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IBM 7330 Magnetic Tape Unit

Original Equipment Manufacturers Information

This publication gives specifications for attaching a control unit to the IBM 7330 Magnetic Tape Unit. All timings, circuits, and necessary cables are stated.

MAJOR REVISION (May, 1964)
This edition, Form A22-6619-3, is a major revision of the preceding edition and obsoletes Form A22-6619-2 and Technical Newsletter N22-0121.

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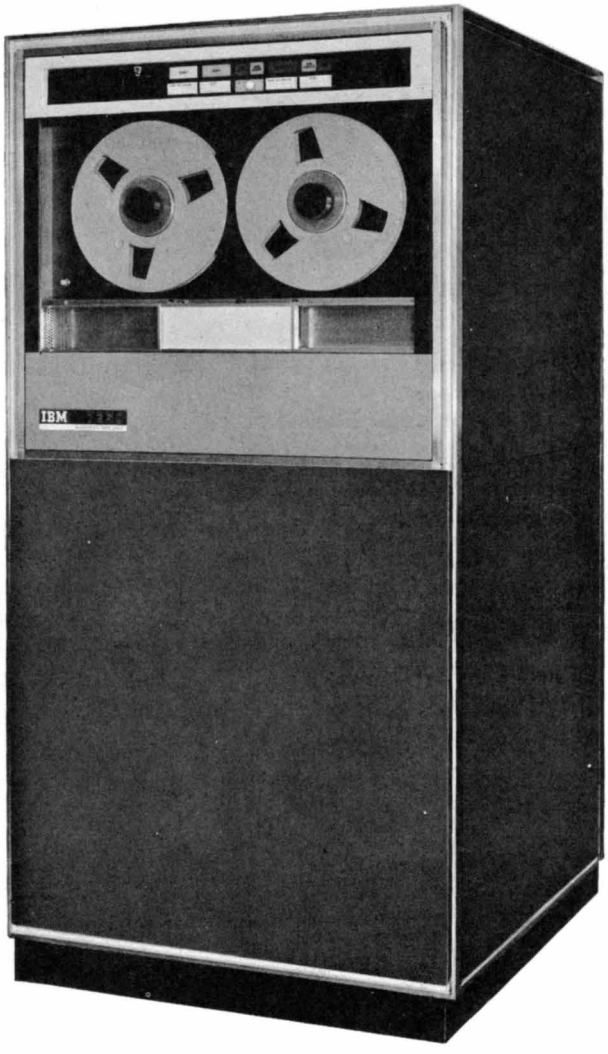


Figure 1. IBM 7330 Magnetic Tape Unit

The IBM 7330 Magnetic Tape Unit (Figure 1) provides the advantages of magnetic tape to users whose operations do not demand the high-speed operation of IBM 729 Magnetic Tape Units. The 7330 Tape Unit can read or write at character densities of 200 or 556 characters per inch. This dual-density feature gives reading and writing rates of up to 7,200 or 20,000 characters per second.

The dual-density feature, inter-record gap, and recording modes make magnetic tapes prepared on the IBM 7330 Magnetic Tape Unit compatible with tapes prepared on IBM 727 and 729 Magnetic Tape Units, the IBM 7701 Magnetic Tape Transmission Terminal, and the IBM 7765 Paper Tape to Magnetic Tape Converter.

The use of BCD (binary coded decimal) or binary tape data codes is determined by the controlling device used with the 7330 tape unit. During reading or writing, tape is moved from the file (left) tape reel through a horizontal vacuum column, across the two-gap read-write head, and through a second horizontal vacuum column to the machine (right) tape reel. Tape speed is 36 inches per second. Tape may be backspaced (at the same speed) over a record or may be rewound to the beginning of the reel.

While tape is moving backward (machine reel to file reel), no writing takes place. There are two speeds of rewind: high speed and low speed. Time for a high-speed rewind does not exceed 2.2 minutes per 2,400 foot reel of tape. Low-speed rewind time is 36 inches per second. After a high-speed rewind, a load arm on the tape unit must be positioned manually, and the tape must be inserted manually into the vacuum columns for further reading or writing. After a low-speed rewind, the tape is ready for further reading or writing without any manual intervention.

Reading or writing is accomplished by passing magnetic tape over a read-write head. The head has two gaps: the first, used for writing only; the second, for reading only. The two-gap head (Figure 2) allows automatic checking of the tape while it is being written. The distance between the read and write gaps is 0.300 ± 0.002 inch. Because the tape transport speed of the 7330 tape unit is 36 inches per second, the read (check) operation occurs 8.33 milliseconds after the character is written.

The IBM 7330 Magnetic Tape Unit uses the non-return-to-zero (NRZI) method of recording. When electrical current flows through the write gap coil, the magnetic oxide particles on the tape are magnetized in one direction. If the current in the coil reverses its direction, the particles on tape are magnetized in the opposite direction. In the NRZI method, a 1 is recorded by a reversal of flux polarity and a 0 by the absence of such a reversal. In this system, the magnetic tape is fully magnetized in each track and polarity is reversed as each 1-bit is written.

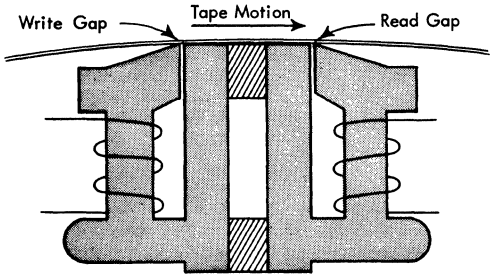


Figure 2. Two-Gap Read-Write Head

In actual tape unit operation, seven recording gaps are placed vertically across the tape. Thus, recording occurs in seven columns or tracks across the tape.

Dual-level sensing is normally used with the two-gap head to increase the detection of errors or weak signals at the time of writing. This circuitry is in the device used to control the tape unit. Signals received by the checking circuitry associated with the read-write head are interpreted at two different energy levels (E1 and E2 in Figure 3). This interpretation or analysis determines that:

1. Data signal strength is at a level that provides good signals when the tape is read at a later time.

2. No unwanted signal (noise) is present on the recorded tape.

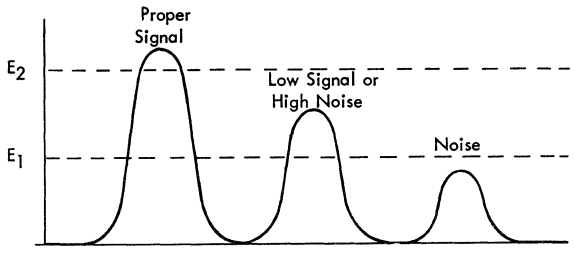


Figure 3. Signal and Noise Levels

Keys and Lights

The operating keys and lights of the 7330 tape unit are shown in Figure 4.

Address Selection Switch assigns a number (from 0 through 9) to the tape unit to identify it to the stored program or controlling device. The switch must not be rotated during a tape operation.

Select Light is on when the computer or controlling device selects the tape unit for operation.

Ready Light is on when the tape unit is mechanically and electrically ready. This means that tape has been loaded properly and the start key has been pressed.

Tape Indicate Light is on when the end-of-tape reflective strip is sensed during a write operation to warn of the approaching end of tape.

Fuse Light is on when a fuse malfunctions; operation cannot be resumed until service personnel correct the condition.

File Protect Light is on when a file protected reel of tape is placed on the file reel hub and when the tape unit is not ready. When this light is on, reading may occur, but writing may not.

Low Density Light is on when the density selection switch is set to LOW DENSITY position.

High Density Light is on when the density selection switch is set to HIGH DENSITY position.

Density Selection Switch places the tape unit in either low-density or high-density status.

Reset Key resets the tape unit to manual control. A low-speed or high-speed rewind operation is stopped by this key. The tape unit is taken from a ready status and the ready light is turned off.

Rewind Key (High Speed) is operative only when the tape unit is not in ready status. The head cover is raised and tape is pulled from the vacuum columns before the high-speed rewind is started.

Rewind Key (Low Speed) is operative only if the tape unit is not in a ready status. Pressing the key causes tape to move backward at 36 inches per second until the load point is sensed.

Start Key turns the ready light on and places the tape unit in a ready status. Manual control keys are disabled.

Reel Release Key is not located with other keys and lights but is below and to the left of the left-hand tape reel position. When this key is pressed, both tape reels may be turned manually for threading tape. The reel door must be opened for access to the key. The reel door should never be opened when the ready light is on or during any rewind operation.

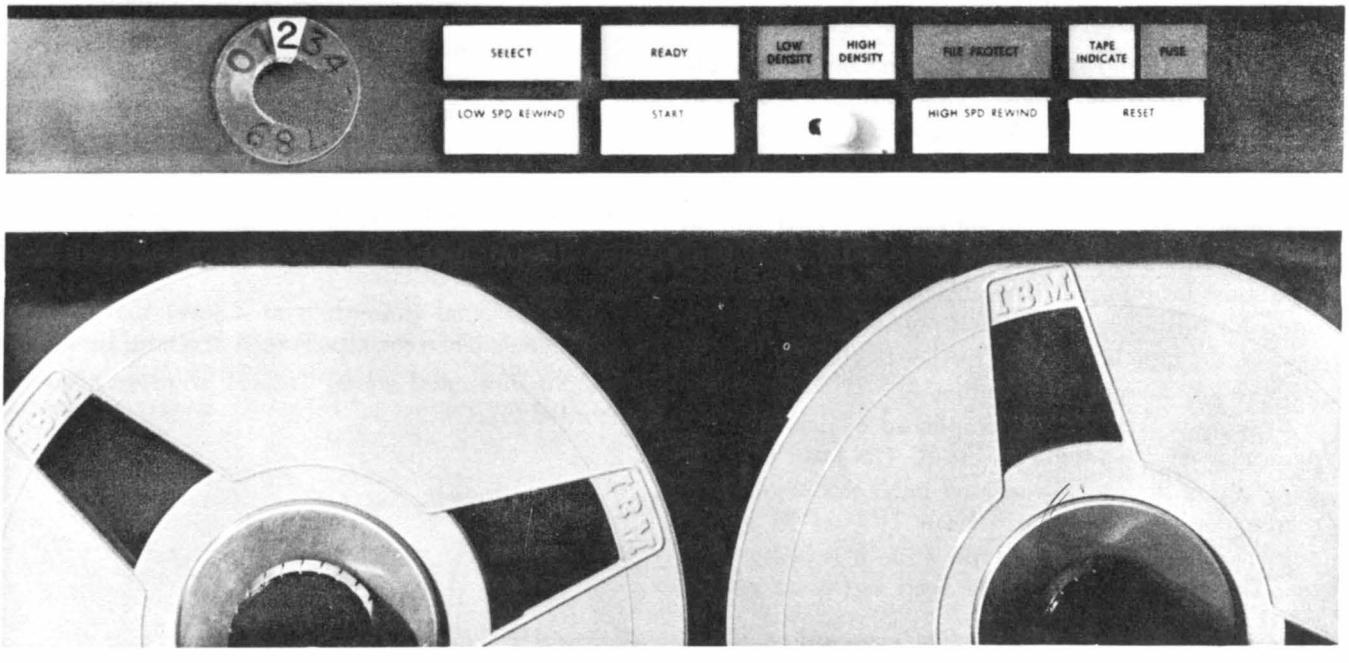


Figure 4. Keys and Lights

Read-Write Head

1. Two-gap construction allows checking while writing.
2. 0.300 ± 0.002 inch between read and write gaps.
3. Track widths:
   Write −0.0480, +0.0000 −0.0005 inch
   Read −0.0300, +0.0000 −0.0005 inch
4. Write current: 65.8, +2.0, −1.8 milliamperes
5. Read head output: 0.024 ± 0.008 volt

Tape Speed

1. Forward, backward, and low-speed rewind: 36 inches per second.
2. High-speed rewind: 220 inches per second (average).

Delays

	1414	1401/1460
1. Write delay	7.2	5.0
2. Write stop delay	4.4	6.6
3. Read delay	3.6	3.6
4. Read stop delay	9.8	9.8
5. Backward read delay	6.4	6.4
6. Backward stop delay	7.8	7.8
7. Write after backspace	—	7.2
8. Forward to backward	205.0	205.0
9. Backward to forward	205.0	205.0

NOTE: All delays are in milliseconds ±2%.

Character Rate

1. Low density: 7,200 characters per second, ±1% at 36 inches per second. Character gate = 90 microseconds.
2. High density: 20,000 characters per second, ±1% at 36 inches per second. Character gate = 22.4 microseconds.

Power Requirements

1. Input voltage: 208 or 230 VAC, ±10%, 60 cycles, 1.1 KVA, three phase.
2. Internally generated voltages are: +6 volts, −6 volts, +12 volts, −12 volts for transistor operating voltages. A −48 volt supply is available for relays and motor circuits.

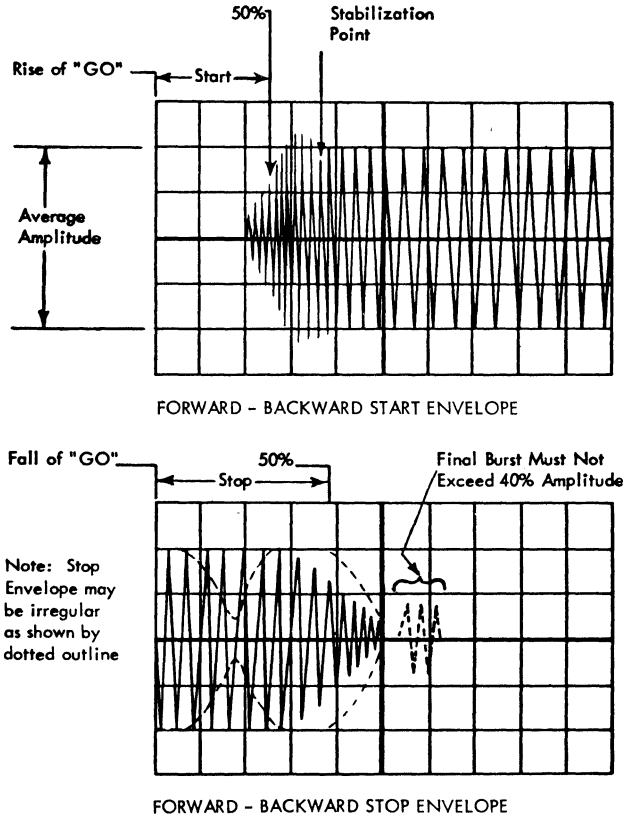


Figure 5. Start-Stop Time Envelopes

Tape Start and Stop Specifications

Start and stop envelopes are shown in Figure 5. Instead of the ideal stop envelope shown in Figure 5, the envelope may have an irregular shape (dotted outline). Stop time should be measured to the last 50 per cent point before tape motion stops. A final burst may occur as shown by the dotted portion and, if the amplitude of this burst is not greater than 40 per cent, it will not affect tape unit operation. More than 40 per cent of total amplitude indicates misadjustment or binds in the moving coil assembly or its linkages.

Conditions and Measurement Points in Figure 5

CONDITION	SPECIFICATION AND MEASUREMENT POINTS
Forward Start	Measured from rise of GO to point where displayed waveform attains 50 per cent of average peak-to-peak amplitude and shall be 2.5 milliseconds (ms), ±0.4 ms.
Forward Stop	Measured from fall of GO to point where displayed waveform diminishes to 50 per cent of average peak-to-peak amplitude and shall be 4.0 ±1.0 ms

Backward Start	Measured from rise of CO to point where displayed waveform attains 50 per cent of average peak-to-peak amplitude and shall be 2.5 ±0.4 ms.
Backward Stop	Measured from fall of CO to point where displayed waveform diminishes to 50 per cent of average peak-to-peak amplitude and shall be 4.0 ±1.0 ms.
Stabilization Point	Measured from rise of CO to point where peak-to-peak amplitude of displayed waveform attains 100 ±5 per cent of average peak-to-peak amplitude and shall occur not later than 5.0 ms after rise of CO.

Noise

1. Write circuit feed-through is less than 400 millivolts, as measured at the read bus of each track of the tape unit, when continuous 1 bits are written in all tracks without tape movement.

2. Cross talk is less than 400 millivolts as measured at the read bus of each track of the tape unit when continuous 1 bits are written in all tracks, except the track being checked (with tape movement).

3. Total noise is equal to the sum of cross talk and feed-through levels.

4. Minimum clipping levels of read pulses at input to final amplifiers of the control unit, to insure no random low-noise pickup, are:

   a. 1.6v peak-to-peak when reading-while-writing.

   b. 0.6v peak-to-peak when reading only.

In IBM tape controls, each track has a dual set of final amplifiers; one set accepts a high-level input, and the other a low-level input. All inputs are peak sensed. The outputs of these dual amplifiers are subsequently compared and checked in other circuitry for error checking. The inputs to the dual amplifiers are:

CHANNEL	READ	WRITE
A	2.4v peak-to-peak	2.8v peak-to-peak
B	2.4v peak-to-peak	0.6v peak-to-peak

Tape Operating Environment

The following conditions for use of IBM magnetic tape are recommended:

Relative Humidity	Temperature	Maximum Wet Bulb Temperature
20%–80%	60°–90°F	78°F

Tape Storage Environment

The following conditions for long term storage of IBM Heavy Duty and Mylar magnetic tape are recommended:

Relative Humidity	Temperature	Maximum Wet Bulb Temperature
20%–80%	40°–90°F	80°F

An exception is unrecorded IBM Heavy Duty Tape; it may be stored under the following conditions:

Relative Humidity	Temperature	Maximum Wet Bulb Temperature
20%–80%	40°–120°F	80°F

Tape exposed to other conditions should be reconditioned to the operating environment for a time period equal to the storage time (to a maximum reconditioning period of 24 hours). When not in use, reels of tape should always be stored vertically in their plastic containers.

When shipping tape-loaded reels, place them in containers and seal each in a plastic bag. Additional protection should be provided by packing in stiff cardboard shipping cartons. Plastic bags and cartons may be obtained from IBM.

Read Preamplifiers

Read preamplifiers should be adjusted to give an output of 8.8 volts, peak-to-peak, while writing high-density tape. A properly operating preamplifier is capable of producing a minimum 10-volt output when operating at maximum gain.

Input-Output Signal Lines

Input-output signal lines are shown in Figure 6. Signal reference levels used are +N which is $\geqq$ +0.65 volt, and −N which is $\geqq$ −0.70 volt. Receptacle pin assignments are shown in Figure 7 and power plug assignments are shown in Figure 8.

−N Output Lines

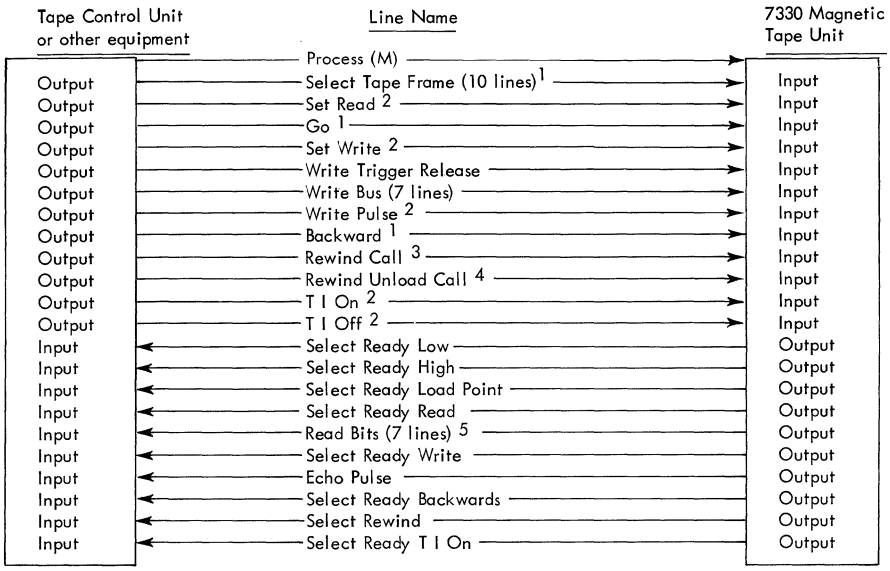
Line Name	Tape Receptacle Number
Select Ready Low	31
Select Ready High	21
Select Ready Load Point	27
Select Ready Read	33
Read Bit 1	82
Read Bit 2	84
Read Bit 4	93
Read Bit 8	95
Read Bit A	102
Read Bit B	104
Read Bit C	113
Select Ready Write	35
Echo Pulse	192
Select Ready Backward	29
Select Rewind	37
Select Ready and TI On	23

−N Input Lines

Line Name	Tape Receptacle Number
Select Tape Frame 0	77
Select Tape Frame 1	79
Select Tape Frame 2	86
Select Tape Frame 3	88
Select Tape Frame 4	97
Select Tape Frame 5	99
Select Tape Frame 6	106
Select Tape Frame 7	108
Select Tape Frame 8	117
Select Tape Frame 9	119
Set Read	13
Go	5
Set Write	11
Write Trigger Release	194
Write Bus 1	172
Write Bus 2	174
Write Bus 4	176
Write Bus 8	178
Write Bus A	180
Write Bus B	182
Write Bus C	184
Write Pulse	196
Backward	7
Rewind Call	9
Rewind Unload Call	39
TI On	1
TI Off	3
Process (M)	49

Internal Control Lines

Both +W and −W reference level lines are used internally for control of motors and relays. The +W line is 0 volt and the −W is −48 volts.



All input lines to the 7330 are -N reference level lines (≧ +0.65 volts)
All output lines from the 7330 are -N reference level lines (≧ -0.70 volts)
1 = Must have rise and fall times of less than 1.5 microseconds
2 = Must have minimum pulse width of 12 microseconds
3 = Must have minimum pulse width of 10 microseconds
4 = Must have minimum pulse width of 4 microseconds
5 = 8.8 volt peak-to-peak around ground

Figure 6. Input/Output Signal Lines

15	Shield	Set Read	Shield	Set Write	Shield	Rewind Call	8 Shield	Bkwd	Shield	Go	Shield	TI Off	Shield	1 TI On
30	Sel Rdy Bkwd	Shield	Sel Rdy LP	Shield			23 Sel Rdy TI On	Shield	Sel Rdy HI	Shield				16
45					Shield	Rew Unld Call	38 Shield	Sel Rewind	Shield	Sel Rdy Write	Shield	Sel Rdy Read	Shield	31 Sel Rdy LO
60							53				Process (M)	Shield		46
75							68							61
85 Shield	Read Bit 2	Shield	Read Bit 1	81						80	Sel TU 1	Shield	Sel TU 0	76 Shield
95 Read Bit 8	Shield	Read Bit 4	Shield	91						90	Shield	Sel TU 3	Shield	86 Sel TU 2
105 Shield	Read Bit B	Shield	Read Bit A	101						100	Sel TU 5	Shield	Sel TU 4	96 Shield
115		Read Bit C	Shield	111						110	Shield	Sel TU 7	Shield	106 Sel TU 6
125				121						120	Sel TU 9	Shield	Sel TU 8	116 Shield
140 -6v				+12v			133	+6v						126
155							148							141
170 -12v							163	Gnd						156
185	Write Bus C	Shield	Write Bus B	Shield	Write Bus A	Shield	178 Write Bus 8	Shield	Write Bus 4	Shield	Write Bus 2	Shield	Write Bus 1	171 Shield
200			Shield	Write Pulse	Shield	Wr Tr Rel	193 Shield	Echo Pulse						186

Figure 7. Tape Receptacle Pin Assignment

POWER PLUG PIN ASSIGNMENTS			
TAPE UNIT		POWER CABLE	
Pin No	Voltage or Control	Wire Size	Type
1	AC outlet - 115 volts	14	AC
2	AC outlet - 115 volts	14	AC
3	Bond	14	
4	Spare	18	
5	Model II & IV reset - 208 volts	18	AC
6	Spare	18	
7	Spare	18	
8	Spare	18	
9	Spare	18	
10	Model II & IV reset - 208 volts	18	AC
11	Unreg AC Ø1	10	AC
12	Unreg AC Ø2	10	AC
13	Unreg AC Ø3	10	AC

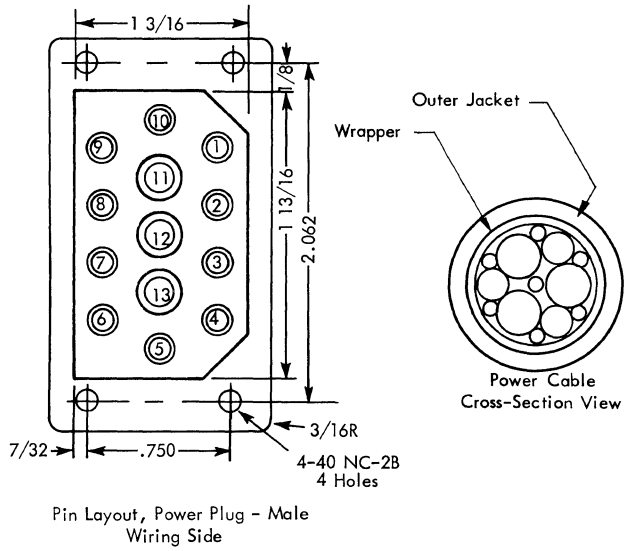


Figure 8. Power Plug Assignments

Electronic Circuits

All output lines from the tape unit are powered by a line driver circuit (Figure 9) except the seven read bit lines. These lines come from a preamplifier (Figure 10). All input lines to the tape unit are terminated in the tape unit by a line terminator shown in Figure 11. Signal, power, tester, and AC outlet receptacles are shown in Figure 12. The two signal receptacles are common (pin 1 of receptacle A is common to pin 1 of receptacle B, and so forth for all pin assignments). One receptacle is used for the connecting cable going to the controlling device or to the field tester; the other must contain a terminating shoe. Possible cable connections between tape unit, field tester, and tape controlling device are shown in Figure 13.

Checking circuitry concerned with the dual-level sensing feature is not a physical part of the tape unit but is normally contained in the control unit associated with the tape unit. Figure 14 shows a sample circuit.

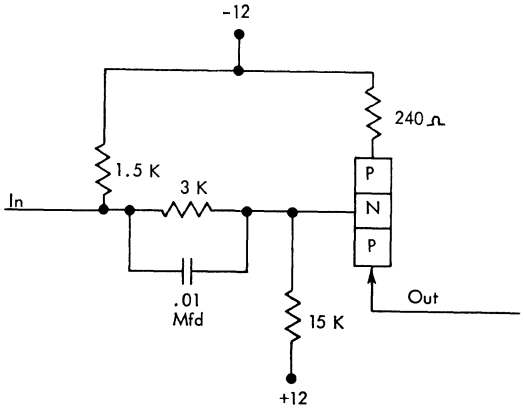


Figure 9. Line Driver Circuit

7330 and 729/7330 Tape Unit Field Testers

The 7330 field tester, IBM P/N 461142, is shown in Figure 15; the 729/7330 field tester, IBM P/N 461390, is shown in Figure 16. They are used to test the 7330 tape unit and simulate writing 1's and 0's, start-stop envelopes, forward-backward motion, and provide scope sync points and test points. The testers are equipped with an 8-foot cable for connection to the tape unit (Figure 13).

General Information

The tape signal cable assembly, IBM P/N 535099, may have an aggregate length of 100 feet. This includes tape unit to tape unit and tape unit to tape control unit. Ten 7330 tape units may be attached to one IBM control unit channel (A or B). Cable length must be specified.

The tape unit power cable assembly, IBM P/N 535098, may have an aggregate length of 100 feet. This includes tape unit to tape unit, tape unit to tape control, and tape control to power source.

A tape unit signal terminating shoe must be installed at the extremity of each tape unit input-output (channel) group. When the A channel tape receptacle is used for the terminating shoe, IBM P/N 556801 is used. For channel B, IBM P/N 556930 is used. Signal and power connections are shown in Figure 13. Figures 17, 18, and 19 are timing charts.

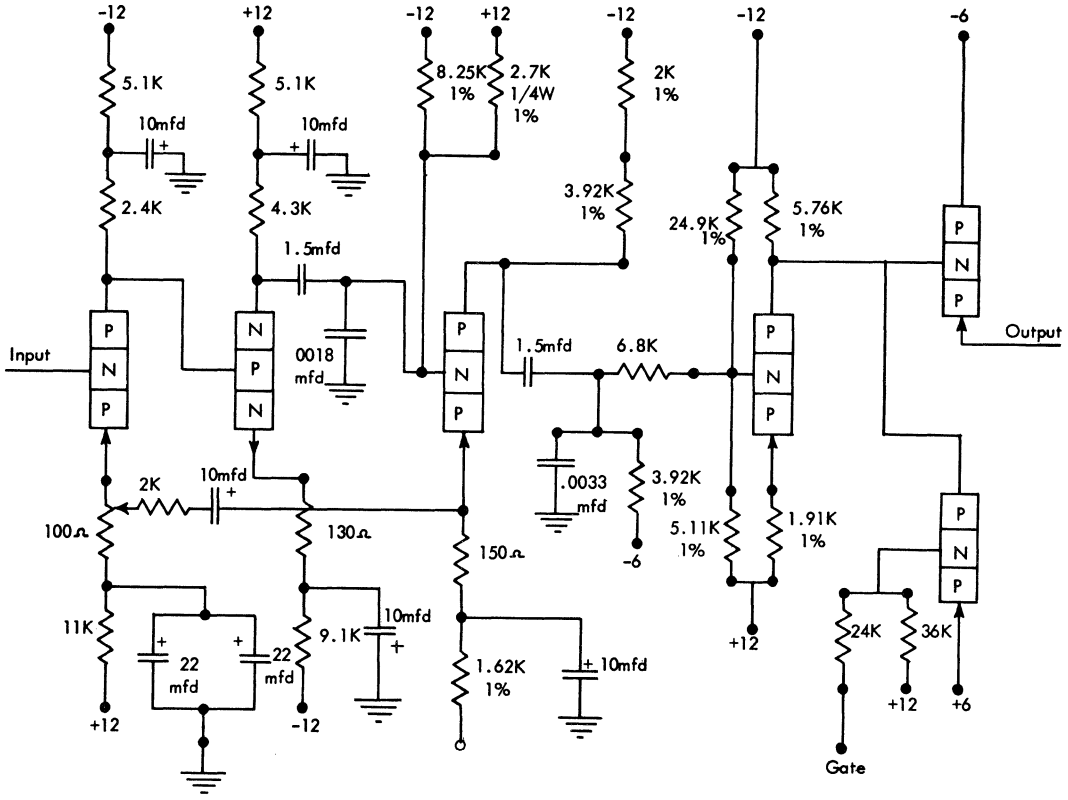


Figure 10. Read Preamplifier

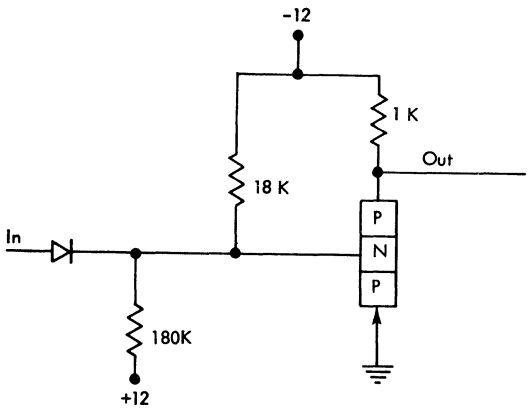


Figure 11. Line Terminator Circuit

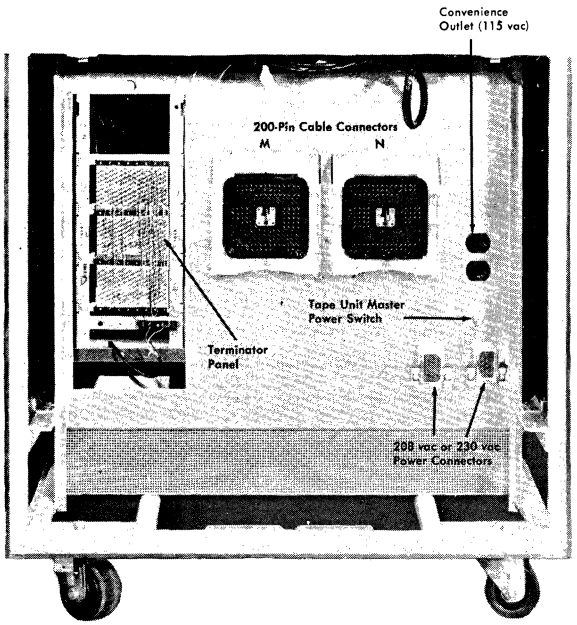


Figure 12. Signal and Power Receptacles

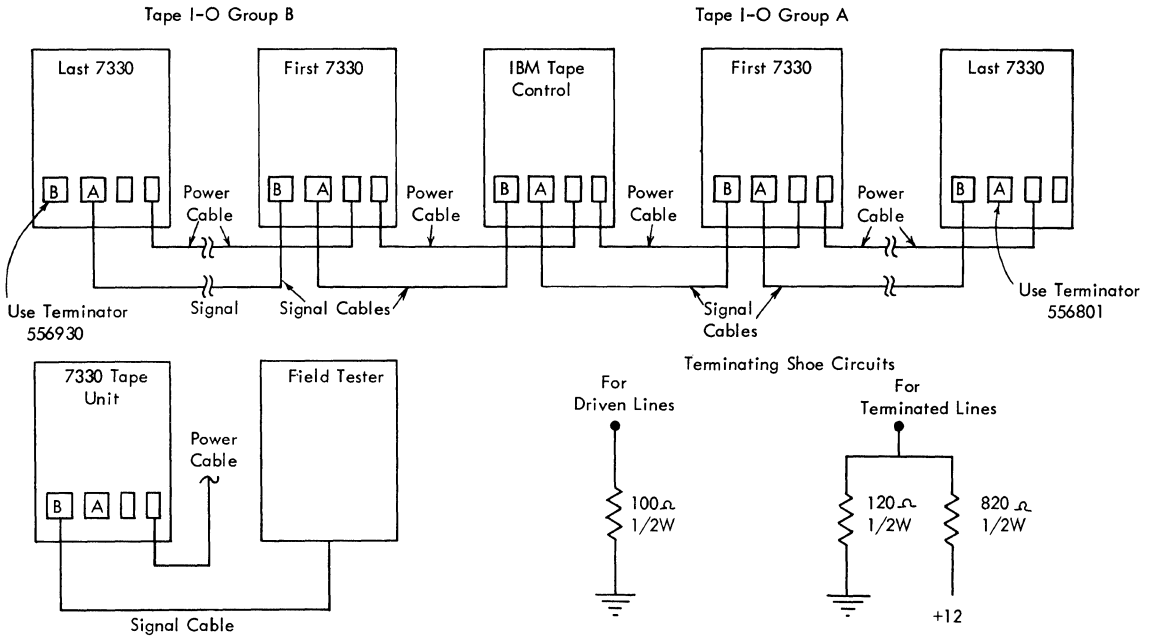


Figure 13. Tape Signal and Power Connections

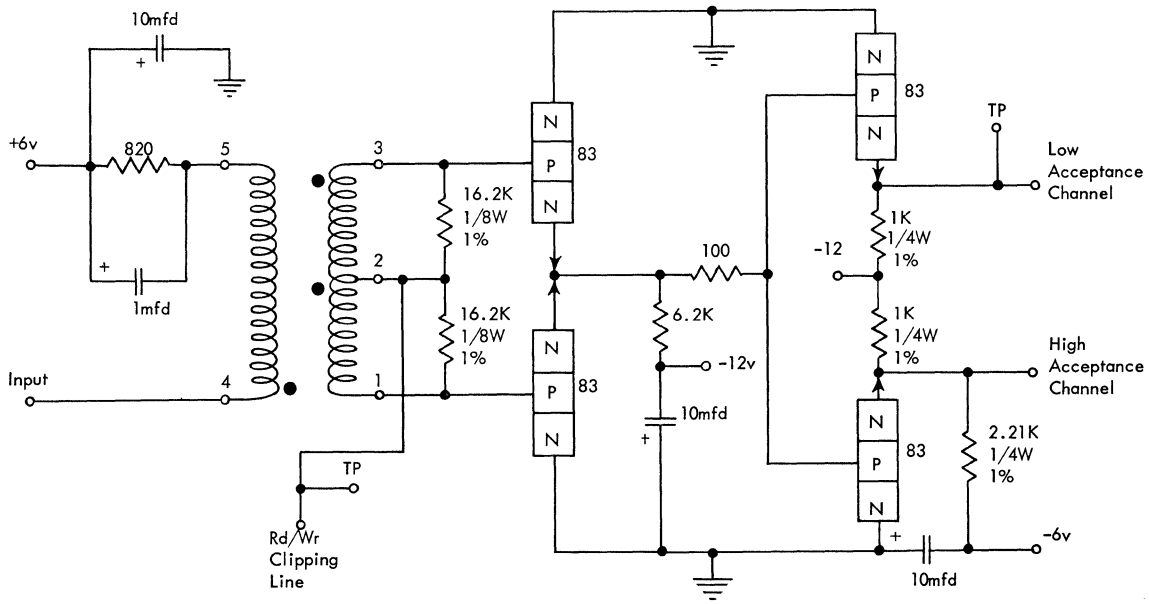


Figure 14. Sense Amplifier, Rectifier, and Clipper

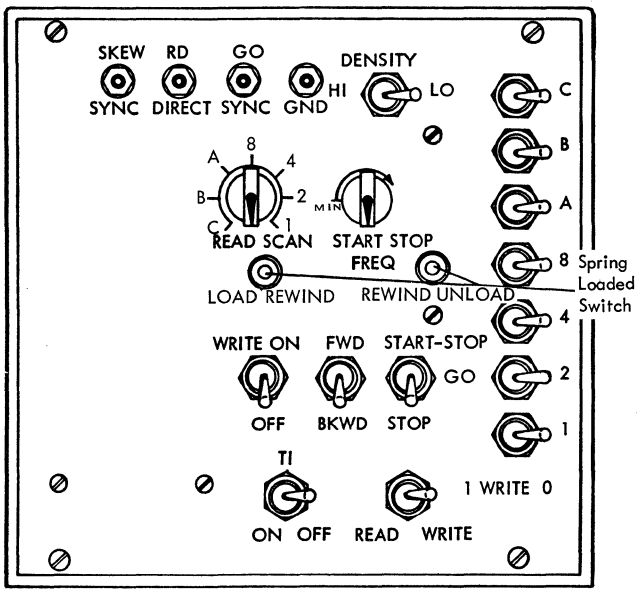


Figure 15. Field Tester for IBM 7330

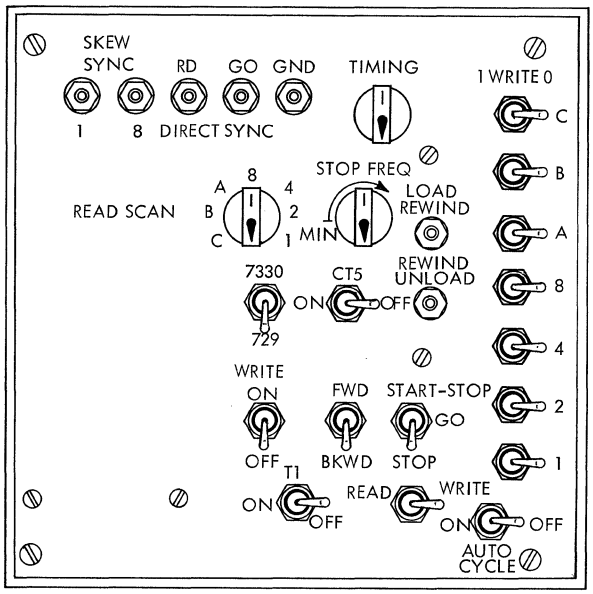


Figure 16. Field Tester for IBM 729/7330

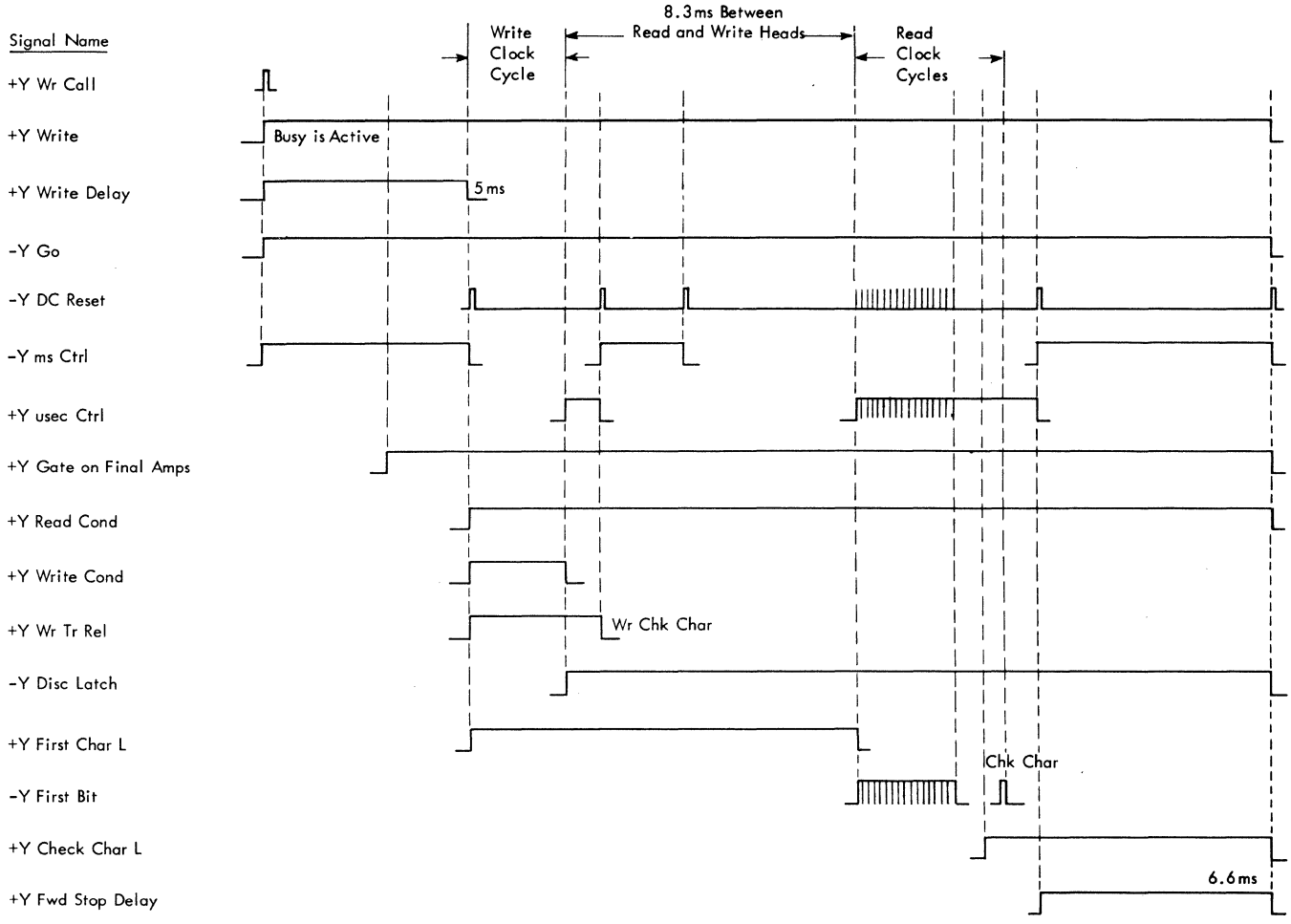


Figure 17. Write Operation Timing Chart

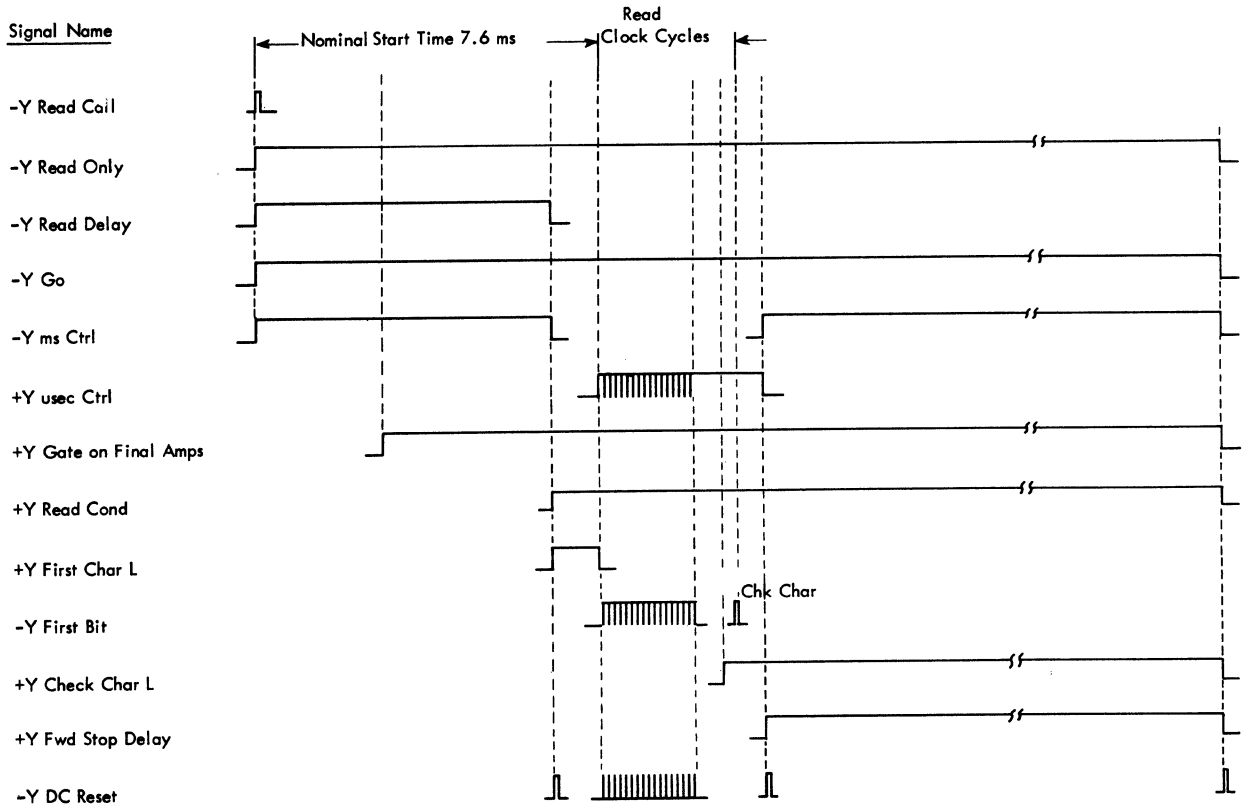


Figure 18. Read Operation Timing Chart

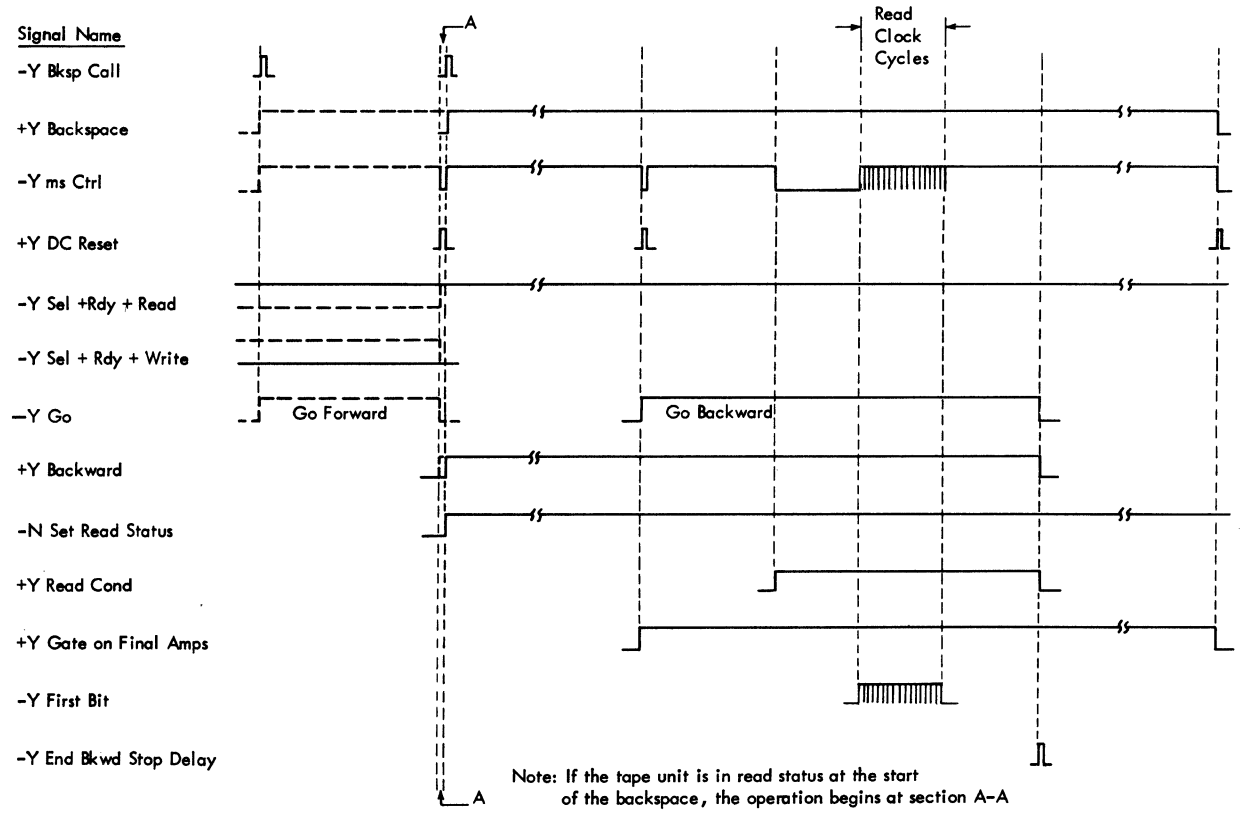


Figure 19. Backspace Operation Timing Chart

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Data Processing Division
112 East Post Road, White Plains, N.Y. 10601