XI PAPER TAPE READER AND PUNCH

GENERAL DESCRIPTION

The GE-225 paper tape reader and punch provides input and output of information to and from the central processor by means of reading and punching paper tape under program control. Access to and from the central processor is through the same channel as that used by the typewriter. The channel feeds information between paper tape and the computer memory via the A and N registers, as illustrated in Figure XI-1. Computer operations using the A and N registers must stop during paper tape data transfer, but all other operations can continue.

Although they are in the same cabinet and are controlled from a single control and indicator panel, the reader and punch function separately; they have their separate loading and operating areas. Reading and punching cannot be done at the same time, but a single program can alternately read tape and punch tape. Figure XI-2 is an illustration of the paper tape reader and punch with the read and punch areas designated.

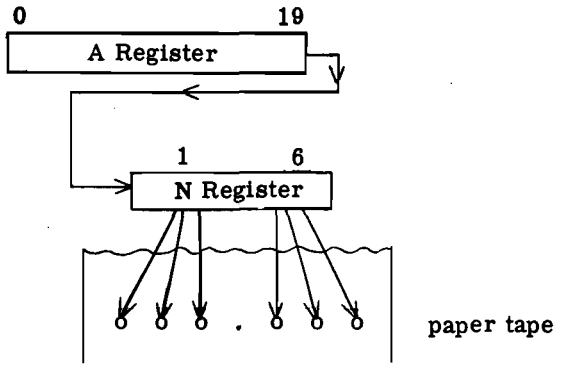


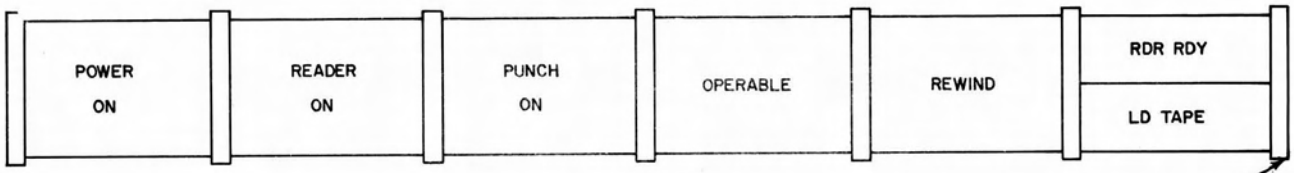
Figure XI-1. Information Flow From the Computer to Paper Tape (6-Channel Tape)

Paper Tape Reader

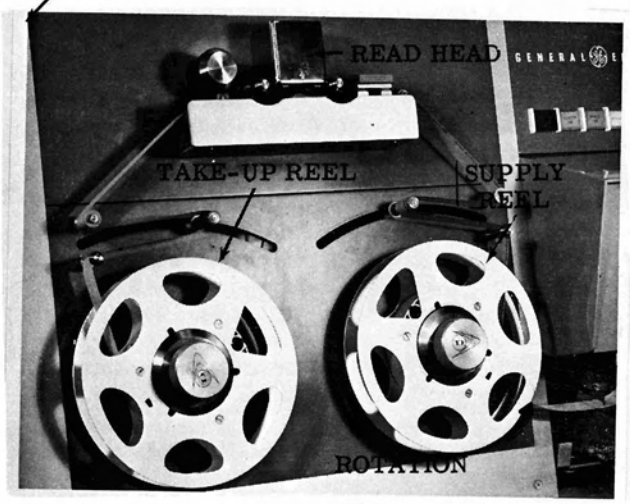
The paper tape reader consists of a photoelectric reading mechanism and reader control logic. The reader control logic interprets commands from the central processor and controls the reader mechanism. Paper tape punched by any unit using standard (10 character-to-the-inch) character and sprocket-hole spacing may be read. Tape requirements are specified under the heading of 'Characteristics of Paper Tape.'

Two models of readers are in general use. The difference between the two is that one model has spoolers and the other does not. The spooler mechanism (Figure XI-2) permits tape to be fed from a supply reel to a takeup reel. Tension arms control tape movement, permitting smooth starting and stopping. The maximum speed with spoolers is 400 characters per second, which is the speed used during rewind. Reading must be at the speed of 250 characters per second which is the LOW setting on the SPEED CHANGE switch. The use of both models is identical when tape is read by the 'strip' method. As the term implies, in the strip method, tape is left in a strip and falls loosely from the read area both before and after reading. An advantage in strip reading is that it can be done at high speed -- 1000 characters a second. A disadvantage in strip reading is that handling long tape is cumbersome and the tape can become tangled and torn, particularly when there are programmed starts and stops. It is best that the strip method be confined to reading tape no more than six feet long. Under the heading of 'Setup Procedure,' operating procedures are given for reading by both the strip method and from spoolers.

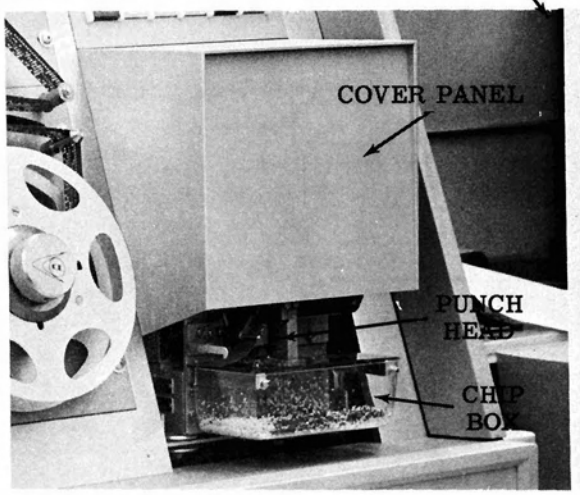
The reader control logic handles parity checking, code level selection, special character control including the delete code, and leader and trailer inhibit.



OPERATOR'S CONTROL PANEL



PAPER TAPE READER WITH SPOOLERS



PAPER TAPE PUNCH

Figure XI-2. Paper Tape Reader and Punch

Reading is performed when information is detected photoelectrically as perforated tape passes between nine photodiodes and a light source. The photodiodes are aligned with the eight information-channel positions and the sprocket position of the tape (Figure XI-3). Photodiodes change the light from the light source to electrical signals. Signals are generated only when light reaches a photodiode by passing through a hole in the tape. The signal is then amplified and sent to the N register of the central processor.

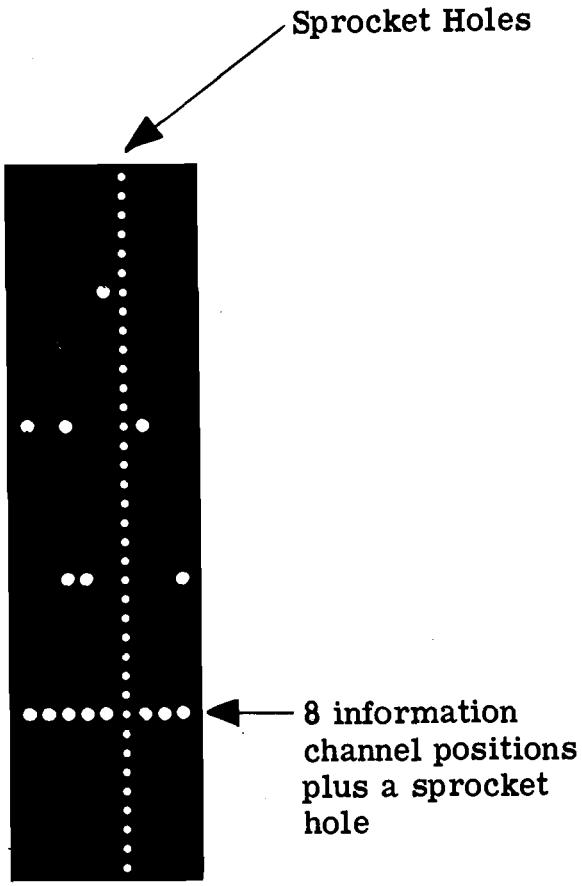


Figure XI-3. Sample of Paper Tape

Tape is moved by the drive assembly which consists of a capstan motor, a pinch roller, and a braking mechanism. When the pinch roller presses against the rotating capstan, tape is moved under the head assembly until it is stopped by the brake or by the removal of power. The steps of a read operation are described under the headings of the applicable program instructions as follows:

A Reader On (RON) Instruction in the program sends power to the capstan motor and causes the capstan to rotate. It clears the N register, and removes power from the paper tape punch and typewriter.

A Read Paper Tape (RPT) Instruction causes the pinch roller to press tape against the rotating capstan, causing the tape to move. As soon as the light source passes through a punched hole in the tape, the photodiodes route the information to the N register. Tape continues to move and information continues to be read until a Halt Paper Tape signal is received, or until one of the following conditions is encountered:

1. The computer is put into the manual mode during paper tape reading
2. There is an echo alarm
3. There is a card reader alarm
4. There is a card punch alarm
5. There is a parity error connected with either memory or the N register and the STOP ON PARITY ALARM/NORM switch on the computer console is set to STOP ON PARITY ALARM

The Halt Paper Tape (HPT) Instruction terminates reading and stops tape movement. It does this by releasing the pinch roller and by activating the brake.

When reading at high speed (1000 char/sec), the tape stops within 0.225 inches of the last character read. This means that the last character read is two characters beyond the read station.

When reading at low speed (250 char/sec), the tape stops within 0.015 inches of the last character read. This means that it stops before the next character passes the read station.

Paper Tape Punch

The paper tape punch consists of the tape punching mechanism and punch control logic. The logic interprets commands from the central processor and controls the punching operation. The punch is capable of punching 5-, 6-, 7-, and 8-level tape at a maximum rate of 110 characters per second. Tape levels are described under the heading of 'Characteristics of Paper Tape.' The sprocket hole (feed hole) channel and a maximum of eight information channels (or seven plus a parity channel) can be punched under program control. (See Figure XI-3.) Information is fed from

the 6-bit N register to the punch mechanism. The sprocket punch pin is actuated mechanically, and punch pins for the other channels are actuated magnetically. A motor drives the punch mechanism. Timing signals produced within the punch send control signals to the paper tape logic so information from the N register arrives at the punch code magnets at the proper time. Each 1-bit received energizes the punch magnet for that channel and drives a punch pin through the paper tape. When no information is received from N, punch magnets are not energized. The steps of a punch operation are described under the headings of the applicable program instructions as follows:

A Punch Power On (PON) Instruction sends power to the punch motor. It also turns power off to the paper tape reader and the typewriter. A 500 millisecond delay is required for the motor to reach operating speed.

A Write Paper Tape (WPT) Instruction must be given for each character to be punched, for the punch punches one character and halts. The instruction causes the information in the N register to be channeled, during a timing pulse, to the punch magnets. The information is then punched and the tape is fed forward one frame.

The Input/Output Power Off (OFF) Instruction removes power from the punch motor, thereby causing all punch operations to stop.

INSTRUCTIONS PERTAINING TO PAPER TAPE

The instructions pertaining to paper tape have already been described, with the exception of the two branch instructions. Branch on N Register Ready (BNR) and Branch on N Register Not Ready (BNN) are used to test whether the N register is ready to receive information.

Because the operator will want to become familiar with the octal codes for the instructions pertaining to paper tape, the following list is presented.

Instruction	Mnemonic Code	Octal Code
Reader Power On	RON	2500014
Read Paper Tape	RPT	2500006
Halt Paper Tape	HPT	2500016
I/O Power Off	OFF	2500005
Punch Power On	PON	2500015
Write Paper Tape	WPT	2500006
Branch on N Ready	BNR	2514005
Branch on N Not Ready	BNN	2516005

CONTROLS AND INDICATORS

In reading or punching paper tape, the operator is concerned with controls and indicators on four different panels. Two of these are on the paper tape reader and punch and two are on the central processor.

Paper Tape Control and Indicator Panel

The panel is on the front of the paper tape reader and punch. It has six switches and indicators, as illustrated in Figure XI-2. The pushbutton switches are used in setting up both the reader and the punch for on-line operation, as described under the heading of 'Setup Procedures.' An important point to remember in the use of the switches is that every time POWER ON is depressed, OPERABLE must also be depressed. Each control and indicator is described in Table XIV.

Paper Tape Maintenance Panel

The maintenance panel is located inside the door at the rear of the paper tape reader and punch cabinet. The panel is illustrated in Figure XI-4. Most of the switches on this panel are for the use of maintenance personnel only, but the operator uses three switches on this panel, and on some models, he uses a fourth. Notice that the left portion of the panel has the heading of PUNCH and the right portion has the heading of READER. The switches used by the operator are:

PUNCH CODE LEVEL SELECTOR switch. This is a 4-position selector switch which must be set to tape level 5, 6, 7, or 8, as designated by the programmer for each program which uses the punch. The switch is at the left of the panel and must not be confused with the similar switch at the right of the panel. Tape levels are discussed under the heading 'Characteristics of Paper Tape.'

READER CODE LEVEL SELECTOR switch. This switch is on the right side of the panel, and performs the same function for the reader as that just described for the punch. It must be set to tape level 5, 6, 7, or 8, as designated by the programmer for each program which uses the reader.*

* Some models use only tape levels 6, 7, and 8; some models use only level 5 tape; other models use tape levels 5, 6, 7, and 8, as described here.

SPEED CHANGE switch. This is a toggle switch at the right side of the panel which, in the HIGH (up) position, selects the 1000 character per second speed for the reader. This speed can only be used for strip reading. In the LOW (down) position, it selects the 250 character per second speed for reading. Tape must always be read from spoolers at low speed. For strip reading, the speed must be set as designated by the programmer.

STRAIGHT TRANSFER MODE SELECTOR switch. Only model 4WGA652 has this switch. It is a 3-position selector switch which must be set to the NORMAL position for all reading and punching unless the straight transfer method is used. When the straight transfer method is used, the switch must be set to 7 LEVEL or 8 LEVEL, as designated by the programmer.

The operator must remember that all of the remaining controls (all toggle switches) must be in the down position. Their position must be checked at the time the operator makes the required switch settings. Table XIV contains descriptions of each of the remaining switches. As is seen from the 'function' column of the table, the switches are used for off-line simulation of on-line reading and punching. They are used by service engineers in equipment testing and repair.

Central Processor Control Console

As with other peripheral operations, the operator monitors the program's progress from the control console of the central processor. (Illustrated in Figure IV-3.) Of particular interest in paper tape operations are the N REGISTER READY and the PARITY indicators and the STOP ON PARITY/NORM switch. Their use is described in Table XIV and in Section IV.

Central Processor Maintenance Panel

This panel (illustrated in Figure XI-5) is located inside the door above the control console. At the right of the top row of indicators are six lights designated N_1, N_2, N_3, N_4, N_5, and N_6. These display information in the N register. When a lamp is lit, it represents a one, when it is not lit, it represents a zero. The information may be read from the lights in octal or binary. At the time of a program halt resulting from an error condition, the operator should read the contents of the N register just as he reads the contents of the A, I, and P registers. This information is of assistance to the programmer or the service engineer in diagnosing the difficulty in the program or in the equipment.

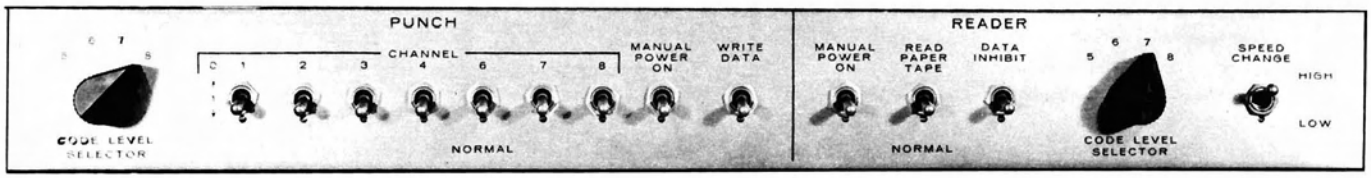


Figure XI-4. Maintenance Panel of the Paper Tape Reader and Punch

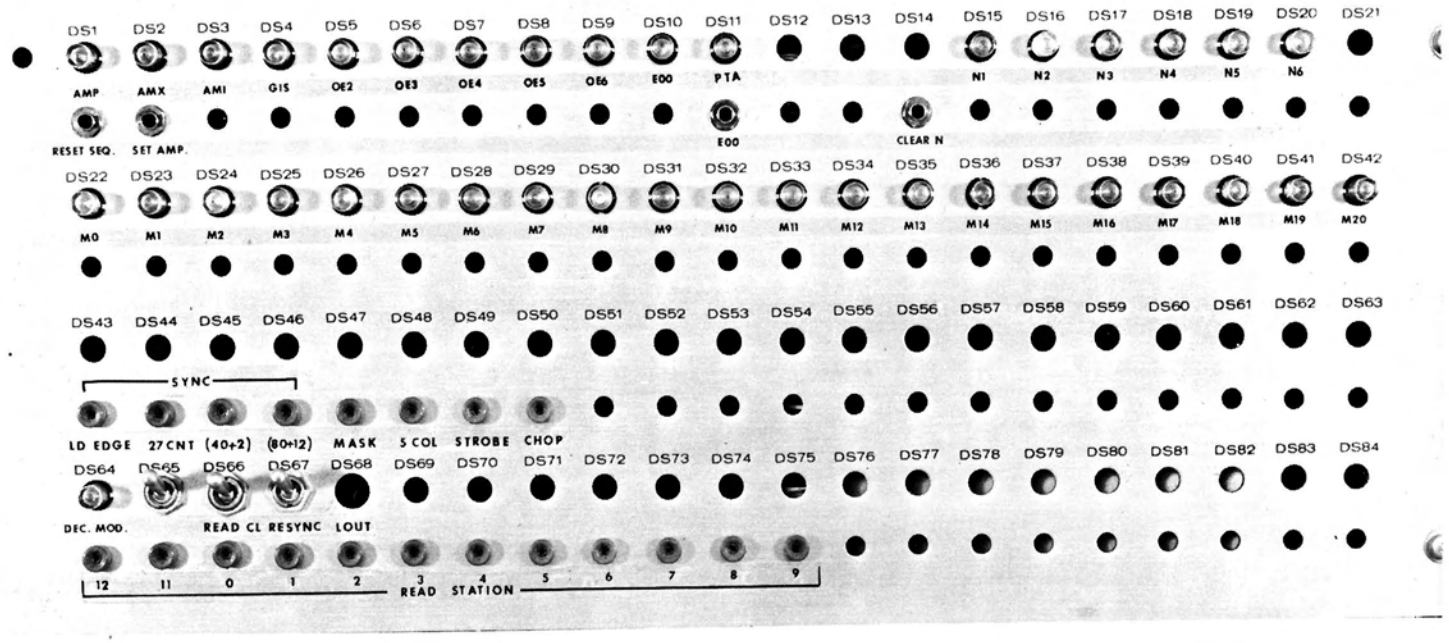


Figure XI-5. Maintenance Panel of the Central Processor

Another indicator which is used by the operator is the PTA light, located in the center of the top row of lights. At the time a parity error is indicated on the control console, the operator must check the PTA light to determine whether the parity error is in the paper tape system or in memory. The PTA light is lit when the error pertains to paper tape.

CHARACTERISTICS OF PAPER TAPE

Visual Reading of Paper Tape

Figure XI-6 is a sample of paper tape which illustrates how tape may be read visually, row by row. A hole in the tape represents a one bit and the absence of a hole in a column represents a zero. The small-sized hole, called a sprocket hole, is to be ignored in reading. It is not mandatory that the operator be able to read tape in order to perform basic tape operations. However, he may want to be able to read it if he works to any extent with tape equipment. Each row across the tape represents one BCD character and is read in octal. Tape BCD characters can be read in their octal representation, as seen in the examples of Figure 6. Holes from positions 1, 2, and 3 are read in binary to obtain the least significant octal digit and holes from positions 4, 5, and 6 are read to obtain the most significant octal digit. Various codes are used to interpret the octal representation of characters. A particular activity may even develop its own code, so the operator must have the proper code on hand before he can convert the octal representation from tape to meaningful numbers, letters, and symbols. A frequently used code is illustrated in the fourth and sixth columns of the chart, Appendix D. For example, the BCD code $(25)_8$ represents the letter V; $(25)_8$ is in column headed 'BCD Memory (octal)' and is opposite the letter V in the column headed 'Paper Tape Character (8 channel)'. Character representation varies with tape levels, as will soon be described. The example just given is for 6-level tape.

Paper Tape Format

Paper tape format is the configuration in which holes are punched on tape in binary code. The GE-225 paper tape system can read and punch four types of formats. These tape formats are identified by the number of channels used. A maximum of eight channels of information may be read or punched on a row of 1-inch paper tape. The CODE LEVEL SELECTOR switches on the equipment permit the routing of 5, 6, 7, or 8

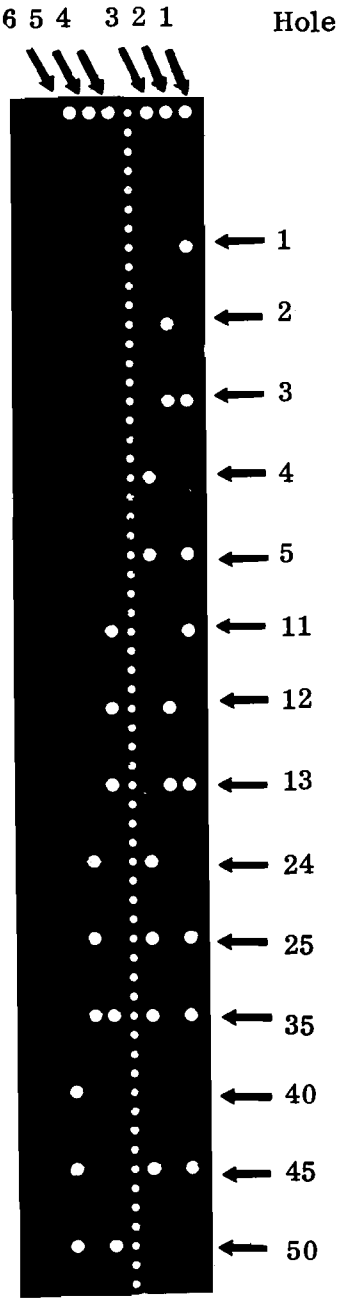


Figure XI-6. Paper Tape BCD Characters Read in Octal

channels of data between the central processor and the paper tape reader and punch. The switches must be set to the proper level by the operator each time a tape is read or punched. The terms 8-channel tape and 8-level tape are synonymous, and, for the purpose of uniformity, the term level will be used in the remainder of this section. The characteristics of each of the various levels of tape will be described in paragraphs which follow.

Paper Tape Qualifications

Three widths of paper tape can be used with the GE-225 Information Processing System: 11/16 inch, 7/8 inch, and 1 inch. The 1-inch tape is considered standard and is more widely used because it can be used with all levels (5, 6, 7, or 8) of reading or punching. The 7/8-inch tape can be used for levels 5, 6, and 7. The 11/16-inch tape can be used for only 5-level reading or punching. Any good quality of tape may be used with the paper tape reader and punch, but an oil-impregnated type of paper performs best.

Parity Generation and Error Detection

When information is punched on 7- or 8-level paper tape, an odd parity bit is punched in channel 5 when necessary to produce an odd configuration of 1 bits in each row. When data is read, each configuration is checked for the proper parity. The parity bit, when present, does not enter the N register, but the detection logic of the paper tape reader and punch senses whether a parity bit should or should not have been detected or generated.

When a parity error is detected during the reading of paper tape, a signal is sent to the central processor which lights the PARITY alarm indicator. The operator cannot be certain whether the PARITY alarm was turned on by the paper tape reader or the central processor memory error detection circuit unless he checks the maintenance panel of the central processor (above the control console). If the error was sensed by the paper tape reader detection logic, the paper tape alarm (PTA) light in the center of the top row of lights on the maintenance panel will be lit. Unless the STOP ON PARITY ALARM/NORM switch has been set to STOP ON PARITY ALARM, or unless the programmer has programmed a stop on parity alarm, the parity error will have no effect on the continuation of paper tape operations. When the computer stops, the operator must examine the tape and mark with the pencil the parity error if he can locate it. He must next follow whatever instructions have been given by the programmer for this condition. Returning to a restart point and rereading or repunching the tape may or may

not correct the error. Parity is generated and detected for 7- and 8-level tape, but not for 5- and 6-level tape.

The operator can easily detect a parity error on tape, for 7- or 8-level tape which should have parity always has an odd number of punches in each row. If there is an even number of punches, a parity error exists. Figure XI-7 illustrates tape punched with numerous parity errors. By examining the various errors in the illustration, it will be seen that even numbers of holes in a row can result from either the absence of a required parity punch in channel 5 or from an extra punch in channel 5 when it is not needed to make the number of holes odd.

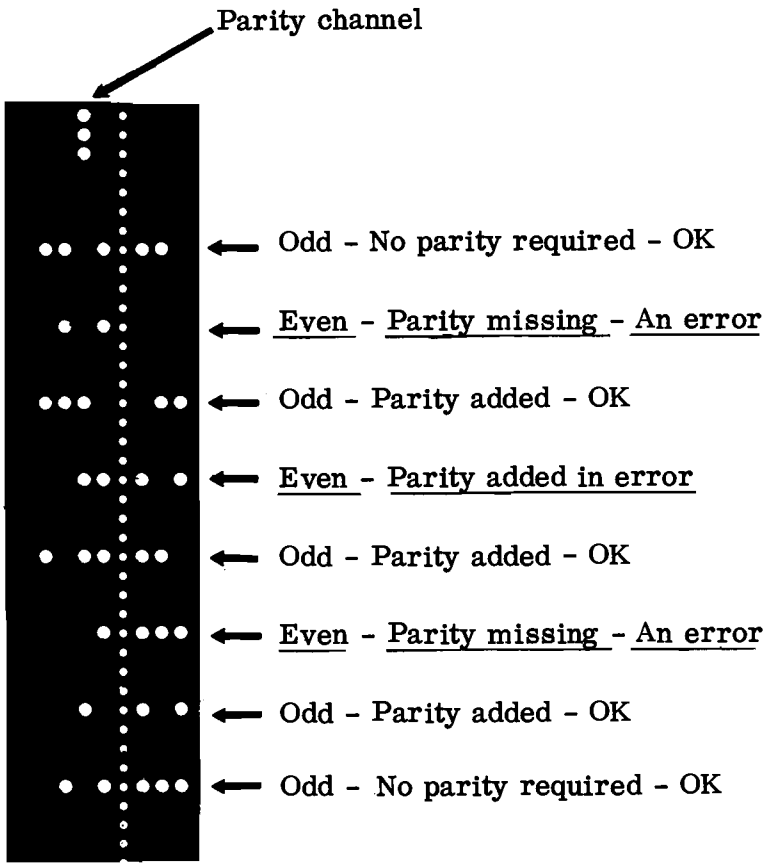
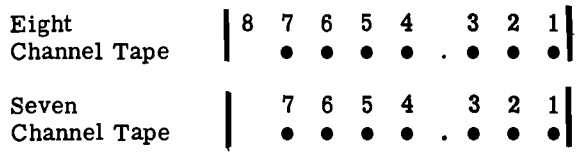


Figure XI-7. Sample of Tape with Parity Errors

Delete Code

The delete code is used to void information on the tape by preventing any of the data from going to the N register. It can be used with either 7- or 8-level tape in the normal mode of operation, and has the configuration shown below.

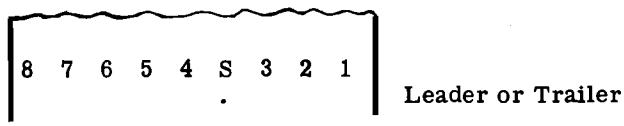


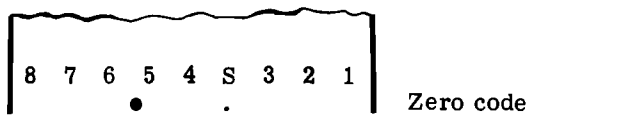
Special Character Control

A special character in the normal mode is the single punch in channel 8. This, of course, is found only on 8-level tape. The 8-punch is sensed by the special character control logic of the paper tape system, and causes all ones to be sent to the N register. Parity is not involved since the parity checking logic is disabled. Only with 8-level tape can an octal 77 be read in the normal mode. On some equipment, a punch is used in channel 8 to indicate a carriage return.

Tape Leader and Trailer Inhibit

The leader and trailer portions of tape have a sprocket hole, but have no other punches representing data. In 7 and 8 level tape, the paper tape reader detects the presence of sprocket holes without data punches. When it does this, it prevents the N register from becoming ready and thereby prevents information from being shifted out of N. The net effect is an ignoring of the portions of tape which have only sprocket holes. When all zeros are present on 7 and 8 level tape, a parity bit is also present. It is the parity bit which differentiates between the leader or trailer and a zero, as is illustrated below.





Because there is no parity bit on 5 and 6 level tapes, the reader cannot tell the difference between the leader or trailer and data consisting of all zeros. As a result, the reader reads zeros while the leader and trailer portions of the tape pass through the read station.

Straight Transfer

Normally, only six bits of data can be transferred between the central processor and a row of information on paper tape. This is considered the normal mode of operation, and the MODE SELECTOR switch in the NORMAL position permits the data transfer of six bits. It is possible that either seven or eight bits of data can be transferred to or from a row of information on paper tape by a method called straight transfer. Since the N register holds only six bits of information at a time, the transfer of more than six bits must be in two stages. The operator must set the MODE SELECTOR switch to either 7 LEVEL or 8 LEVEL to permit the transfer of either one or two bits of information into a 2-bit buffer register of the paper tape system. Figure XI-8 illustrates an example of 8-level straight transfer. The 8-bit data word 10011101 is transferred from the A register to paper tape via the N register and the buffer register. The program calls first for a shift of two data bits from the A register to the N register with a Shift A and N Right instruction (SAN2). A Write Paper Tape instruction (WPT) moves the two bits from the N register to the buffer register. The instruction SAN6 next moves the remaining six bits to the N register, and the WPT instruction transfers all eight bits to paper tape. When 7-level straight transfer is used, the procedure is the same as that just described with the exception that the buffer register holds one instead of two bits of information. When reading or punching by the straight transfer method, the appropriate CODE LEVEL SELECTOR switch must be set on 8.

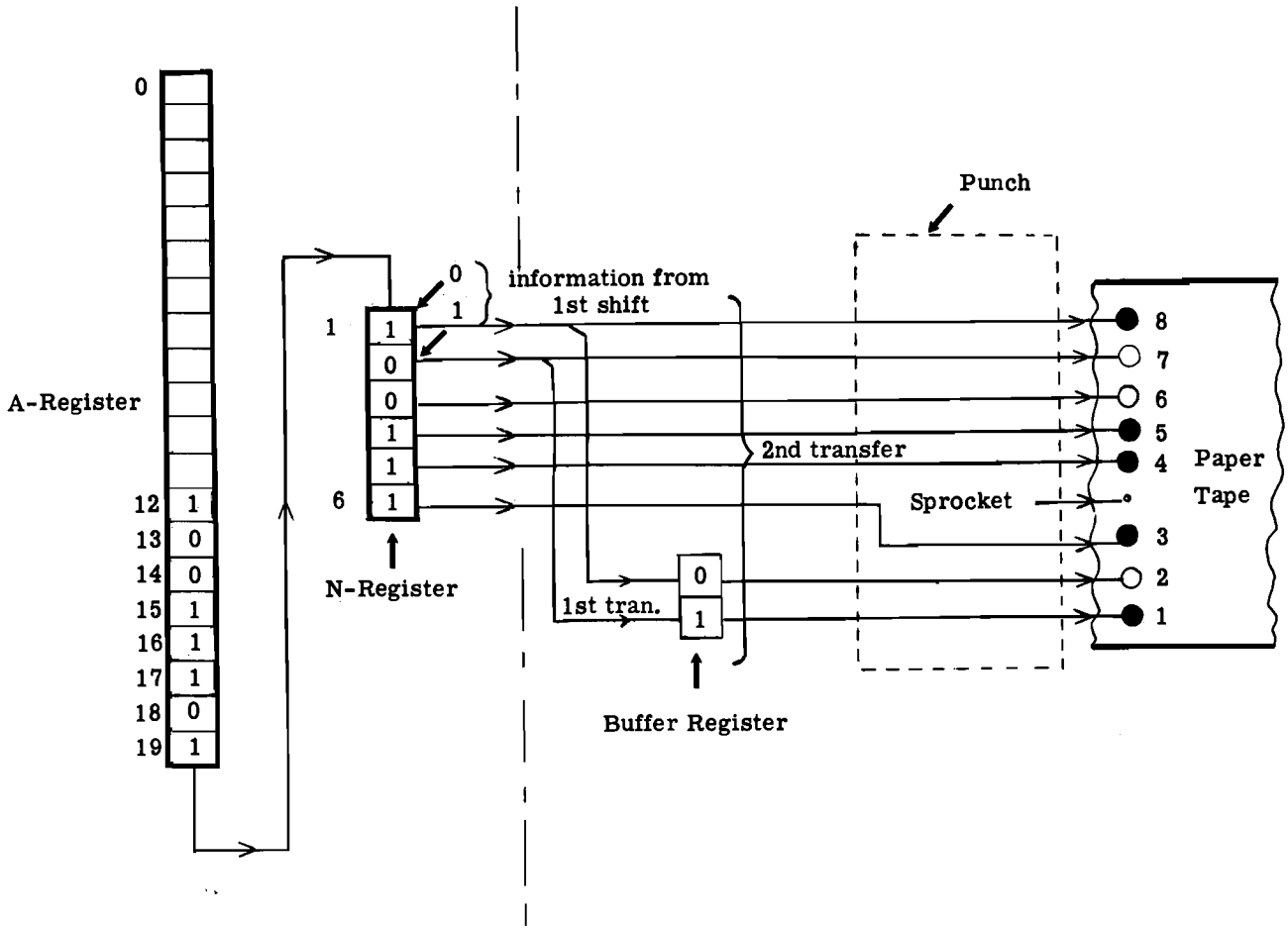


Figure XI-8. Straight Transfer of 8 Bits of Data

Tape Levels

The special characteristics of various levels of tape have already been described. By way of a summary, the characteristics of each level of tape will be listed and the transfer of information between the N register and the tape will be illustrated.

Five-Level Tape. Figure XI-9 illustrates the transfer of information from five-level tape to the N register. Since only five channels are involved, no information is sent to or from the N_1 position of the N register.

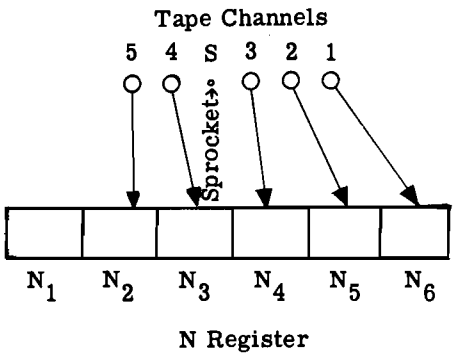


Figure XI-9. Five-Level Tape Information Transfer

Summary (5-Level Tape)

1. The paper tape reader reads zeros (sends zeros to the N register) when each sprocket hole of the leader or trailer is sensed. The paper tape punch feeds tape to create a leader or a trailer when the N register contains 000000.
2. No parity check is made and no parity bit is on the tape.
3. No delete code is possible.
4. The straight transfer method does not apply.
5. The highest octal number which can be read or punched is $(37)_8$.

Six-Level Tape. Figure XI-10 illustrates the transfer of information from six-level tape to the N register.

Summary (6-Level Tape)

1. The paper tape reader reads zeros when each sprocket hole of the leader or trailer is sensed. The paper tape punch feeds tape to create a leader or a trailer when the N register contains 111111.
2. No parity check is made and no parity bit is on the tape.
3. No delete code is possible.
4. The straight transfer method does not apply.
5. The highest octal number which can be punched is $(76)_8$, and the highest number which can be read is $(77)_8$.

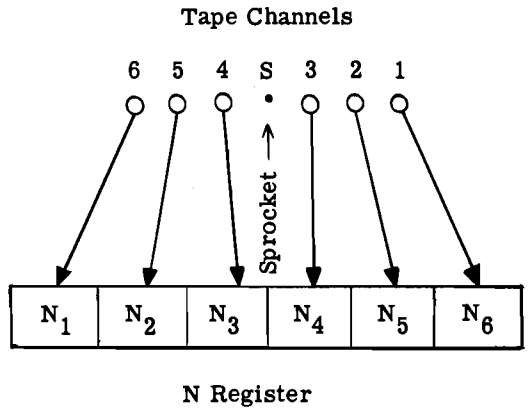


Figure XI-10. Six-Level Tape Information Transfer

Seven-Level Tape. Whenever data punched in any row of tape (in the normal mode) produces an even number of holes (ones), a parity check generates a parity bit in channel five. This is to make the total number of holes in that row odd. The use of channel five for parity prevents its use for data, so channel six is used to send or receive data to or from N_2 of the N register and channel 7 is used with N_1 of the N register. To visually read tape in octal, one must ignore channel five, as is illustrated in examples A and B of Figure XI-11. The configuration in A is read as $(75)_8$ and that in B is read as $(56)_8$.

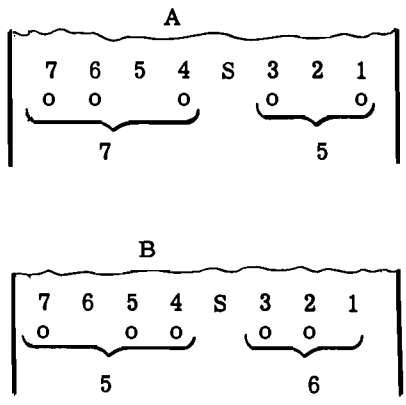


Figure XI-11. Octal Reading of Seven-Level Tape (normal mode)

Figure XI-12 illustrates the normal mode of transfer of information from seven-level tape to the N register.

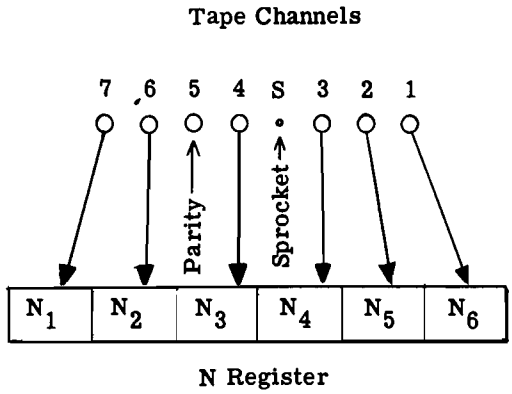


Figure XI-12. Seven-Level Tape Information Transfer (normal mode)

Summary (7-Level Tape)

1. The paper tape reader ignores the leader and trailer ends of the tape (when only sprocket holes pass the read station).

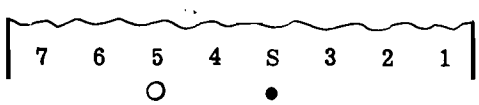
2. A parity bit is generated and punched in channel 5 (in the normal mode) when necessary to make an odd number of holes in a row.

3. All ones punched in a row of tape (in the normal mode) indicate to the paper tape reader that no information is to be sent to the N register. The all-ones configuration is used as a delete code. It can also be used to feed tape to make a leader or a trailer.

4. The straight transfer method may be used to transfer seven bits of data at a time between the A register and paper tape via the N register.

5. The highest octal number which can be read or punched in the normal mode is $(76)_8$. The highest number in the straight transfer mode is $(177)_8$.

6. A zero is punched (in the normal mode) as a parity punch (channel 5). Likewise, a parity punch is read as a zero as is illustrated below.



Eight-Level Tape. Eight-level tape is similar to seven-level tape in most respects. The visual reading of tape punched in the normal mode is the same as was illustrated in Figure XI-11. The transfer of information in the normal mode between tape and the N register is the same as was illustrated in Figure XI-12 with one exception. The exception is the special character control which senses a hole punched in channel eight and causes six 1 bits to be placed in the N register. Figure XI-13 illustrates the special character transfer. No parity check and no parity bits are involved with this special character.

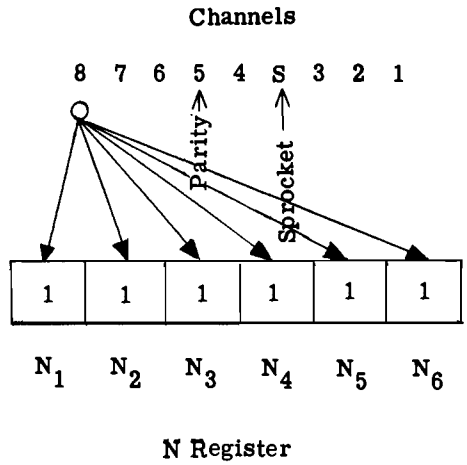


Figure XI-13. Special Character Transfer, Eight-Level Tape

Figure XI-14 illustrates visual reading of 8-level tape punched in the straight transfer mode. The tape illustrated in A is read as $(257)_8$ and that in B is read as $(176)_8$.

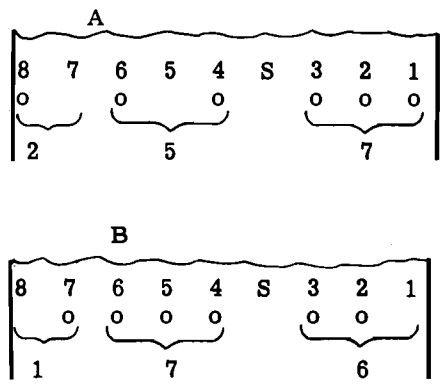


Figure XI-14. Straight Transfer Mode, Eight-Level Tape

Summary (8-Level Tape)

1. The paper tape reader ignores the leader and trailer end of the tape (when only sprocket holes pass the read station).

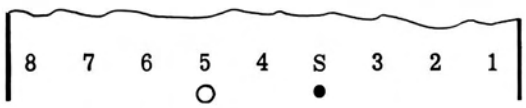
2. A parity bit is generated and punched in channel 5 (in the normal mode) when necessary to make the number of holes in a row odd.

3. Seven ones punched in a row of tape indicate to the paper tape reader that no information is to be sent to the N register. This all-ones configuration is used as a delete code.

4. The straight transfer method may be used to transfer eight bits of data at a time between the A register and paper tape via the N register.

5. The highest octal number which can be read in the normal mode is the single punch in channel 8 which sends $(77)_8$ to the N register. The highest number which can be read from tape in the straight transfer mode is $(377)_8$.

6. A zero is punched (in the normal mode) as a parity punch (channel 5). Likewise, a parity punch is read as a zero, as is illustrated below.



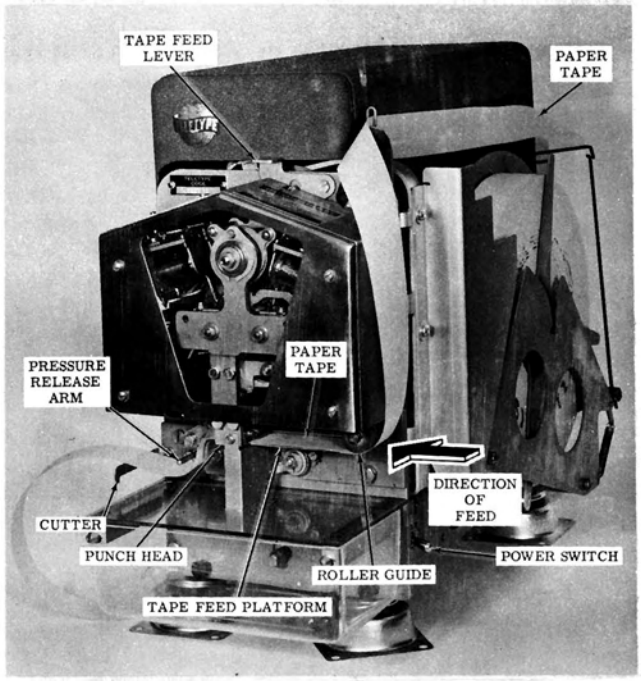


Figure XI-15. Front View of Punch Mechanism

SETUP PROCEDURE - PUNCH

The following are the procedures for readying the paper tape punch for on-line operation with the GE-225 central processor.

1. Empty the chip box (Figure XI-2) if it needs emptying. The box is removed by pulling it forward.

2. Open the cover panel of the punch (Figure XI-2) and pull the punch mechanism all the way out to a latched position.

3. If the paper tape width is to be different from that previously used, notify the service engineer of the need for him to adjust the punch head to accommodate the new tape width.

4. Check to make sure that the power switch (Figure XI-15) on the lower front corner of the right side of the paper tape punch is in the ON (up) position. (It should always be left on.)

5. Check the amount of paper tape on the supply reel. If the supply is low or is exhausted, load a new reel of tape, using the following steps:

   a. Lift the supply reel (Figure XI-16) out of its holder.

   b. Unscrew the tape retainer by turning it counterclockwise to separate the two sides of the reel. Remove the old roll of tape.

   c. Place the new roll of tape on the reel hub so the tape unreels from the bottom and toward the right.

   d. Screw the tape retainer back in place until it is snug. Be careful to keep the roll of tape centered under the retainer.

   e. Insert the tape reel back into its original position in the groove on the side of the punch. When inserted correctly, the tape unreels from the bottom and toward the rear of the punch housing.

f. Place the follower arm (Figure XI-16) against the paper on the reel. (At the base of this arm is an 'out of paper' switch which causes the N register to go 'not ready' when the roll of paper is exhausted.)

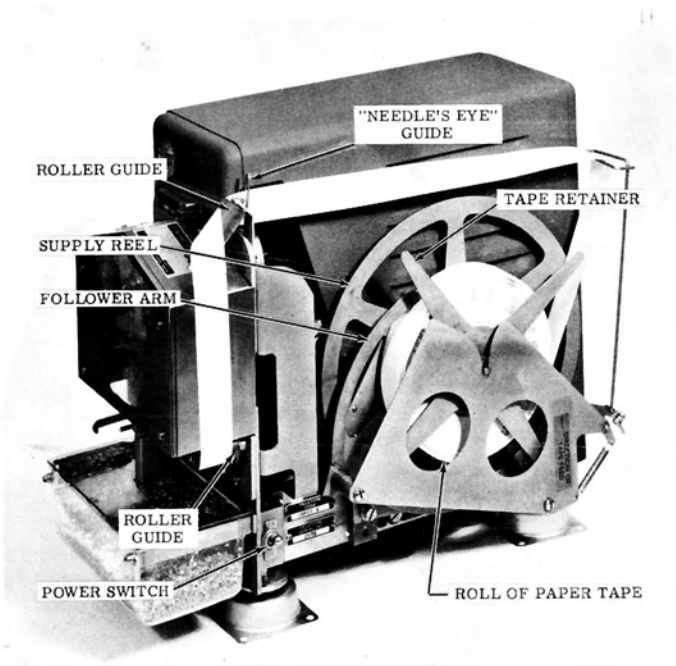


Figure XI-16. Side View of Punch Mechanism

g. Thread the tape through the tape guides as illustrated in Figures XI-15 and 16.

h. Cut or tear the end of tape at a 45 degree angle.

i. Push the tape under the punch head from right to left while pressing it flat against the tape feed platform. (Figure XI-15.)

j. Raise the pressure release arm and thread the tape under it. Pull the tape under the cutter.

k. Depress the POWER ON and OPERABLE switches on the paper tape control and indicator panel (Figure XI-17) to turn power on and clear the circuitry. Switches will be illuminated when on.

l. Turn power on by either of the following methods:

(1) On the console of the central processor, issue a PON command, octal designation $(2500015)_8$.

(2) On the maintenance panel (Figure XI-4) set the MANUAL POWER ON switch in the up position. (This must be the switch on the PUNCH half of the panel which is the left half.)

m. Depress the tape feed lever (Figure XI-15) while gently pulling the tape until the punch takes hold. (Remember to turn the MANUAL POWER ON switch to the down position if it was used.)

6. By depressing the tape feed lever, continue running tape until the required length of leader has been run. Strip reading requires a leader about one foot long. Reading from spoolers requires a leader about six feet long. If the punch has not been used for several hours, move four or five feet of extra tape through it using the tape feed lever. (This removes any trace of oil that may have dropped into the punch head.)

7. Release the punch from its locked position by pressing up on the extender latches in the base and at the rear of the punch mechanism, while pushing the punch back into its cabinet. Push the punch all the way back until it is engaged by the catch at the rear of the cabinet.

8. Set the following PUNCH switches on the paper tape maintenance panel (PUNCH switches are on the left side of the panel). See Figure XI-4.

a. Set the CODE LEVEL SELECTOR switch to the proper setting (5, 6, 7, or 8) as designated in programmer instructions.

b. Set the MODE SELECTOR switch to the proper setting (Normal, 8 level, or 7 level) as designated in programmer instructions.

c. Check to see that all other switches are in the down position. These include the eight CHANNEL switches, the MANUAL POWER ON switch, and the WRITE DATA switch.

The punch is now ready to be addressed from the central processor.

After tape has been punched, depress the tape feed lever to run sufficient tape to make a trailer about three feet long.

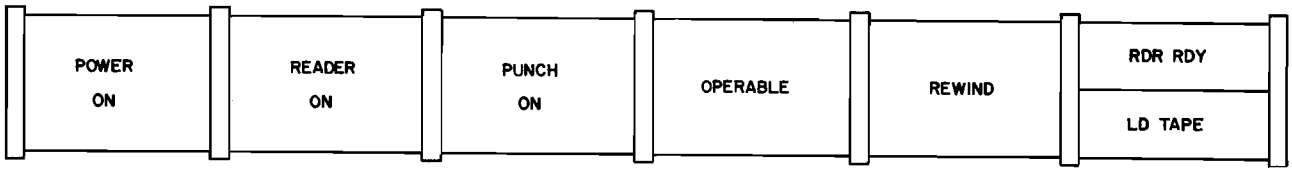


Figure XI-17. Paper Tape Control and Indicator Panel

See the description of how to use spoolers while punching -- in the Special Procedures portion of this section.

SETUP PROCEDURE - READER

A. Reader With Spoolers

1. Set the following READER switches on the paper tape maintenance panel (READER switches are on the right side of the panel). See Figure XI-4.

   a. Set the CODE LEVEL SELECTOR switch to the proper setting (5, 6, 7, or 8) for the tape to be read.

   b. Set the MODE SELECTOR switch to the proper setting (Normal, 8 level, 7 level) as designated in programmer instructions.

   c. Set the SPEED CHANGE switch to the LOW speed position.

   d. Check to see that all other switches are in the down position. These include the MANUAL POWER ON, READ PAPER TAPE, and DATA INHIBIT switches.

2. If paper tape is only a few feet long, load tape for 'strip reading' as described in section B which follows.

3. If the paper tape is already on a reel, remove the old reel (step 4b below) and install the reel on the paper tape reader as described in step 4e and subsequent steps.

4. If tape is to be wound on a reel, load tape reels as follows:

   a. If the POWER ON switch on the paper tape control and indicator panel is illuminated, depress it to turn power off. This is necessary to release the electromagnetically operated brake and also to prevent reels from turning if tape tension arms are accidentally bumped.

   b. Remove the supply reel (the right-hand reel) from the spooler hub by loosening the knob, turning it counterclockwise. Lift the reel off the hub. (See Figure XI-2.)

   c. Place the end of tape into the retainer slot on the reel so the sprocket holes are farthest from the operator and closest to the reader cabinet when the reel is in place. The end of tape which goes in the slot is the end punched last and the end to be read last.

   d. Rotate the reel clockwise by hand until all of the tape is on the reel.

   e. Return the supply reel to the spooler mounting hub and turn the knob until it is snug. Tape should come off the reel from the bottom and toward the right.

   f. Thread the end of tape from the supply reel into the retainer slot of the takeup reel and turn the takeup reel counterclockwise 2 or 3 turns to securely fasten the tape as illustrated in A of Figure XI-18.

5. Thread tape through the read area (Figure XI-19) as follows:

   a. Turn reels toward each other to obtain several feet of slack.

   b. With both hands, lift the paper tape between the reels until it is level with the read area as shown in B of Figure XI-18.

   c. Holding the tape parallel to the reader, move it toward the capstan, head assembly, tape guides, and brake so that it goes under all of these. It may be necessary to lift the brake slightly to make room for

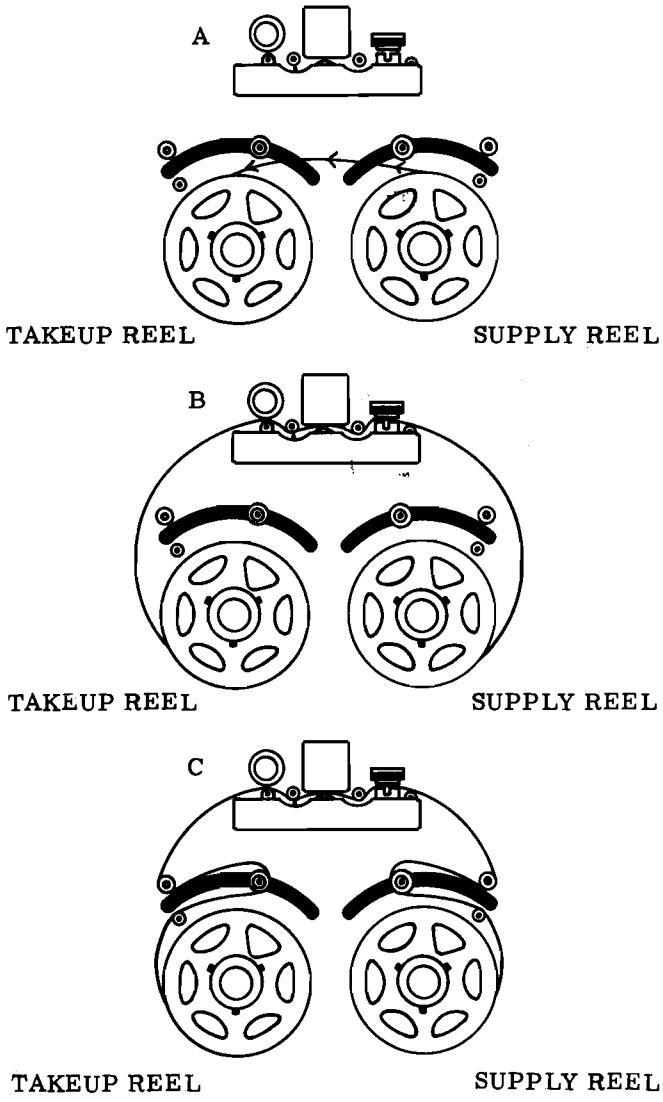


Figure XI-18. Threading Tape on Spoolers

the tape. After the tape appears to be in place, move it back and forth to make sure it is not caught.

d. If the paper tape is a different width from the tape previously used, adjust the tape guides (Figure XI-19) by pushing them in or pulling them out to the proper dentent position. Again make sure the tape can move freely.

e. Check to make sure power is off. The POWER ON switch on the paper tape control and indicator panel must not be illuminated.

f. Route tape to the outside of the guides on either side of the tape reels, as shown in C of Figure XI-18, and thread the tape around the tension arms. To do this, move the tape inward, one side at a time, with index finger moving between the tape guides. Loop the tape over the follower arm; the follower arm may be moved toward the side of the spooler as the tape is looped over it.

6. Depress the POWER ON and OPERABLE switches on the paper tape control and indicator panel (Figure XI-17) to turn power on and clear the circuitry. Switches will be illuminated when on.

7. Depress the RDR RDY/LD TAPE switch to set it in the RDR RDY position. RDR RDY will be illuminated.

The reader is now ready to be addressed from the central processor.

After tape has been read, if it is to be saved for reading again, it must be rewound onto the supply reel by depressing the REWIND switch on the control and indicator panel.

B. Reader Without Spoolers

1. Set the following READER switches on the paper tape maintenance panel (Reader switches are on the right side of the panel). See Figure XI-4.

   a. Set the CODE LEVEL SELECTOR switch to the proper setting (5, 6, 7, or 8) for the tape to be read.

   b. Set the MODE SELECTOR switch to the proper setting (Normal, 8 level, 7 level) as designated in programmer instructions.

   c. Set the SPEED CHANGE switch to the proper HIGH or LOW speed position, as designated in programmer instructions.

   d. Set all other switches to the down position. These include the MANUAL POWER ON, READ PAPER TAPE, and DATA INHIBIT switches.

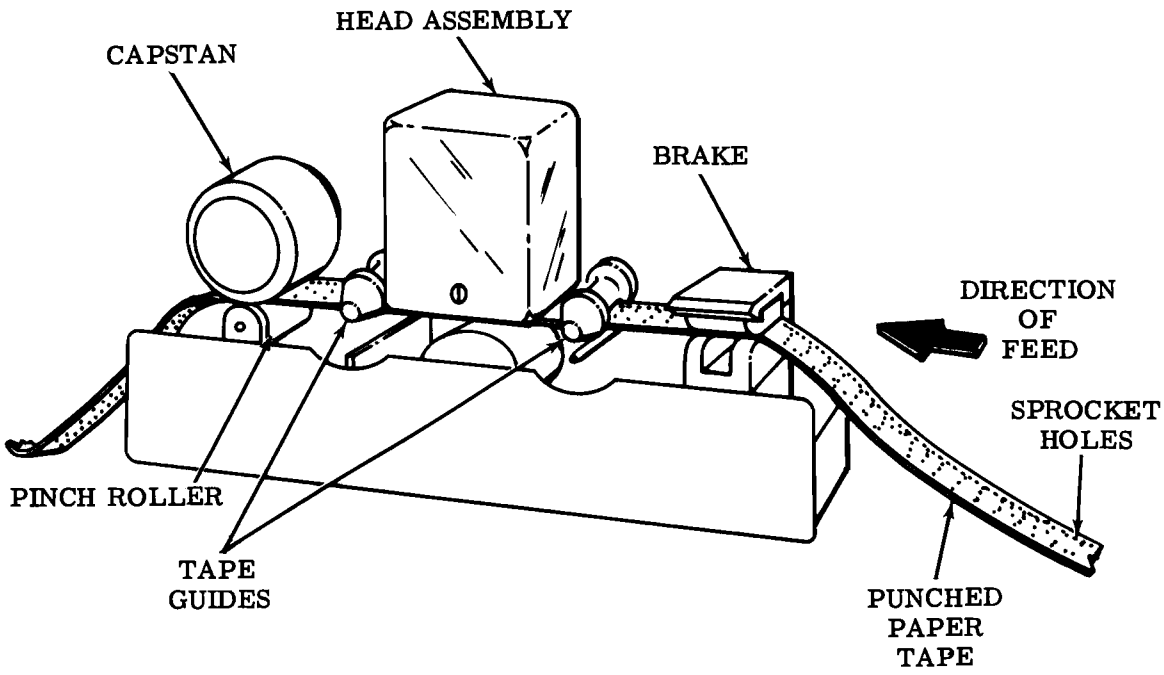


Figure XI-19. The Paper Tape Read Area

2. Depress the POWER ON and OPERABLE switches on the paper tape control and indicator panel (Figure XI-17) to turn power on and clear the circuitry. Switches will be illuminated when on.

3. Depress the RDR RDY/LD TAPE switch on the control and indicator panel to set it in the LD TAPE position. LD TAPE will be illuminated.

4. Hold the leader end of the tape parallel to the reader cabinet so the sprocket holes are farthest from the operator and closest to the cabinet.

5. Holding the tape parallel to the reader, move it toward the capstan, head assembly, tape guides, and brake so that it goes under all of these (Figure XI-19). It may be necessary to lift the brake slightly to make room for the tape. After the tape appears to be in place, move it back and forth to make sure it is not caught.

6. If the paper tape is a different width from the tape previously used, adjust the tape guides by pushing them in or pulling them out to the proper dentent position.

7. Depress the RDR RDY/LD TAPE switch to set it in the RDR RDY position. RDR RDY will be illuminated.

The reader is now ready to be addressed from the central processor.

TABLE XIV

SUMMARY OF CONTROLS AND INDICATORS FOR THE PAPER TAPE READER AND PUNCH

Location	Control or Indicator	Function
Paper tape control and indicator panel (Figure XI-17)	POWER ON switch and indicator	Provides AC power to both the reader and the punch. Is illuminated when power is on.
	READER ON indicator	Indicates (by illumination) when on-line reading is in process.
	PUNCH ON indicator	Indicates (by illumination) when on-line punching is in process.
	OPERABLE switch and indicator	Clears all control circuits in both the reader and punch. Is illuminated when circuits are cleared.
	REWIND switch and indicator	Rewinds paper tape from the takeup reel to the supply reel. Is illuminated when depressed to rewind.
	RDR RDY/LD TAPE switch and indicator	Determines and indicates by LD TAPE illuminated when reader brake is released for loading tape. Indicates by RDR RDY illuminated when brake is engaged to move tape.
Paper tape punch (Figure XI-15)	Power Switch	Turns on power to the punch motor. Should always be left on (up).
	Tape Feed Lever	When depressed, feeds tape. (Power must be on.)
Paper tape maintenance panel (Figure XI-4)	STRAIGHT TRANSFER MODE SELECTOR switch for both reading and punching (Model 4WGA652 only)	Selects NORMAL mode of reading and punching or 7- or 8-LEVEL STRAIGHT TRANSFER mode of reading or punching.
	PUNCH CODE LEVEL SELECTOR switch	Selects the 5-6-7- or 8-LEVEL mode of punching.

TABLE XI.V (CONT.)

Location	Control or Indicator	Function
Paper tape maintenance panel (Figure XI-4)	PUNCH CHANNEL switches (data simulators for maintenance personnel use only)	In the center position, switches simulate 1-bits in off-line operation. In the up position, switches simulate 0-bits in off-line operation. In the NORMAL (down) position, switches permit on-line reading and punching.
	PUNCH MANUAL POWER ON switch	In the up position, simulates a PON instruction (turns on power) to permit manual off-line punching. Disables the parity generator circuit. In the down position, permits on-line punching.
	WRITE DATA switch (For maintenance personnel use only)	In the up position, simulates a WPT instruction to permit off-line continuous punching of the character set by the PUNCH CHANNEL switches. In the down position, permits on-line punching. (DATA INHIBIT must be up for off-line punching).
	READER MANUAL POWER ON switch (For maintenance personnel use only)	In the up position, simulates on RON instruction (starts capstan motor) to permit off-line reading. In the down position, permits on-line reading.
	READ PAPER TAPE switch (For maintenance personnel use only)	In the up position, simulates a RPT instruction (moves tape) to permit off-line reading of tape. In the down position, permits on-line reading. (DATA INHIBIT must be up for off-line reading.)
	DATA INHIBIT switch (For maintenance personnel use only)	In the up position, prevents any flow of information between the punch or reader and the N register, permitting off-line testing. In the down position, permits on-line punching and reading.
	READER CODE LEVEL SELECTOR switch	Selects the 5-6-7- or 8-LEVEL mode of reading.

TABLE XIV (CONT.)

Location	Control or Indicator	Function
Paper tape maintenance panel (Figure XI-4)	SPEED CHANGE switch	Selects either HIGH (1000 char/sec) or LOW (250 char/sec) speed of reading tape. HIGH speed is for strip reading only.
Central Processor maintenance panel (Figure XI-5)	PTA indicator	When lit, indicates parity error was detected by the paper tape system. When not lit at time of parity error, indicates the error was detected by the memory detection circuitry.
	N Register indicators N_1, N_2, N_3, N_4, N_5, N_6	Show by illumination contents of the N register during input from the paper tape reader and output to the paper tape punch.

SPECIAL PROCEDURES

Operator Maintenance of Equipment

The following should be performed at least once a day. The cleaning should be done on a cooperative basis with or under the direction of the service engineer.

1. Clean the reader pinch roller and capstan with a cloth dipped in alcohol. Do not use acetone, ketone, or similar solvents.

2. Clean the area of the read station with a tooth pick tipped with cotton and dipped in alcohol.

Care of Paper Tape

Make every effort to keep paper tape clean. Never let it drag across the floor. Dirt picked up on the tape can become caught in the vicinity of the read station and the pinch and capstan rollers. Avoid getting tape wet from water, oil, or any other liquid. Dampness not only makes tape tear easily, but when transferred to the equipment can be damaging.

Splicing Paper Tape

Tape may be overlapped and glued together if it is torn before it is punched. When paper tape becomes torn after it is punched, it too can be spliced together for reading. However, extreme care must be taken to align the two portions of tape so that the holes exactly match and so there is no space between to permit light to penetrate through at the divide. Any misalignment or extraneous light can cause a parity error. Scotch tape or other transparent tape may be used in splicing. Coded tape splicer equipment is available on the market, and with this equipment, better splices can be made.

Using Spoolers While Punching

During lengthy punching operations it is convenient to thread the paper tape onto the takeup reel of the spooler mechanism. In this way the tape can be wound onto the reel as it is punched (instead of falling on the floor where it might become tangled, torn, or soiled).

A method of threading the tape is illustrated in Figure XI-20. After the tape is wound on the takeup reel, it can be moved to the supply reel from where it can read or can be removed and stored.

Steps for winding tape onto the takeup reel are as follows:

1. Depress the TAPE FEED lever on the punch to create a leader four or five feet long.

2. Make sure that power is off before threading the tape onto the takeup reel. To do this, check to see if the POWER ON switch on the paper tape control and indicator panel is illuminated and if it is, depress it to turn power off.

3. Thread the tape onto the takeup reel as illustrated in Figure XI-20.

4. Depress the POWER ON switch and the OPERABLE switch and proceed with punching as usual.

Steps for winding tape onto the supply reel are as follows:

1. Depress the TAPE FEED lever on the punch to create a trailer about three feet long.

2. Make sure that power is off. To do this, check to see if the POWER ON switch is illuminated and if it is, depress it to turn power off.

3. Thread the tape through the tape guides above the supply reel and around the tension arm as illustrated in C of Figure XI-18.

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

5. Depress the REWIND switch.

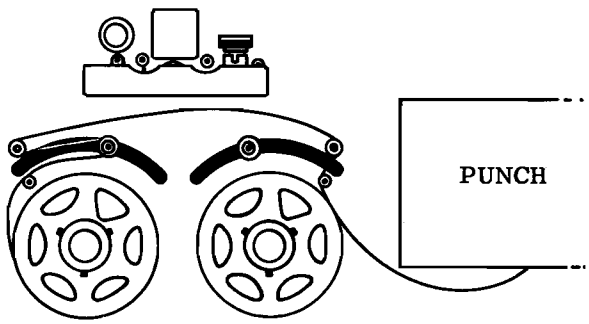


Figure XI-20. Using Spoolers in Punching

ERRORS AND OPERATOR CORRECTIVE ACTION

An operator check list can be made directly from Table XIV which lists all paper tape system controls and indicators. The incorrect setting of any of the controls for either punching or reading tape will result in operator errors which need correction. The following table lists some of the error conditions encountered in paper tape operations and recommends corrective action.

TABLE XV

PAPER TAPE READER AND PUNCH ERROR CONDITIONS

Error Condition	Possible Cause	Corrective Action
Read Command is given but tape fails to move	Programmer did not issue a RON instruction	Manually issue a RON (250014_8) and inform the programmer.
	Reader control logic was not in a ready status	Depress the OPERABLE switch on the paper tape control and indicator panel.
Reader moves tape after a read command but no data gets to the N or A registers	Data inhibit switch on maintenance panel is in wrong position (up instead of down)	Put data inhibit switch in down position, start program over.
	Programmer did not issue a SNA instruction after the N register came ready	Suggest that the programmer check his program.
Erroneous data is punched on tape or read from it	Switches on maintenance panel are not in the proper position	Open rear door and check switches.
Punch Command is given but no tape is punched	Switch on punch mechanism is not on	Turn on switch at lower right hand side of punch mechanism.
	Tape in punch not feeding properly	Gently pull tape at output of punch block while depressing tape feed lever on punch until tape feeds by itself.
	Write data switch on paper tape maintenance panel is in wrong position	Put WRITE DATA switch in down position.
	Programmer did not program a PON instruction	Manually issue a PON (2500015_8) instruction and inform the programmer.

TABLE XV (CON'T.)

Error Condition	Possible Cause	Corrective Action
Punch Command is given but no tape is punched	Punch logic not in READY STATUS	Depress the OPERABLE switch.
	Punch channel switches are in center position	Put punch channel switches in the down position.
A PØN INSTRUCTION is issued but punch does not start	Punch MANUAL POWER ON switch on rear maintenance panel is in wrong position	Put punch MANUAL POWER ON switch in down position.
	Switch on punch mechanism not on	Turn on switch at lower right side of punch mechanism.