

TX-0 COMPUTER  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
CAMBRIDGE 39, MASSACHUSETTS

M-5001-38

MAGNETIC TAPE SYSTEM

October 19, 1962

## MAGNETIC TAPE SYSTEM

This memorandum describes the magnetic tape unit installation, together with its main electronic features. First the design characteristics of the unit are described, and second the ways in which information can be stored in or read out from the tape. Proper loading and unloading of the magnetic tape drive is essential for reliable behavior of the system. The necessary steps are presented at the end of this memorandum. The programming features of the system are described in Memorandum No. 5001-28-1 "Programming for the Magnetic Tape System," together with programming examples.

### The TX-0 Tape Unit

The system uses a Potter Model M906II tape handling mechanism. The information stored on the tape is compatible with the IBM 729 tape system, used on 704, 709 and 7090. The reading and writing speeds are 75 inches/sec. and information is stored in 7 parallel tracks, across 1/2" tape. On one of the tracks a parity bit is recorded which can be odd or even, according to the writing mode of operation as we shall see later. The remaining six bits form a character, which, assembled with two others form a TX-0 word, transmitted to or from the Live Register of TX-0. Two hundred characters are stored in each inch of tape, so that 15,000 characters may be transmitted per second. Information may be read or written only while the tape is moving in a forward direction. The system records information by saturating the tape in either the positive or negative direction. The direction of the tape magnetization is reversed each time a 1 is recorded. This known as a non-return to

zero (NRZ) system of recording. The flux reversals are transferred into pulses at the output of the read amplifiers, where pulse represents a 1, and no pulse a 0.

One reflective strip is placed at each end of the tape, to sense the load point and the end of the tape. These strips are placed on opposite sides of the tape. Their disposition is as shown in Figure 1.

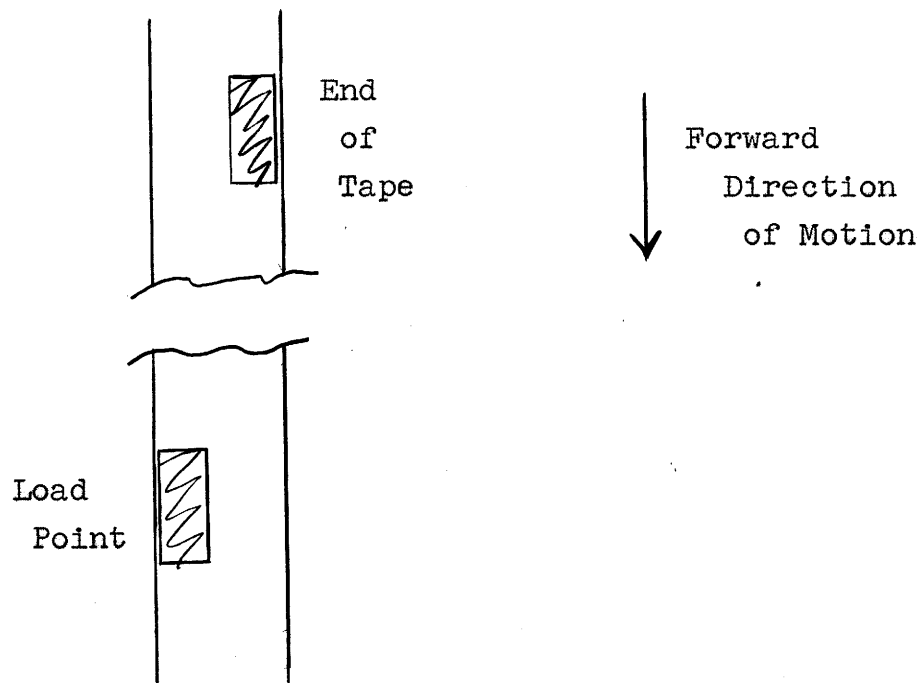
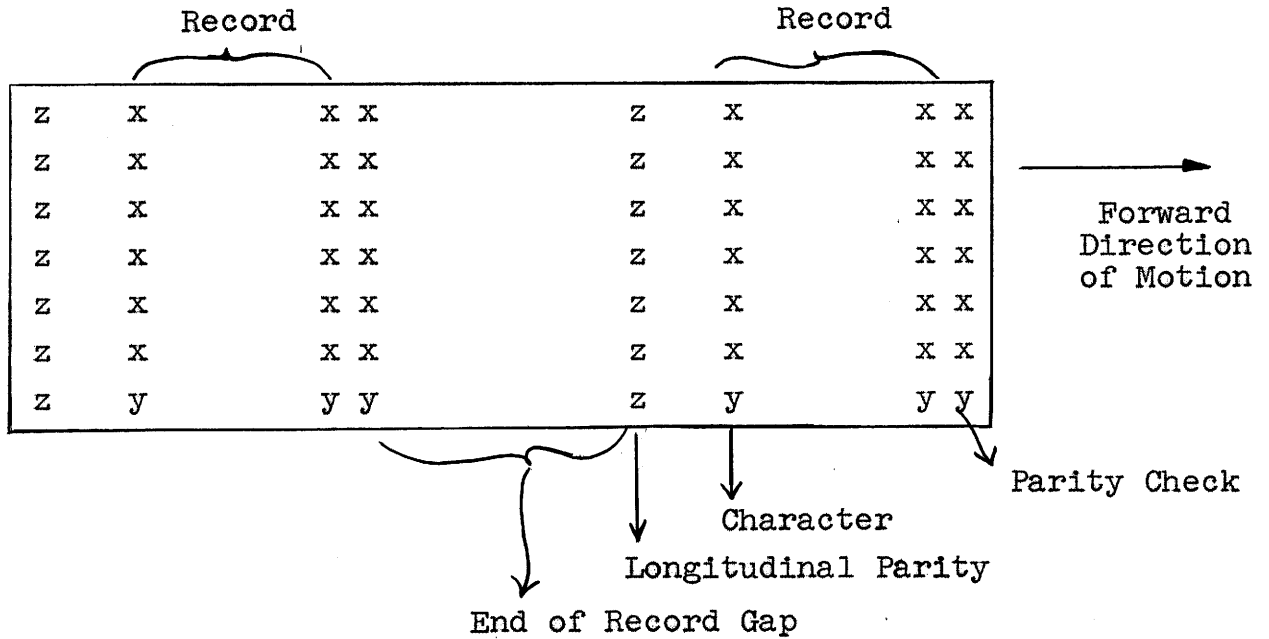


FIGURE 1

### The IBM Recording System

The 727 IBM tape units operate to detect a flux change, as previously described. There are 7 tracks recorded in a line across the tape. Six of the tracks transmit information and the seventh track contains a parity check bit. The seven channels of the recor-

ded information are or'ed together to form a timing pulse which signals when the seven channels of the line are to be read. Thus spaces may be detected by not writing in any of the seven channels. This system (IBM 727) detects spaces either as an end-of-record, or an end-of-file. The gap between records is 0.75" long. The track layout is shown in Figure 2.



- 0.75" is end of record gap.
- 0.02 is space between longitudinal check and last character written on tape.
- 0.005" is spacing between characters on tape.

FIGURE 2

In addition to the checking bit of the six tracks, a longitudinal check is written at the end of a record. This 7 bit character is the parity check of each track from the beginning of the record or file marks. This is an even check, i.e., the bit written forms an even number of 1's for the particular track. However, with respect to the TX-0 system this character cannot be read out of the

tape, and therefore is invisible for the TX-0 user. It is used only for compatibility purposes.

The IBM 727 uses two modes of recording. The binary mode is for normal data recording, and the binary coded decimal (BCD) form is used to make recordings for use with peripheral equipment.

A file protection ring is provided in the system, compatible with the IBM method of recording. The ring is placed on the back of the upper reel of tape, and its presence is a necessary condition for writing on the tape. If the ring is not present, the tape is protected, and writing is impossible.

#### The Binary Mode

Six 6-bit words are placed on the tape to form a 704 word. The six words are placed such that the first 6 bits of the word (the least significant bits) appear first on the tape, followed by the second least significant bits and so on up to the sixth character containing the six most significant bits of the number. In the TX-0, the word is 18 bits long, and therefore only three characters are needed to make a TX-0 word. Whenever a TX-0 word is read from the tape, the bit of the first character read will occupy bits 2, 5, 8, 11, 14, 17; the second character will occupy bits 1, 4, 7, 10, 13, 16; and the last character will occupy bits 0, 3, 6, 9, 12, 15 in the Live Register. In this binary mode, the redundancy or parity bit is adjusted such that an odd number of bits appear across the tape in the seven channels of the recorded information.

#### Binary Coded Decimal (BCD Mode)

This mode is only similar to the binary mode in that six bit words of a 704 or 709 or 7090 are placed on the tape. In the BCD

mode, not all of the 64 six-bit characters are used. The parity or redundancy check bit is adjusted such that an even number of ones appear across the tape in the seven channels. Because the character 000000 would have a parity bit of 0, this would appear on tape as a space, and as such is not a legal character on the tape. Hence it is not used in the BCD mode. Table 1 shows how the various BCD characters are coded on the tape. On the TX-0 it is possible to program the type of parity check recorded, and therefore, by means of a suitable program, information can be transferred between the 7090 and the TX-0. It is also possible to use the Computation Center off-line equipment with tapes recorded on the TX-0.

#### Handling the Magnetic Tape System

The tape drive has to be properly loaded in order to obtain reliable performance and avoid damage to the tape. To unload the tape transport proceed as follows:

- (a) Rewind the tape.
- (b) When the tape is at load point (load point light on) push the manual control in the reverse direction. The tape will move backwards until it is pulled off the lower reel. The unit will be automatically turned off.
- (c) Open the door, and turn the handle R (see Figure 3) on the left side of the unit, half a turn clockwise. This operation will bring together the two tension arms. Manually turn the upper reel until the rest of the tape is wound in it.

TABLE 1

<u>Character</u>	<u>Tape</u>	<u>Character</u>	<u>Tape</u>
0	001010	J	100000
1	000001	K	100010
2	000010	L	100011
3	000011	M	100100
4	000100	N	100101
5	000101	O	100110
6	000110	P	100111
7	000111	Q	101000
8	001000	R	101001
9	001001	~}	101010
=	001011	o}	101011
--	001100	\$	101100
+	110000	*	010000
A	110001	blank	010001
B	110010	/	010010
C	110011	S	010011
D	110100	T	010100
E	110101	U	010101
F	110110	V	010110
G	110111	W	010111
H	111000	X	011000
I	111001	Y	011001
+}	111010	Z	011010
o}	111011	±	011011
.	111100	,	011100
)	100000	(	
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- (d) Take the upper reel out by loosening the hub in the center of the reel and holding the reel so it will not turn.

To load a tape on the unit, proceed as follows:

- (a) Verify that the file protection ring is in or out of the reel as appropriate. Place the reel over the upper hub, and tighten the hub while holding the reel in. The tape should be wound in the reel with the oxide coated surface towards the center of the reel and the free end of the tape should hang down from the right hand side of the reel.
- (b) Open the hinged pad P so that the surface of the pad becomes perpendicular to the surface of the magnetic heads.
- (c) Open the vacuum chamber cover.
- (d) Pull about three feet of tape from the upper reel and thread it in the unit as shown in the schematic diagram in Figure 3.
- (e) Close the vacuum chamber cover and hinged pad.
- (f) Wind the free end of the tape in the lower reel with two or three turns. Do not stick the tape to the reel in any way.
- (g) Turn the handle half a turn counterclockwise.
- (h) Turn both reels in such a way so that the tension arms move about three inches away from the fixed rollers.
- (i) Close the door.



THREADING SCHEMATICS

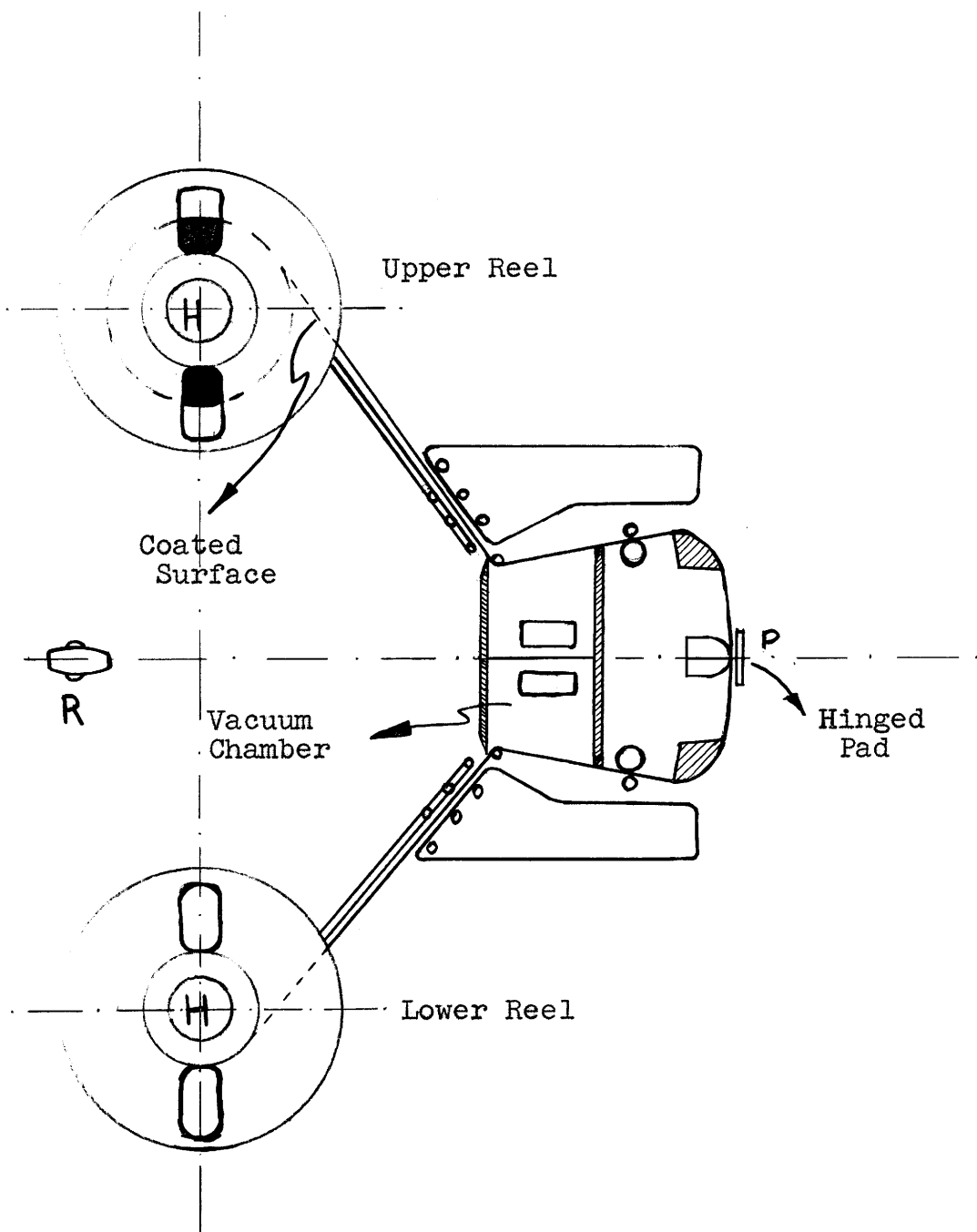
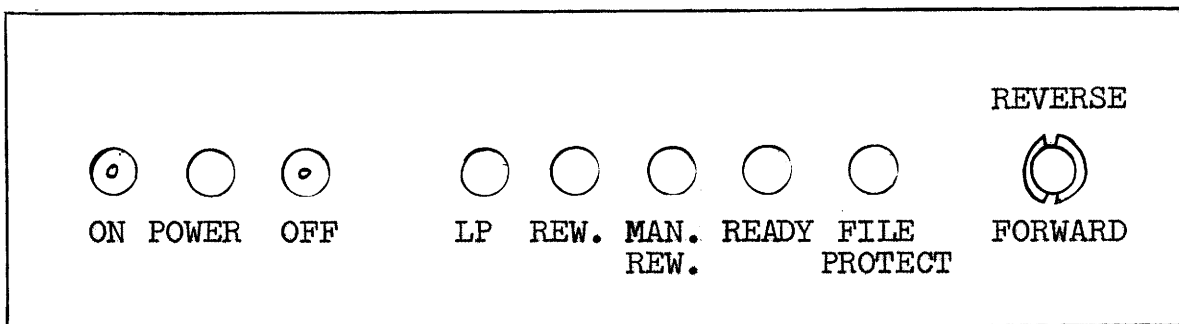


FIGURE 3

- (j) Push the on push-button and wait until the ready light goes on.
- (k) Push the manual switch in the forward direction until you are sure that the load point passed over the photoelectric sensing device and then press the re-wind push-button.

When you finish using the unit, press the off push button.

Tape Controls



ON push-button (Wait until the ready light goes on before operating the unit.)

POWER ON indicator

OFF push-button

LOAD POINT light (goes on whenever the tape is at load point.)

REWIND light (goes on while tape is rewinding.)

MANUAL REWIND push button (if pressed when tape unit is ready it will rewind the tape.)

READY light (goes on when the unit is available for the computer.)

FILE PROTECT light (goes on whenever the upper reel does not have the file protection ring.)

Manual switch: Up (REVERSE) the tape moves in the reverse direction.

Down (FORWARD) the tape moves in the forward direction.

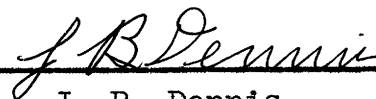
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Supplement to the Magnetic Tape Memo M-5001-38

A new lever switch has been added to the Magnetic tape unit control.

REW

STOP

This switch has momentary contacts up and down. For the up position, the unit rewinds normally; whereas the down position is used to stop a runaway tape, as in the case of the unit trying to read a blank tape. The stop button in the computer does not stop the tape unit, only stops the program running at the time. For normal operation, if the tape is moving when the stop button is pushed it will stop by itself as follows:

On write, the unit will deselect normally due to absence of the cpy instruction.

On read, the unit will move up to the nearest end of record gap and stop in its normal position, probably clobbering the live register.

On forward spacing or backspacing, the unit will stop at the nearest end of record gap without disturbing the live register.

Beware of the stop lever, because it stops the unit at any place, overriding any command given to the unit except a rewind command. If that occurs, it is advisable to rewind the tape so it will be positioned properly for the next command.