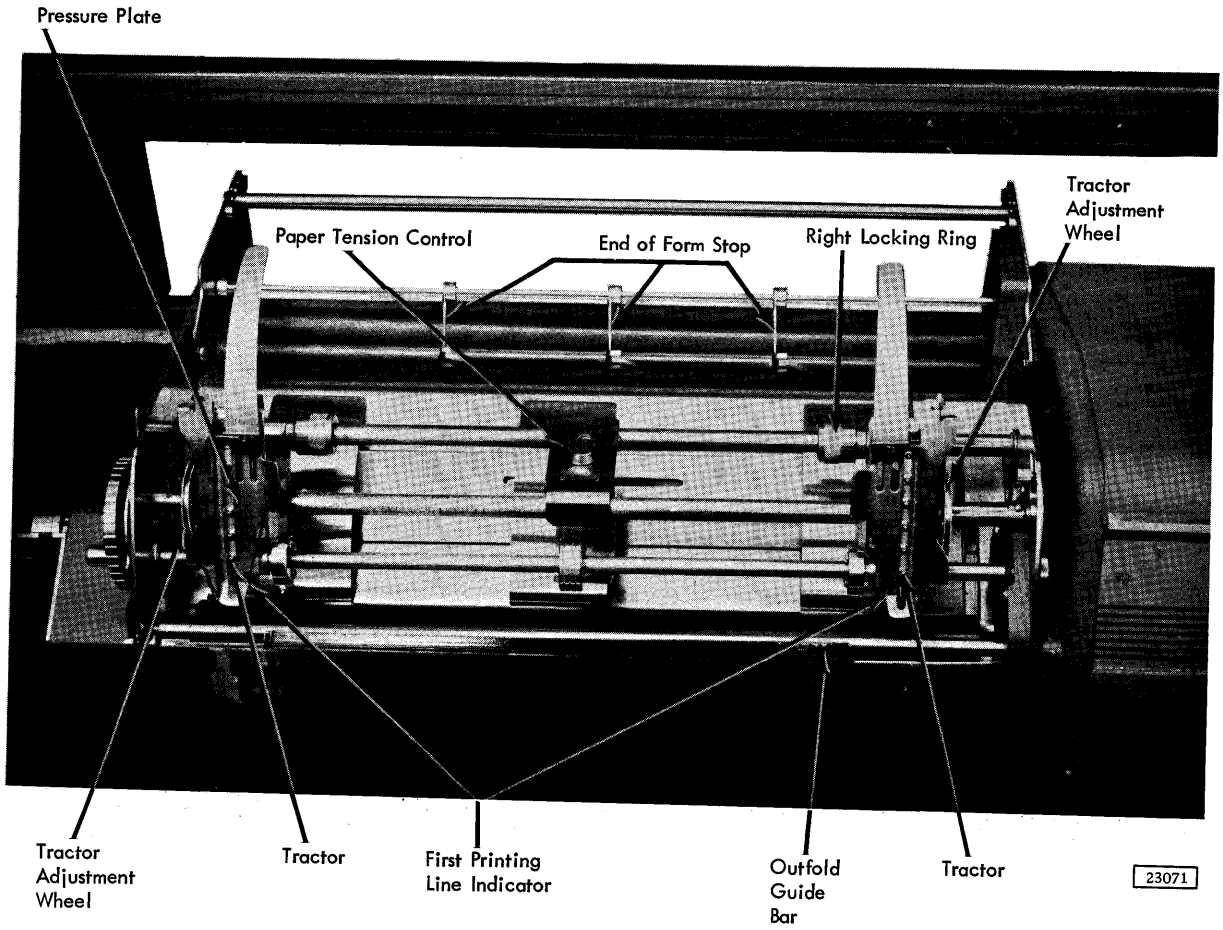


Figure 15. Front of Carriage

lever. The threading of the ribbon around the guide rollers is shown in Figure 16.

FORMS DESIGN

The 1132 carriage, with forms tractor installed, can accommodate continuous forms up to 16-1/2 inches wide (minimum width 4-3/4") and 132 line spaces long. Forms can be designed to permit printing in practically any desired arrangement.

Refer to the IBM publication Form and Card Design, Reference Manual (Form C20-8078) for information on form design considerations.

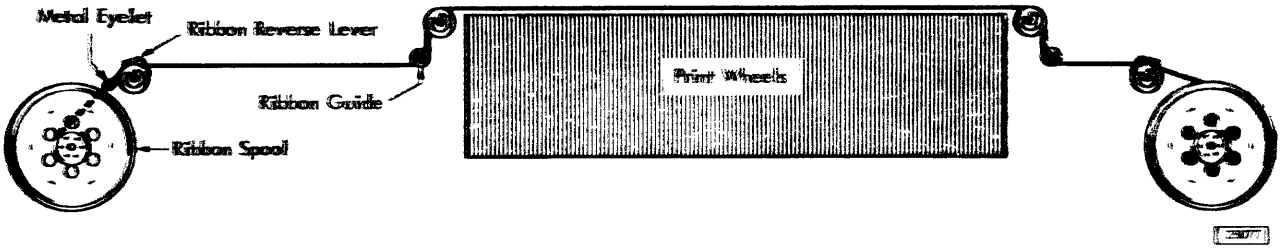


Figure 16. Ribbon-Feed Schematic

IBM 1442 CARD READ-PUNCH

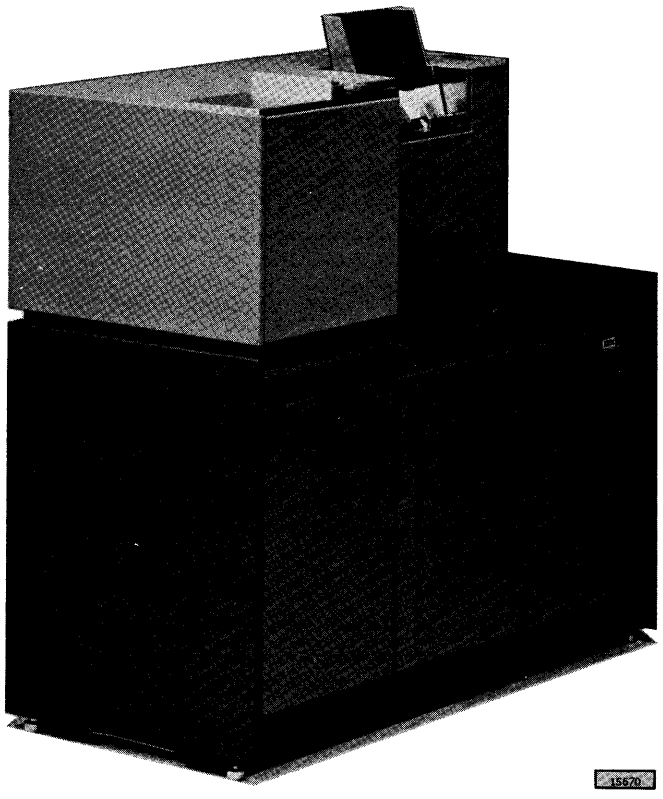
The IBM 1442 Card Read-Punch provides punched card input/output for the system to which it is attached. Card reading and punching are program controlled by the central processing unit.

The maximum machine speeds for card reading and card punching are:

Model 6:	Read	- 300 cards per minute
	Punch	- 80 columns per second
Model 7:	Read	- 400 cards per minute
	Punch	- 160 columns per second

FUNCTIONAL CHARACTERISTICS

Cards are placed in the hopper face down, 9-edge first. The hopper holds approximately 1200 cards. Cards are fed from the hopper 9-edge first. Figure 17 illustrates the path the cards follow during reading and/or punching operations.



IBM 1442 Card Read-Punch

Card Reading

Card reading is initiated by a program (Read Start) command. The card is fed through the reading station during the second card feed cycle (first card read cycle). This causes columns 1-80 of the card to be read in one continuous motion of the card. The card is read serially, that is, column by column, beginning with column one. Reading is accomplished through the principle of photocell sensing. Figure 18 illustrates the path of the card through the photocell reading mechanism. Each card column is read twice by the photocells, and the readings are compared for agreement. This read-check process continues until all 80 columns have been read.

After a read operation is completed, the card is registered in column 1 at the punch station.

Card Punching

If a punch command is initiated, an incremental punch drive causes the card to be punched and moved through the punch station. The CPU compares the punched data with data in core storage (to be punched) to verify punching accuracy.

The card motion and punching process continue until a signal from the program indicates the last column to be punched. Upon this signal, the 1442 punches and generates an operation complete interrupt. Once punching is terminated in this manner it cannot be restarted in this card.

NOTE: All cards pass through the read and punch stations, but reading and/or punching occurs only by program instruction.

When the hopper becomes empty during a feed cycle, the 1442 is taken out of Ready status. The operator may continue processing cards by loading more cards into the hopper and pressing the Start key or he may initiate a Last Card Sequence by pressing the Start key without loading more cards in the hopper.

Programming Considerations

Read

Data transfer begins with the data read from column one of the card and continues until all 80 columns are transferred from the reader to core storage. The instruction specifies the core storage location to which the character read is transferred.

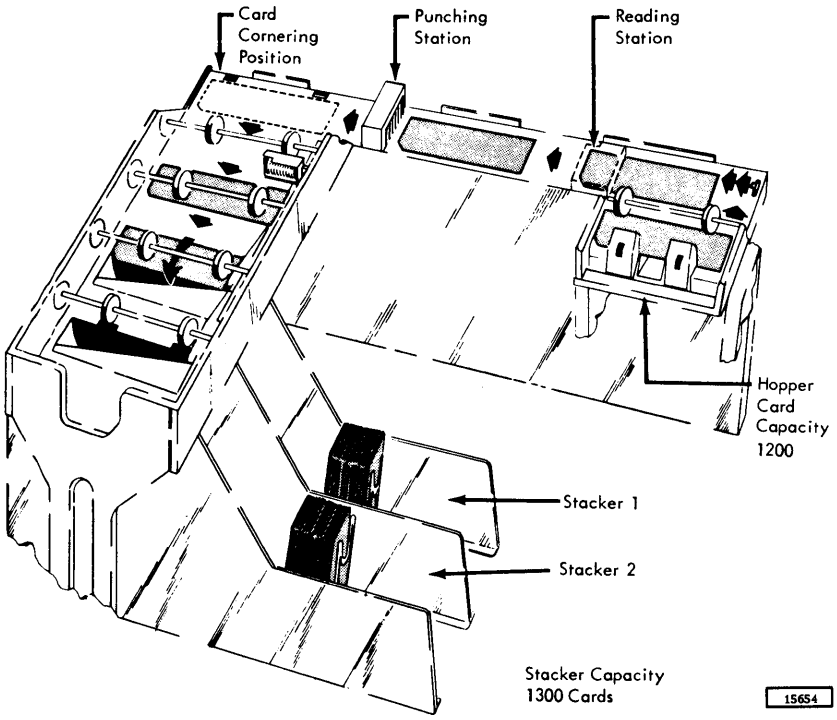


Figure 17. IBM 1442 Card Feed Path

NOTE: The Read Card instruction causes a card at the Punch station to be transported through the Punch station to the stacker. The card read moves from the Preread station to the Punch station as the following card feeds from the hopper to the Read station.

Maximum reading rates can be attained if following Feed and Read commands are given within 35 milliseconds (25 ms in the Model 7) after the End Operation interrupt (operation complete) is given by the 1442. If a read-cycle command does not occur within this time, the maximum reading rate becomes 285 cards per minute (cpm) for the Model 6 and 375 cpm for the Model 7.

Less time will be required of the CPU for servicing the 1442 when less than 80 columns of the card are read into core storage, thereby leaving more time available for computing.

Punch

Punching rates depend on the number of columns spaced and punched, that is, the position of the card when the last column is punched. The punching speed ranges are:

Model 6 - 49 cpm to 255 cpm (12.5 ms per column spaced or punched)

Model 7 - 90 cpm to 340 cpm (6.5 ms per column spaced or punched)

Table 2 shows approximate punch cycle times and cards per minute rates based upon the last column punched.

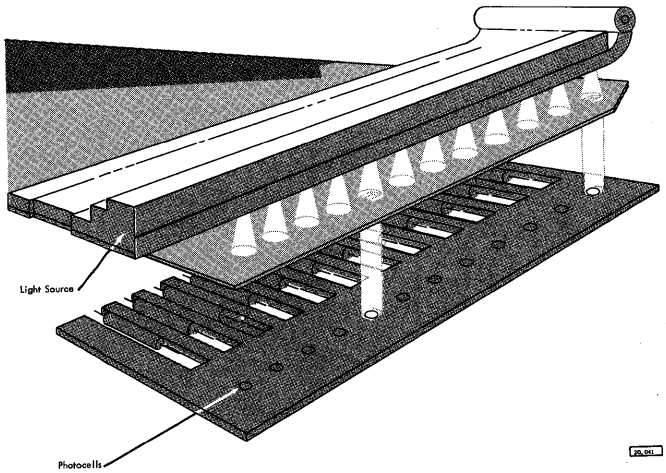


Figure 18. Photocell Reading.

Table 2. Punch Cycle Times and Cards Per Minute Rates (Approximate)

Last Column Punched	Punch Time (ms)		Total Punch Cycle Time (ms)		Cards per Minute	
	Model 6	Model 7	Model 6	Model 7	Model 6	Model 7
1	13	6	229	169	202	355
10	125	63	341	226	176	265
20	250	125	466	288	127	208
30	375	188	591	351	102	171
40	500	250	716	413	84	145
50	625	313	841	476	71	126
60	750	375	966	538	62	112
70	875	438	1091	601	55	100
80	1000	500	1216	663	49	91

Z3095

The instruction specifies the core storage location from which the character is to be transferred to the 1442. The punch operation is terminated by the End Punch bit contained in the data word of the last column to be punched.

Combined Reading and Punching

It is important to consider card design when the operation calls for reading a card, processing the information, and then punching the results into the same card. A significant increase in card throughput results from punching into the beginning columns of the card (see Table 2).

Data Coding

The 1442 reads and punches any combination of holes in any card column. Any code translation required must be done by the stored program. During normal read operations the twelve rows (12–9) in a card column correspond to the 0–11 bits, respectively, in the core storage word (Figure 19).

Selective Stacker

The Selective Stacker is a standard feature of Models 6 and 7. The feature allows Stacker No. 2 to be selected under program control. If a stacker is not specified by the program, the cards eject to Stacker No. 1.

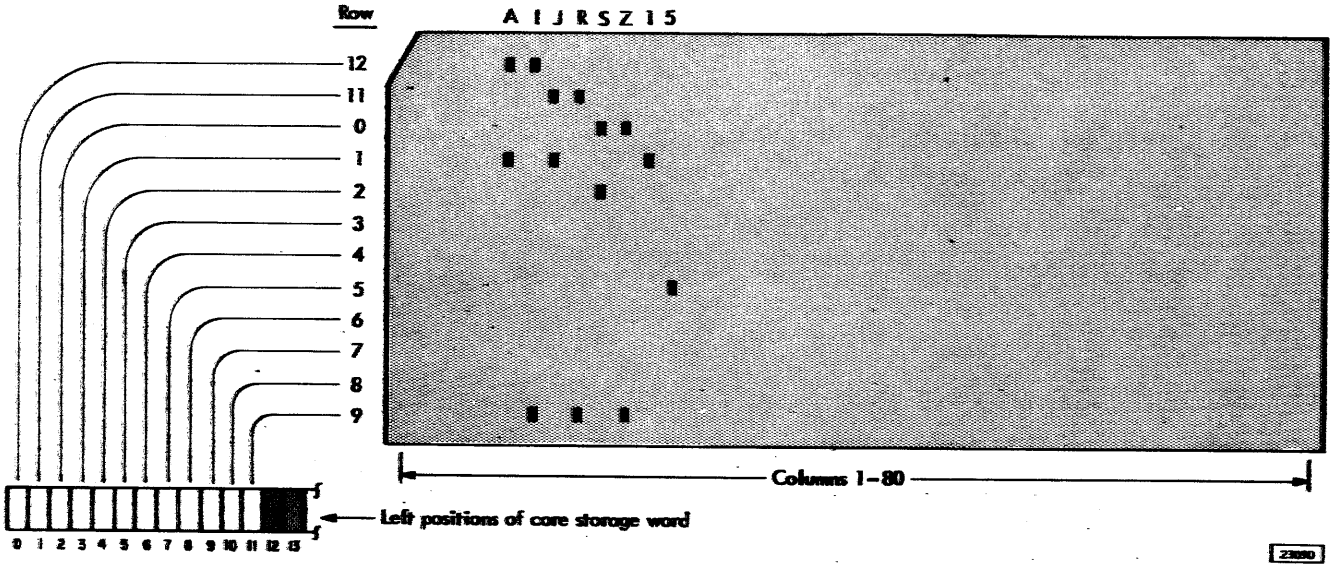


Figure 19. Card Code/Core Storage Transfer

OPERATIONAL CHARACTERISTICS

Operating Keys and Lights

The operating keys and lights, Figure 20, give the operator a visual indication of the operating condition of the IBM 1442 and provide start, stop and runout control.

Keys

Start Key. This key is used to perform the following functions.

1. For initial run in.
2. To restore ready after manually stopping the 1442.
3. To initiate a Last Card Sequence.

Stop Key. This key removes the 1442 from the Ready status.

Nonprocess Runout Key. The NPRO key is used to eject cards from the read-punch path without processing them. This key also resets a Check condition. It is effective only when the hopper is empty. If the Check light is on, raise the cover, clear the card feed, and close the cover to make the NPRO key function.

Lights

Ready Light. The Ready light indicates that the 1442 is prepared to accept instructions from the processor. The following conditions are required to have the 1442 in a Ready status.

1. Power on.
2. A card registered at the read station by initial run in.
3. Either cards in the hopper or the 1442 in the Last Card Sequence routine.
4. Stacker not full.
5. Chip Box light off.
6. Check light off.

End File Light. This light turns on when the Last Card Sequence routine is initiated.

Chip Box Light. This light indicates that the chip box is either full or removed.

Power On Light. This light indicates that power is supplied to the 1442.

Check Light. This attention Check light is turned on when any of the six check condition lights (back lighted panel) are turned on. The check condition lights indicate the area and/or cause of the check.

Feed Interrupt. This check condition light is turned on when a card fails to feed from the hopper to the read area.

Stacker Light. This light indicates a card is out of position in the card transport area between the punch station and the stackers.

Read Station Light. This light indicates a mispositioned card in the read station.

Punch Station Light. This light indicates a card is out of position in the punch station.

Read Register Light. This light is turned on if a read check error occurs during a read cycle (the two photocell readings of a column did not compare).

Punch Check Light. The Punch Check light is turned on if data to be punched and the image of the punch magnets impulsed do not compare.

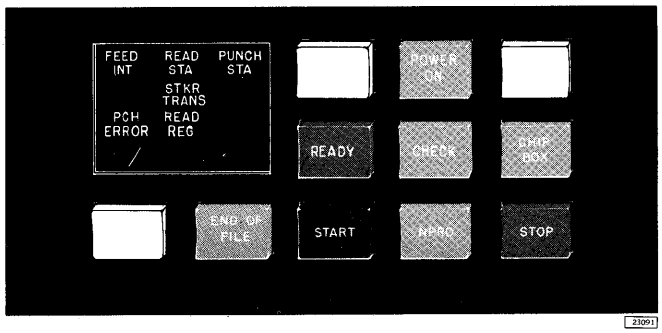


Figure 20. Operator Lights and Keys

The IBM 1627 Plotter provides a reliable, easy-to-operate plotting system by converting tabulated digital information to graphic form. Bar charts, flow charts, organization charts, engineering drawings, and maps, in addition to graphs or drawings that depict financial, scientific, or technical data, can be plotted on the 1627 Plotter.

Two models of the 1627 are available.

Model 1 - Plotting area: 11 inches by 120 feet
Step size: 1/100 inch increments
Speed: 300 steps/second

Model 2 - Plotting area: 29-1/2 inches by 120 feet
Step size: 1/100 inch increments
Speed: 200 steps/second

Additional information on both models is given in Table 3. Either model of the 1627 can be attached to the using system.

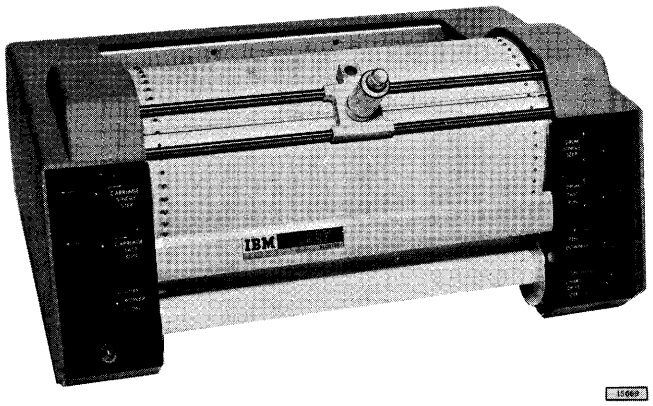
Table 3. 1627 Characteristics

		Model 1	Model 2
Speed	x, y Increments	18,000 Steps/Min	12,000 Steps/Min
	Pen Status Change	600 Operations/Min	600 Operations/Min
Increment Size		1/100 inch	1/100 inch
Chart Paper	Width	12 inches	31 inches
	Plotting Width	11 inches	29-1/2 inches
	Length	120 Feet	120 Feet
	Sprocket Hole	.130 Inch Dia.	.188 Inch Dia
	Dimensions	on 3/8 Inch Centers	on 1 inch Centers

23086

FUNCTIONAL CHARACTERISTICS

The recording of data by the 1627 is accomplished by the incremental movement of the pen on the paper surface (y-axis) and/or the paper under the pen (x-axis). The pen is mounted in a carriage that travels horizontally across the paper as viewed from the front of the plotter. The vertical plotting motion is achieved by rotation of the pin feed drum (Figure 21) which also acts as a platen.

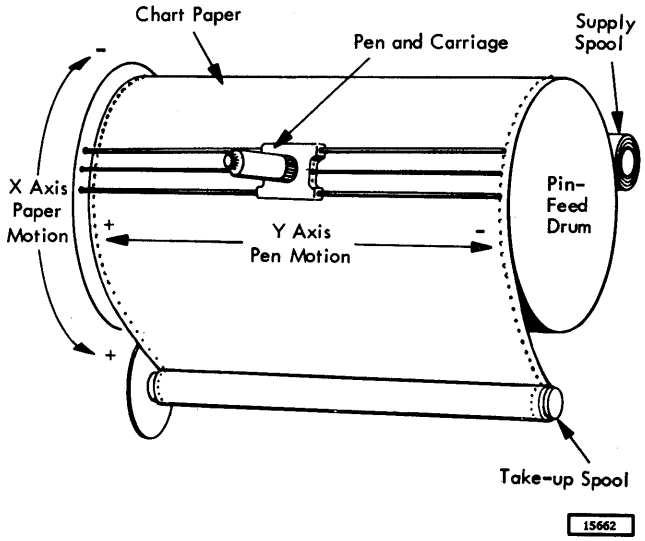


15669

IBM 1627 Plotter, Model 1

The drum and the pen carriage are bi-directional; that is, the paper moves up or down and the pen moves left or right. A control is also provided to lower or raise the pen in relation to the chart paper surface. The pen remains in the "raised" or "lowered" position until directed to change to the opposite status.

The drum and pen-carriage movements and the pen status are controlled by CPU instruction. The bits are decoded into a directional signal and relayed



15662

Figure 21. Paper and Pen Motions (1627)

to the 1627 Plotter. Each signal to the plotter causes a 1/100 inch incremental movement of the pen carriage and/or paper, or raise or lower pen movement. The motion or action resulting from a decoded directional signal is shown in Figure 22.

Programming Considerations

The time required for the execution of a raise or lower pen command is 100 ms. The time required to plot a point is approximately 3.3 ms for the Model 1 and approximately 5.0 ms for the Model 2. In order to keep the plotter operating at full speed, subsequent control information must be sent to the plotter 0.5 ms after an interrupt (step complete) from the plotter.

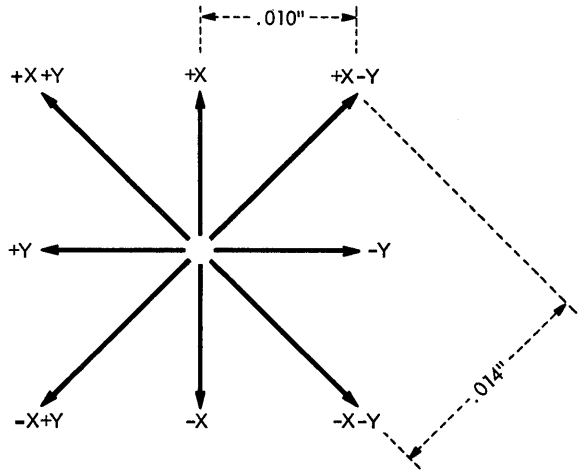
OPERATIONAL CHARACTERISTICS

Operator Controls

Seven operating controls and one Power On light are mounted on the front panels of the 1627 (Figures 23 and 24). A description of the function of each control follows:

Power. This switch connects power from the CPU to the 1627. The switch operates only when the CPU mainline power switch is in the ON position. There is no "power-on delay" involved with the 1627 Power switch, i.e., the plotter can operate as soon as the switch is turned on.

Carriage Fast Run. This switch allows the pen carriage to be stepped rapidly to the left or right at the rate of 120 steps a second. The Carriage Fast Run switch is used to move the carriage to any desired area of the graph.



NOTES:

1. Raise and lower pen motions are not shown above.
2. Normally, graphs are plotted so that their horizontal axes are, in reality, the X axis as shown above.

23087

Figure 22. Directional Signal Plotter Action

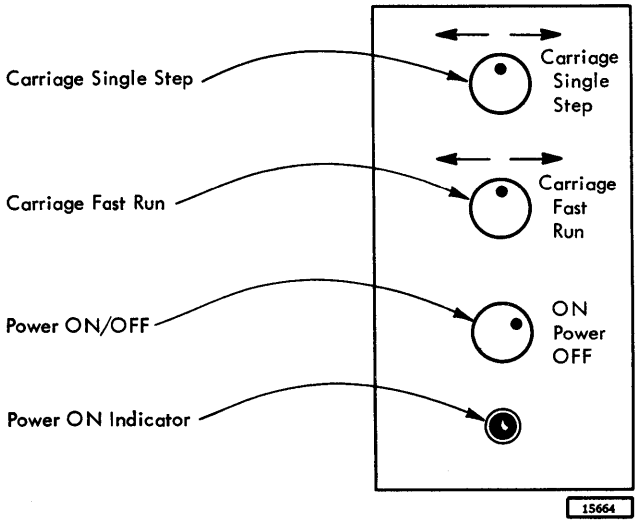


Figure 23. Left 1627 Controls

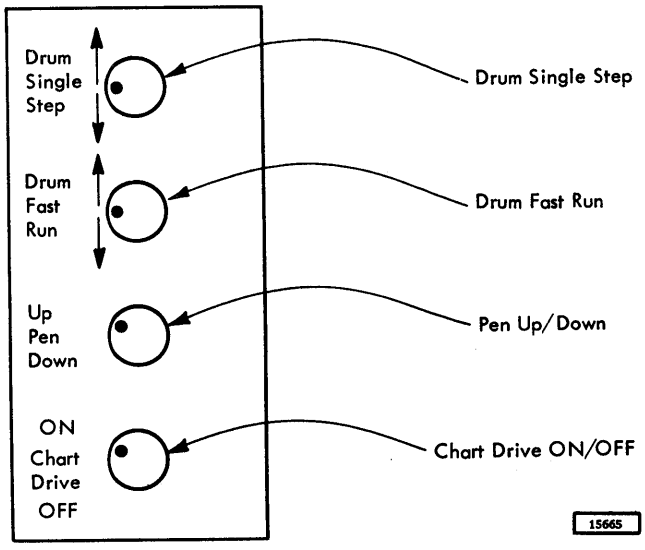


Figure 24. Right 1627 Controls

Carriage Single Step. This switch allows the pen carriage to be moved in single-step increments (1/100 inch) either left or right. The Carriage Single Step switch permits the operator to accurately align the carriage along the y-axis of the chart.

Drum Fast Run. This switch allows the drum to move the paper rapidly up or down at the rate of 120 steps a second. The Drum Fast Run switch is used in conjunction with the Carriage Fast Run switch to position the pen to any desired area of the graph.

Drum Single Step. This switch allows the drum to be rotated in single-step increments (1/100 inch) in either direction. The Drum Single Step switch is used in conjunction with the Carriage Single Step switch to permit the operator to accurately align the pen on a point or fixed coordinate on the graph.

Pen. This switch provides for manually raising or lowering the pen.

Chart Drive. This switch allows the front and rear chart drives to be disabled. When recording on single sheets of graph paper, the Chart Drive switch should be in the OFF position. When recording on roll-paper, this switch should be in the ON position.

Vernier Control. A vernier control is provided on the 1627, Model 2, to vary the size of the pen carriage increments. In this way, the pen traverse is adjusted to match the printed scale of the chart paper which may vary in width due to high or low humidity. The Vernier control knob is located at the left end of the drum above the switch panel. For work with non-scale paper, the control should be centered at the zero position. To adjust the vernier control for scaled paper:

1. Use the reticle to accurately position the pen carriage over a vertical grid line located to the right of the chart center.
2. Program the system to move the pen carriage 1000 increments to the left.
3. When the carriage completes its travel (10 inches), use the vernier control to position the carriage directly over the 10th grid line from the starting position.

(In this explanation, one grid line per inch is assumed. Normally, graph paper is printed with two or more grid sizes.)

Setup Procedures

The setup procedures for the 1627 consist of installing the chart paper and pen assembly, and aligning the pen carriage and chart paper with the starting point of the graph. These procedures are described in the following paragraphs.

Installation of Chart Roll Paper. To install a roll of chart paper in the plotter:

1. Turn the Power switch to OFF.
2. Remove the pen assembly, if installed, by loosening the knurled knob at the bottom of the pen holder and lifting the assembly out of the carriage.

> CAUTION: Use care when handling the pen assembly. This assembly is manufactured to close tolerances for optimum performance.

3. Rotate the right rear chart spool by hand until the drive key is pointing upward.
4. Hold the new roll of chart paper so that the key slot in the core is pointing upward. Place the roll against the spring-loaded left rear idler spool and force the spool to the left.
5. Lower the paper roll into the paper well and slide the right end onto the drive spool. Make certain the drive key engages the key slot in the core.
6. Install a paper roll core on the two front spools below the drum, in the same manner as with the paper roll.
7. Pull a short length of paper off the roll, slide the end under the carriage rods, under the tearbar, behind the core, and fasten it to the front side of the core with two or three short pieces of cellophane tape. Wind one or two turns of paper onto the core. Make certain the drum sprockets are properly meshed with the sprocket holes on both sides of the paper.
8. Reinstall the pen assembly in the carriage.
9. Turn the Power switch to ON.

NOTE: The pen is down with power off, so the pen assembly should be installed with the carriage over an area outside the "recording area." If the pen does not raise when power is turned on, turn the Pen switch to DOWN, then to UP.

The roll of chart paper can be removed by reversing the installation sequence.

Installation of Single Sheet Graph Paper. A single sheet of graph paper may be used for plotting and is installed as follows:

1. Set Power and Chart Drive switches to OFF.
2. Remove the pen assembly from the carriage.
3. Slide the graph paper sheet under the carriage rods onto the drum surface.
4. Fasten the top edge of the paper to the drum with two or three short pieces of cellophane tape. Rotate the drum by hand, keeping the paper smooth and flat against the drum surface. Fasten the bottom edge of the paper in the same manner as the top edge.
5. Reinstall the pen assembly in the carriage. (See note under step 9 in Installation of Chart Roll Paper.)
6. Turn the Power switch to ON.

Reverse the procedure for the removal of single sheet graph paper. Any remaining tape adhesive should be cleaned from the drum surface with acetone or cleaning solvent.

Reticle Adjustment. An alignment reticle is provided to permit accurate alignment of the pen carriage to the chart paper. The reticle is inserted in place of the pen assembly in the carriage. By using the carriage and drum controls, the carriage can be moved to align the cross-hairs of the reticle with the desired starting position of the graph. When the reticle is removed and the pen assembly inserted into the carriage, the pen point is aligned to the position indicated by the cross-hairs. An alternate offset reticle is provided which does not require removal of the pen. It is mounted on the pen carriage and the distance between the cross-hairs and pen point is exactly one inch on the x-axis.

Pen Assemblies. The components of the pen assembly are illustrated in Figure 25. Four ballpoint pens are supplied with the recorder: black, blue, red, and green. To assemble the pen, insert the pen desired into the plunger, insert the pen and plunger into the holder, and install the threaded cap. Align the key on the holder with the key slots in the carriage and press the pen assembly into the pen mounting. Tighten the knurled nut on the bottom of the pen assembly.

NOTE: The ballpoint pens used with the 1627 may blot. Therefore, it is recommended the pen tip be cleaned after each hour of use. Also, since the life span of the pen is approximately 5 to 7 hours of use, the user may wish to replace a pen before plotting a critical project.

Operation Checkout

The following procedure is recommended as an overall check of the operation of the 1627 Plotter. This procedure should be performed prior to the start of automatic recording, and if the plotter is used infrequently, a checkout should be performed approximately once a week. Frequent cleaning is also advised, especially of the drum surface and carriage rails. They should be wiped with a clean soft cloth.

Checkout Procedure

1. Install the chart paper and install the pen assembly in the carriage.
2. Turn the Power and Chart Drive switches to the ON position. Turn the Pen switch to the DOWN position.

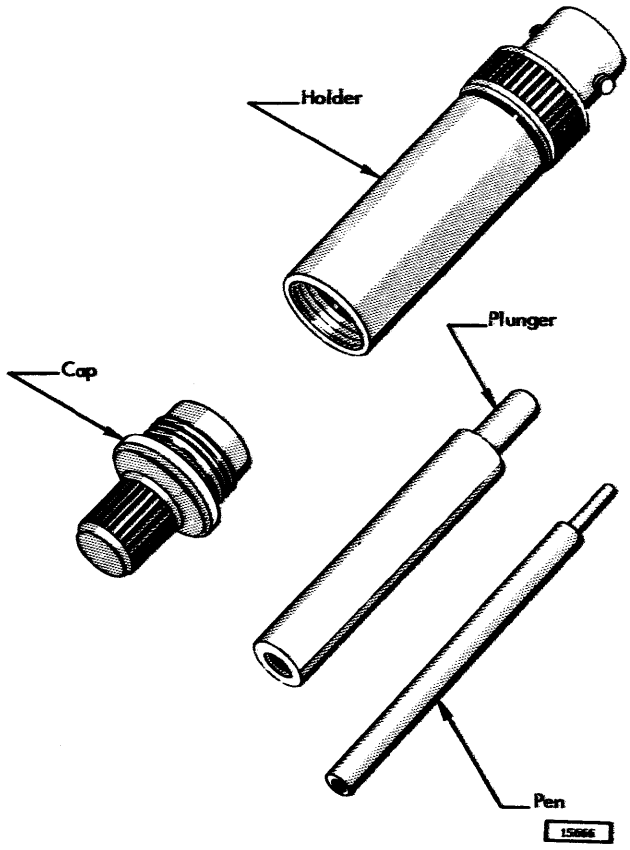


Figure 25. Pen Assembly Components

3. Turn the Drum Fast Run switch to the UP position and check that the pen traces a vertical line.
4. Turn the Pen switch to the UP position and check that the pen lifts off the paper surface.
5. Turn the Pen and Drum Fast Run switches to the DOWN positions and check that the pen retraces the line drawn in step 3.
6. Turn the Carriage Fast Run switch to the left position and check that the pen traces a horizontal line. When the carriage reaches its limit of travel, turn the Carriage Fast Run switch to the right, and check that the pen retraces the horizontal line.
7. Alternately operate the Carriage Single Step and Drum Single Step switches. Check that both the carriage and drum move only one step each time one of the switches is operated.
8. With the carriage positioned near the right side, set the Carriage Fast Run switch to the left position and Drum Fast Run to the DOWN position. Allow the pen carriage to run until it reaches the left side, then turn both switches to the off (center) position. Check that the pen traces a 45° line. Operate the Drum Single Step switch several times in the same direction. Set the Drum Fast Run switch to the right. When the carriage reaches the right side, turn both switches off. Check that the pen traces another 45° line and that the lines are parallel.
9. Repeat step 8, changing the switch settings to produce two 45° lines at right angles to the first two.

Program Checkout Routine

It is useful to include a program checking routine within a program designed for plotter use. This routine is used for "debugging" the program initially and for checkout of the system at any time. The program check provides a graphic representation to replace the feedback checks used in other output units.

The logic of a program check is simple: (1) plot a plus symbol (+) at the start of the program (outside the graph area), and (2) return to this location at the end of the program to superimpose an X over the plus symbol. Refer to Figure 26 for an example.

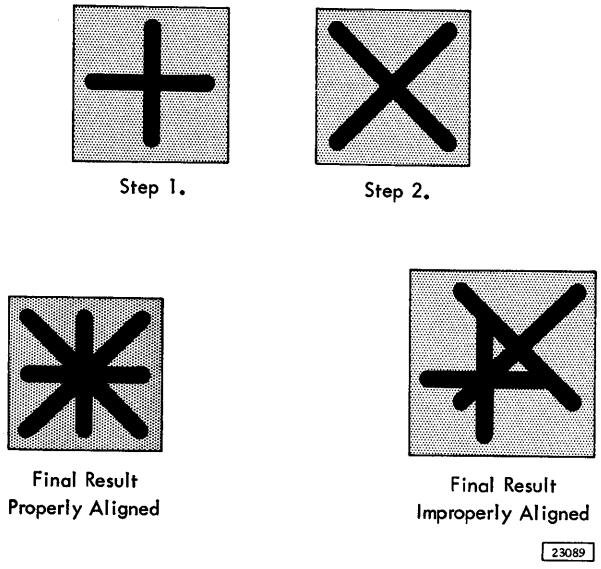


Figure 26. Program Checkout Technique

CUT ALONG LINE

READER'S SURVEY FORM

IBM 1130 Computing System
Input/Output Units

A26-5890-2

Is the material:	Yes	No	No Opinion
Easy to read?	☐	☐	☐
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Fully covered?	☐	☐	☐
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b. For information about programming? ☐
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