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MODEL 100X
MAGNETIC
TAPE
RECORDER

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INTRODUCTION

This manual contains the required information for the operation and maintenance of the Cipher Model 100X magnetic tape recorder. Please read this manual thoroughly before unpacking, installing, or operating the recorder. The manual is divided into seven (7) sections, as follows:

I Description and Specifications
II Unpacking, Inspection, and Installation
III Operation
IV Theory of Operation
V Maintenance
VI Troubleshooting
VII Parts List, Schematics, & Assembly Diagrams

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SECTION I

DESCRIPTION AND SPECIFICATIONS

1-1. GENERAL.

1-2. The Model 100X Recorder is a high-performance, digital, magnetic tape recorder manufactured by Cipher Data Products, Inc., San Diego, California. The recorder is available with a dual-gap head providing read-after-write capability or a single-gap head for applications where simultaneous read and write operation is not required. Various tape speed and density capabilities are available as well as a 7- or 9-track option (refer to Table 1-1). The recorder is designed to operate on 105- to 250-volts a.c., single-phase, 48- to 63-hertz line power. If the compliance arm retraction feature is not required, the recorder can operate on line power frequencies up to 420 hertz. Reels to 10.5-inches in diameter can be accommodated.

7 or 9 Track
Read After Write
Read/Write
Write Only
Read Only
Overwrite
Tape Speeds (IPS) Standard: 45, 37.5, 25, 18.75, or 12.5 Nonstandard: Any fixed speed within the range of 2-45.
Data Density (BPI): 800, 556, 200
Dual Density Combinations (BPI): 800/556, 800/200, 556/200
Local Density Selection
Remote Density Selection
Power: 400 Hz operation (without compliance arm retraction system)
Logic Options (See Section IV)
Facade Color (White is standard)

Table 1-1. Optional Features

1-3. PURPOSE.

1-4. The recorder is designed to be used in data acquisition and computer processing systems where data must be acquired and stored on magnetic tape. Writing and reading of digital data is in IBM-compatible NRZI format. Data recorded by a Model 100X Recorder will be completely recovered when the tapes are read by IBM or similar equipment.

1-5. PHYSICAL DESCRIPTION.

1-6. The Model 100X Recorder (Figure 1-1) is designed to be hinge-mounted in a standard 19- or 24-inch equipment rack. All components are mounted on a precision-ground, cast-aluminum plate. When the equipment rack is securely anchored, the printed circuit boards and other internal components are accessible from the front by releasing the adjustable pawl fastener and swinging the recorder open on its hinges. A transparent hinged, front cover protects the transport from dust and other foreign matter while allowing observation of tape motion. The pushbutton controls, which light when the commanded sequence is complete, are mounted on the front trim panel where they are accessible with the cover closed. The power connector is a standard, three-pin, grounded plug.

1-7. Four printed circuit boards are used in the Model 100X40 Recorder, a read/write board, a control/servo board, and a power board; all mounted on the rear of the mounting plate. An EOT/BOT detector board is mounted on the front of the unit, under the head cover. The Model 100X60 Recorder has a fifth board, the single-gap head adapter board, mounted to the read/write board, providing for single-gap head operation.

1-8. TAPE TRANSPORTS.

1-9. The reel-to-reel transport uses two servo-controlled, direct-drive, dc torque motors to drive the tape reels. The reels are secured to the hub by lever-actuated, expanding rings. Two spring-loaded compliance arms maintain tape tension at eight ounces and serve as tape storage buffers. A compliance arm retractor system, energized when power is turned on, drives the compliance arms to their full-up position for ease of tape threading. During the load sequence the compliance arms are returned to the operating position to provide their buffering and tensioning function.

1-10. The tape path includes both roller and fixed guides, the head and cross-feed shield, and a tape cleaner. The roller guides utilize precision bearings to minimize friction and reduce wear, and the fixed guides are hard-chrome plated. The fixed guides, on each side of the head, are the single-edge type. The outer, or reference flange of the guide, is fixed to an exact dimension and the bottom flange of the guide is spring loaded to force the tape against the reference edge at all times. This arrangement provides minimum skew and minimizes the effect of tape width variations. In

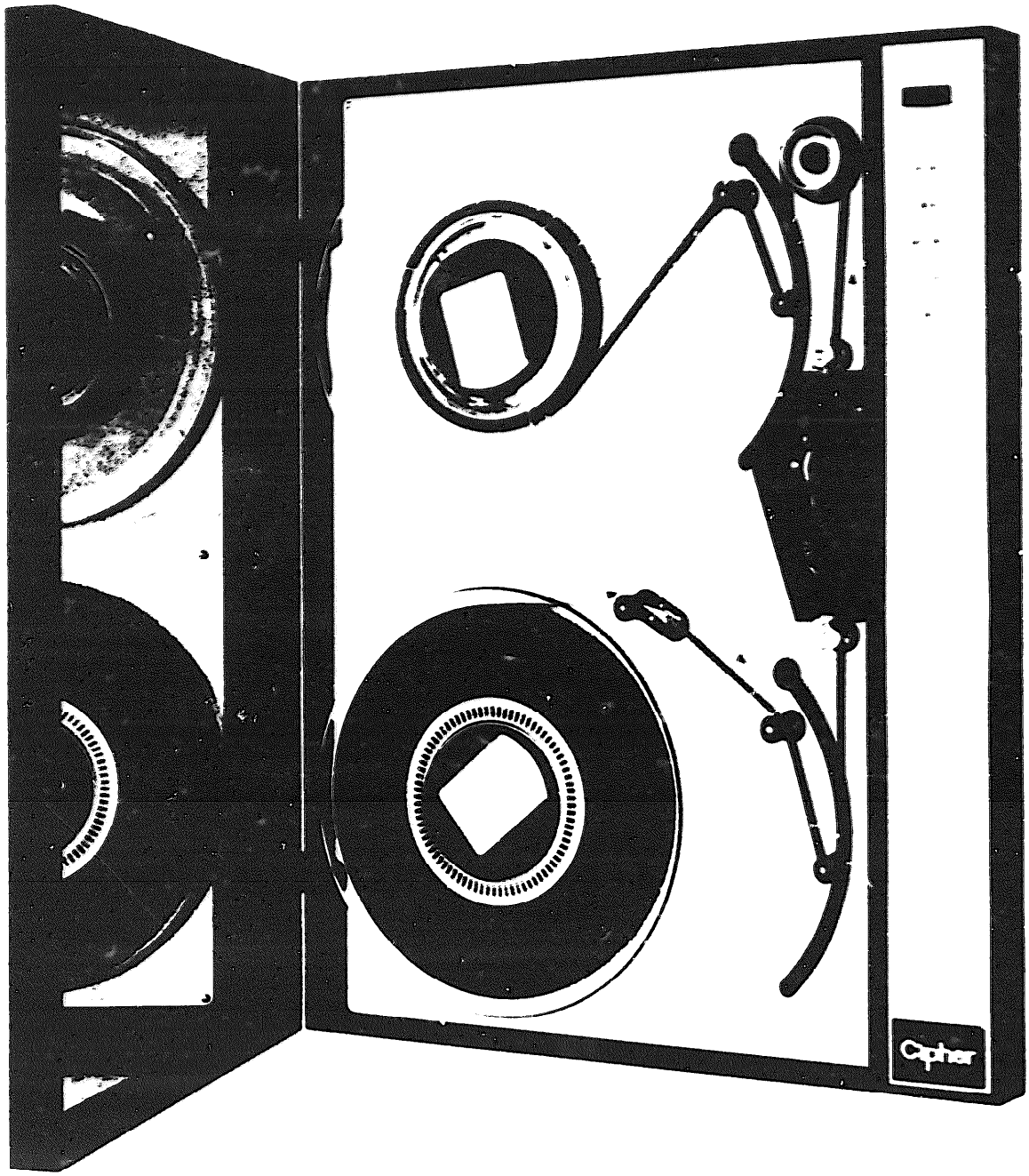


Figure 1-1. Model 100X Recorder

addition, the head and cross-feed shield are mounted on an adjustable plate which provides precise azimuth alignment.

1-11. A tape cleaner is mounted between the supply reel and the lower compliance arm roller guide to minimize tape contamination. The curved cleaning surface is made of burr-free, non-magnetic stainless steel with chemical-etched perforations.

1-12. FUNCTIONAL DESCRIPTION.

1-13. See Figure 1-2 for a system block diagram. The Model 100X Recorder uses a 180-degree wrap capstan drive for controlling tape movement during write, read, and rewind operations. The capstan is controlled by a velocity servo. The velocity information is generated by a dc tachometer that is directly coupled to the capstan motor shaft and produces a voltage proportional to the angular velocity of the capstan. This voltage is compared to the reference voltage from the ramp generator using operational amplifier techniques and the difference is used to control the capstan motor. This capstan control technique gives precise control of tape accelerations and tape velocities, thus minimizing tape tension transients.

1-14. During a write operation, the tape is accelerated in a controlled manner to the required velocity. This velocity is maintained constant and data characters are written on the tape at a constant rate such that:

$$\text{Bit density} = \frac{\text{Character Rate}}{\text{Tape Velocity}}$$

When data recording is complete, the tape is decelerated to zero velocity in a controlled manner. Since the write operation relies on a constant tape velocity, inter-record gaps (IRG) must be provided to allow for the tape acceleration and deceleration periods. Control of tape motion to produce a defined IRG is provided externally by the customer controller, in conjunction with the tape acceleration and deceleration characteristics defined by the recorder specifications.

1-15. An optional overwrite feature provides for editing previously recorded data. The overwrite signal causes Write Enable to ramp on and off, minimizing the change in inter-record gap magnetism when rewriting a record. The write reset used with the overwrite option causes both write head current and erase head current to be turned off immediately after writing the new record to prevent destroying data in the following record.

1-16. During a read operation, the tape is accelerated to the required velocity in a time interval sufficiently short to allow tape velocity to become constant before data signals are received. Seven or nine data channels are presented to the interface depending on the recorder model. They are accompanied by a read data strobe (RDS) pulse derived from a monostable multivibrator circuit. The end of a record is

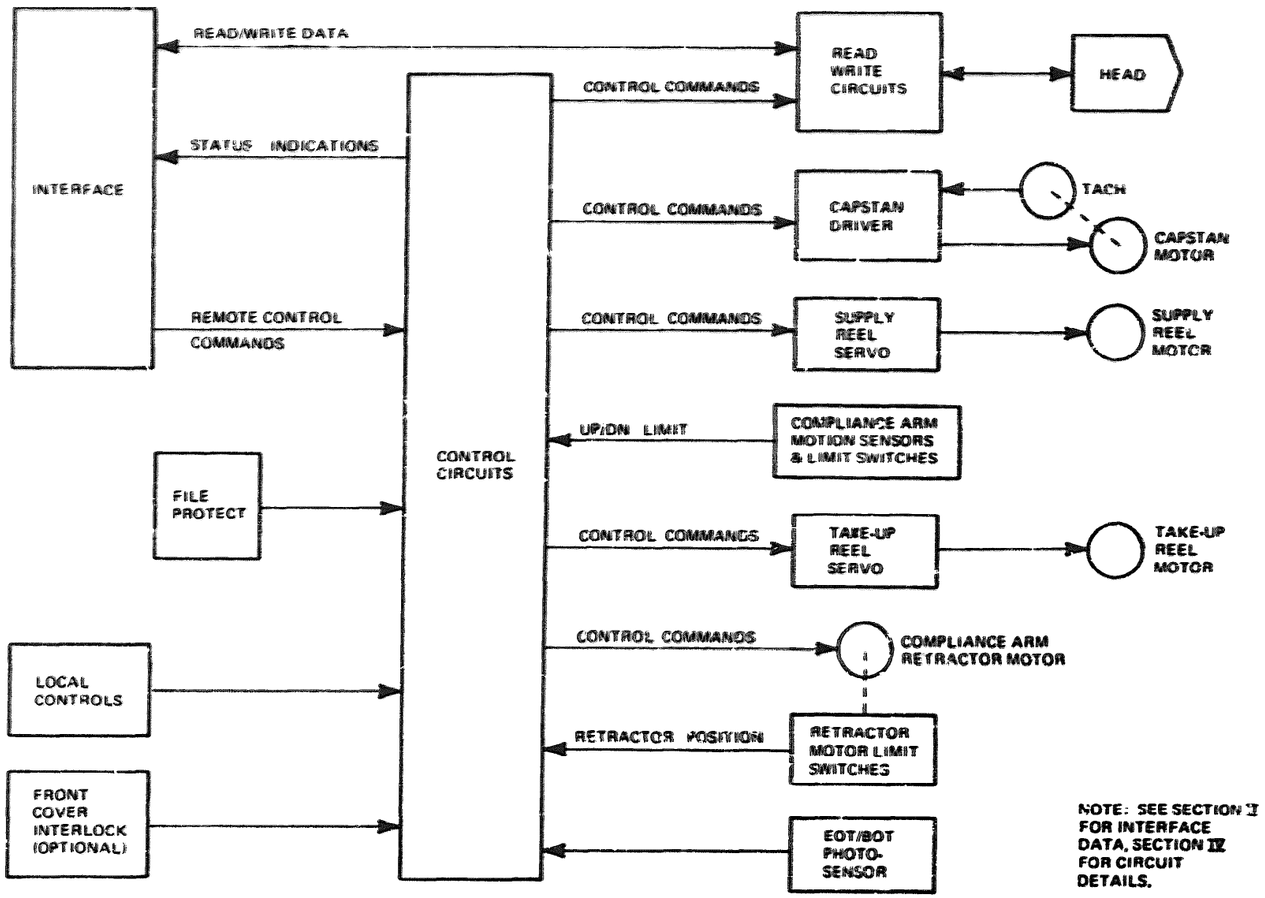


Figure 1-2. System Block Diagram.

detected in the customer controller using gap detection circuits and the tape commanded to decelerate in a controlled manner. The transport can operate in the read mode in either the forward or reverse direction. When operating in a shuttling mode (e.g. synchronous forward, stop, synchronous reverse, and stop), no turnaround delay is required between the end of one motion command and the beginning of the next motion command in the opposite direction. To guarantee IBM-compatible tapes, with fully saturated gaps and precise dimensions, tape motion must be allowed to cease before switching the motion control lines and write enable line.

1-17. In addition to the capstan control system, the recorder consists of supply and take-up reel servo systems, a compliance arm system, a magnetic head and associated read/write electronics, and the control logic.

1-18. The compliance arm system buffers the relatively fast starts and stops of the capstan from the slower, high-inertia supply and take-up reels. As tape is taken from or supplied to the compliance arms, a photoelectric sensor measures the displacement of the arms and feeds an error signal to the respective reel motor servo. This signal is amplified and used to control the reel motor such that the reel will either supply or take up tape to maintain the compliance arm in its nominal operating position. The compliance arm system is designed to provide a constant tape tension of eight ounces as long as the arm is within its operating region. Tape spillage is prevented, in the event power is lost, by a self-braking feature designed into the servo circuitry. When power is lost, the take-up reel motor terminals are connected together through a current limiting resistor and the supply reel motor terminals are directly connected, producing a dynamic braking action.

1-19. The magnetic head writes and reads the flux transitions on the tape under control of the read/write electronics. In the read-after-write configuration, the recorder is continuously reading and the write function must be enabled to write. Switching from the read to the write mode with the single-gap head is accomplished by remote command. The erase head provides continuous dc erase across the full width of the tape during write operations.

1-20. The control logic operates on manual commands to enable tape, once loaded, to be brought to the load point. At this stage, remote commands control tape motion, writing, and reading. The logic also provides rewind and unload functions in conjunction with the manual REWIND control. A photoelectric sensor assembly, consisting of a lamp and two phototransistors, is used to detect the beginning-of-tape (BOT) and end-of-tape (EOT) markers as well as unthreaded or broken tape. The detection area of the sensor assembly is approximately 1.2 inches from the write head gap.

1-21. MECHANICAL AND ELECTRICAL SPECIFICATIONS

1-22. The mechanical and electrical specifications for the recorder are shown in Table 1-2.

Net Weight	80 lb. (36.29 kg.)
Shipping Weight	100 lb. (45.36 kg.)
Dimensions:	
Height (with 0.5 in. filler panel)	24.5 inches (62.2 cm.)
Width	19.0 inches (48.3 cm.)
Depth (from mounting surface)	12.5 inches (31.8 cm.)
Depth (total)	15.1 inches (38.4 cm.)
Mounting (standard 19-in. RETMA rack)	EIA specifications
Power	115/230 VAC 48 to 63 Hz (A 400 Hz model is available without the compliance arm retraction system.) 275 watts max.
Fuse	6.25 ampere, 3 AG, quick acting
Tape (computer grade):	
Width	0.5 inch (1.27 cm.)
Thickness	1.5 mil (0.04 mm.)
Reel Diameter	10.5 inch (26.67 cm.)
Tape Tension	8 ounces (226.8 grams)
Recording Mode & Density:	
7-Track: IBM compatible NRZI	200/556/800 bpi
9-Track: IBM compatible NRZI	800 bpi
Tape Speed: Standard	45/37.5/25/18.75/12.5 ips
Nonstandard available	2 to 45 ips
Speed Variation:	
Instantaneous	±3% (max. byte to byte)
Long term	±1% (max.)
Rewind Speed	150 ips (nom.)
Start/Stop Time (inversely proportional to tape speed)	8.0 ± 0.55 ms at 45 ips
Start/Stop Distance	0.19 ± 0.02 inch (0.48 ± 0.05 cm.)

Table 1-3. Mechanical and Electrical Specifications

Interchannel Displacement Error:	
800 bpi	150 microinches (.004 mm.) max.
556 bpi	200 microinches (.005 mm.) max.
Beginning of Tape (BOT) and End of Tape (EOT) detectors	Photoelectric (IBM compatible)
Interface	DTL (Low True)
Electronics	All Silicon
Operating Temperature	2° to 50°C
Relative Humidity	15 to 95% noncondensing
Altitude	20,000 feet (6096 meters) max.

Table 1-2. Mechanical and Electrical Specifications (cont.)

1-23. INTERFACE SPECIFICATIONS.

1-24. Section II contains a table of interface connections. Signal characteristics are as follows:

Levels: True is Low: 0 to 0.4 volt (approximately)
False is High: +3 volts (approximately)

Pulses: Levels as above. Edge transmission delay over 20 feet of cable is not greater than 200 nanoseconds.

The interface circuits are designed so that a disconnected wire results in a false signal. Figure 1-3 shows the interface configuration for which the recorder has been designed.

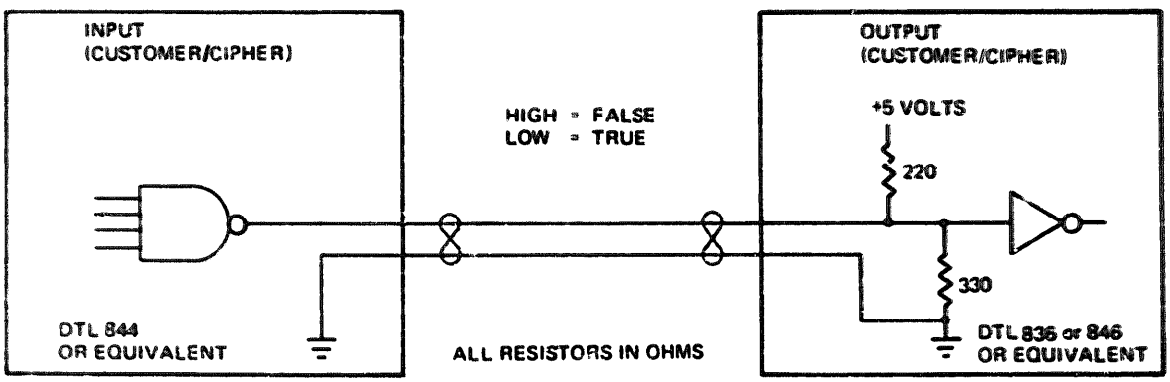


Figure 1-3. Interface Configuration

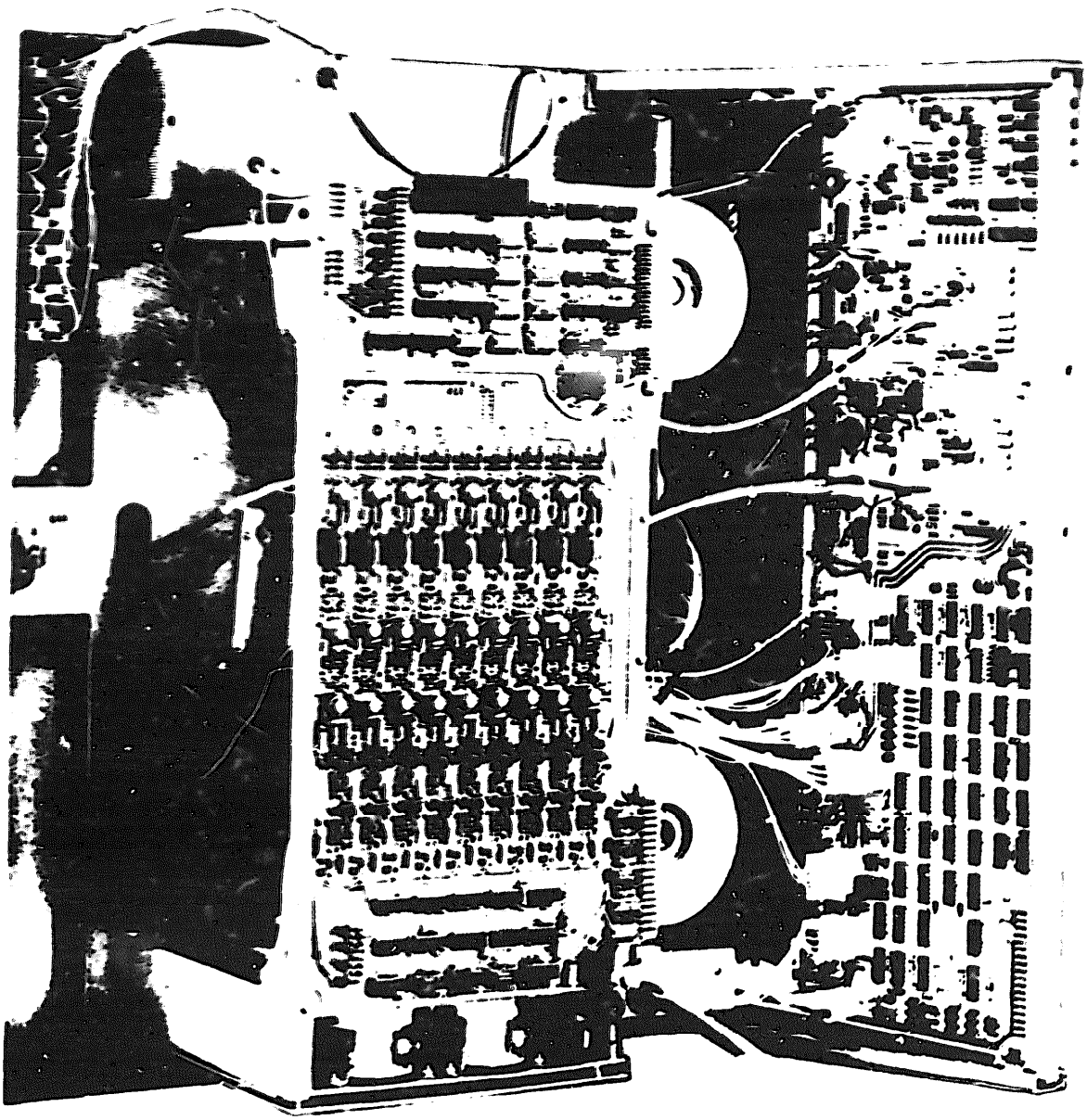


Figure 1-4. Model 100X Recorder, Rear View

SECTION II

UNPACKING, INSPECTION, AND INSTALLATION.

2-1. GENERAL.

2-2. This section provides instructions for unpacking, inspecting, and installing the recorder.

2-3. UNPACKING AND INSPECTIONS.

2-4. The recorder is shipped in a double container to minimize the possibility of damage during shipping. Unpack as follows:

a. Place the shipping container in the position indicated on the container.

b. Open the outer container and remove the packing blocks. Remove the inner container and open it so that the recorder and its shipping frame can be lifted from the container.

c. Lift the recorder out of the container using the shipping frame and set it down so that access to both front and rear is available.

d. Check the contents of the shipping container against the packing slip and investigate for possible damage. If there is any damage, notify the carrier.

e. Examine the compliance arms, reel hubs, capstan, and other components in the tape path, for foreign matter.

f. Check the printed circuit boards and all connectors for correct installation. Check that the plug-in relay on the control/servo printed circuit board is securely in place.

g. Check that the identification label on the back of the recorder bears the correct model number and line voltage requirement. If the actual line voltage at the installation differs from that on the identification label, the power transformer taps should be changed (See Table 2-1). The retractor motor and power indicator wires should remain on the 115-volt terminals.

INPUT VOLTAGE	CONNECT TERMINALS	LINE TO TERMINALS
105	4 & 8, 3 & 7	3 & 4
115	4 & 8, 2 & 6	2 & 4
125	4 & 8, 1 & 5	1 & 4
210	4 & 7	3 & 8
220	4 & 7	2 & 8
230	4 & 6	2 & 8
240	4 & 6	1 & 8
250	4 & 5	1 & 8

Table 2-1. Power Connections

2-5. POWER CONNECTION.

2-6. A fixed, strain-relieved power cord is supplied for plugging into a polarized 115-volt outlet. For other power sockets, the supplied plug must be removed and the correct plug installed.

2-7. INITIAL CHECKOUT.

2-8. Section III contains a detailed description of all controls. To check for proper recorder operation before placing in the system, perform the following:

a. Connect the power cord (replace power plug and change power transformer primary connections if necessary).

b. Clean tape path in accordance with Section V.

c. Load tape as described in Section III.

d. Turn power on by depressing POWER control.

e. Momentarily depress LOAD control to apply capstan-motor and reel-motor power. The delay at this point is required to allow the arm retractor mechanism to clear the compliance arms.

f. Momentarily depress LOAD control a second time to initiate the load sequence. The tape will move forward until it reaches the BOT tab. The LOAD indicator should light when the BOT tab reaches the photosensor and remain lit until the tape moves off the load point. At this point, there will be no action when the LOAD control is depressed.

g. Check ON LINE by depressing the control repeatedly and observing that ON LINE indicator is alternately lit and extinguished.

h. With the recorder off-line (ON LINE indicator not illuminated), press the alternate action FORWARD control. Run several feet of tape onto the take-up reel and press the FORWARD control again to stop the tape.

i. Press the alternate action REVERSE switch. Tape will move backward until the BOT tab reaches the photosensor, when it will stop.

j. Using the FORWARD control, run several feet of tape onto the take-up reel. Depress the FORWARD control again to stop the tape. Depress the REWIND control momentarily to initiate the rewind mode and light the REWIND indicator. The tape will rewind past the BOT tab, enter the load sequence, return to the BOT tab and stop with the LOAD indicator lit. If the REWIND control is momentarily depressed when the tape is at BOT, the LOAD indicator will be extinguished, the REWIND indicator lit, and the tape will rewind until tape tension is lost. This action is used to unload tape. The reel can be removed as outlined in Section III.

k. Visually check the components of the tape path for correct tape tracking (tape rides smoothly in the head, guides, etc.).

2-9. RACK MOUNTING.

2-10. The recorder is designed to be mounted in a standard 19-inch wide RETMA equipment rack. A front panel height of 24 inches and a minimum depth of 12.5 inches behind the mounting surface is required. A 1/2-inch filler panel is provided to increase height to 24.5 inches when needed. Mount the recorder as follows (see figures 2-1 and 2-2);

a. Install the hinge pin blocks on the equipment rack using 10-32 pan head screws (see Figure 2-1). Do not fully tighten the screws. Place a No. 10 shim washer on each pin.

b. Set the shipping frame down with the front door of the recorder facing up (i.e., lying in a horizontal position). Remove the screws securing the recorder to the frame.

c. Lift the recorder out of the shipping frame, position it 60 degrees from the closed position, and hang on the hinge pin blocks (see Figure 2-2).

d. Adjust the hinge pin blocks on the equipment rack so that the recorder hangs symmetrically in the rack. Tighten the screws.

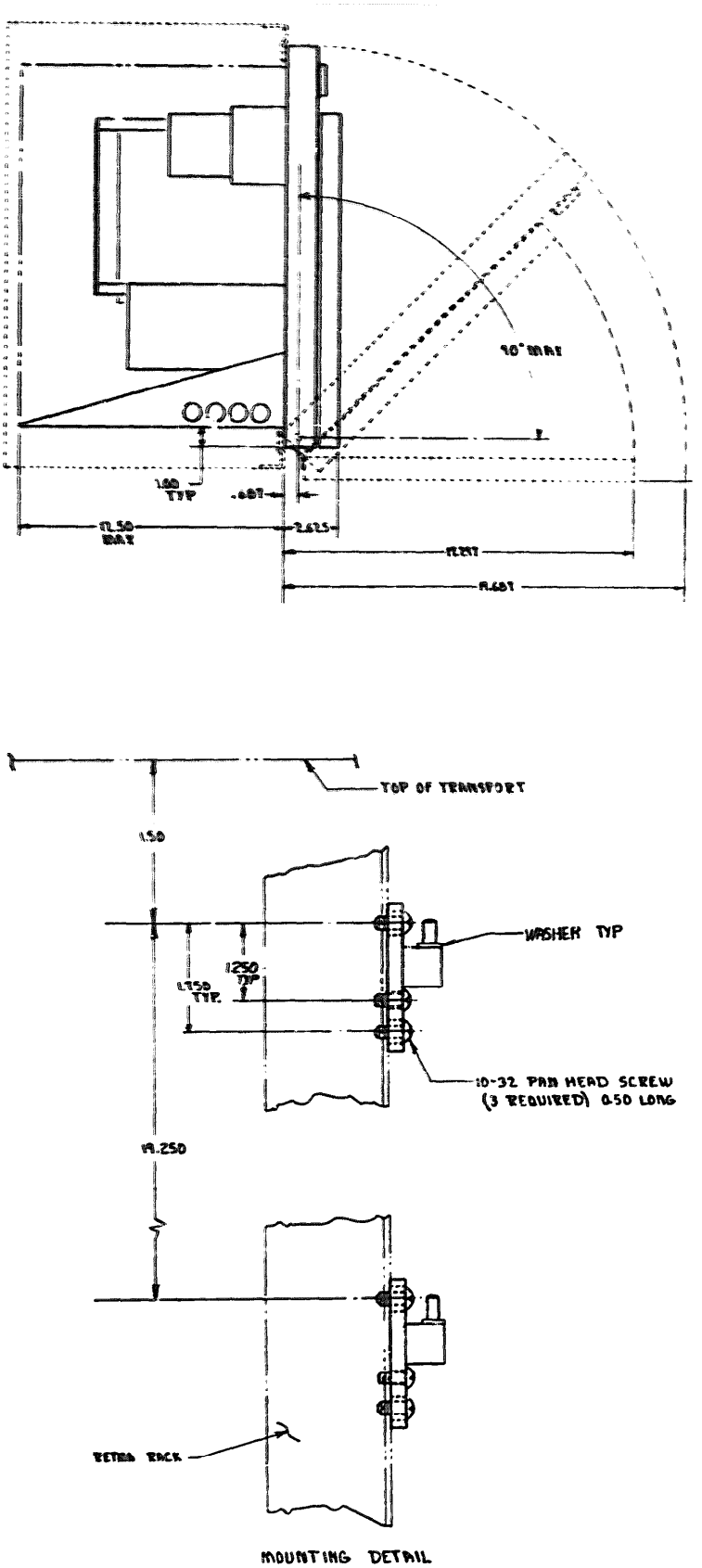


Figure 2-1. Rack Mounting

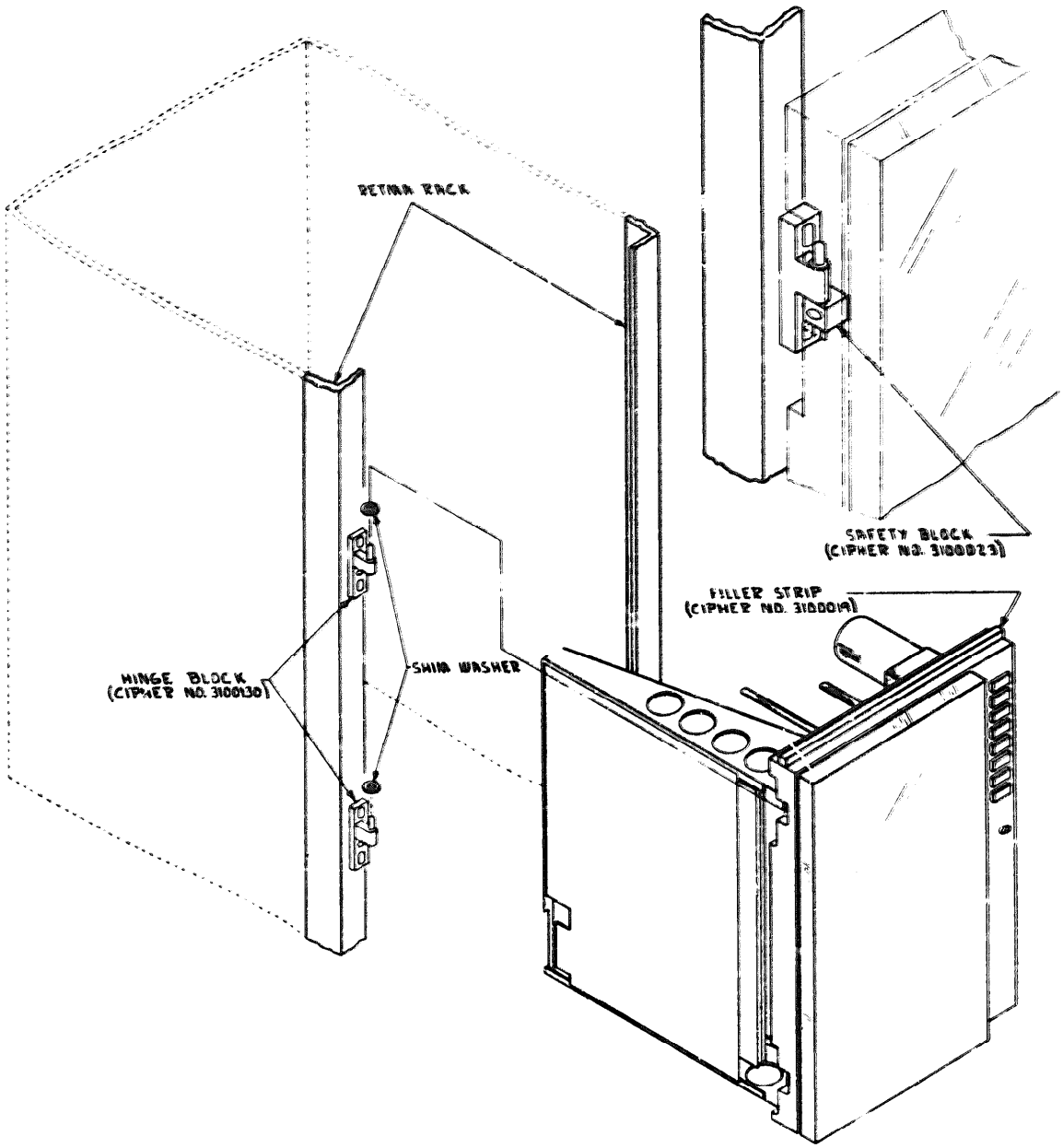


Figure 2-2. Installation

e. Open the recorder to 90 degrees and install the safety blocks, using 4-40 screws (see Figure 2-2).

f. Check that the adjustable pawl fastener engages behind the equipment rack. Adjust if necessary.

g. Clean the tape deck as described in Section V.

2-11. INTERFACE CONNECTIONS.

2-12. Interconnection of Cipher Data Products and Customer equipment requires a harness of individual twisted pairs, each with the following characteristics:

a. Maximum length of 20 feet.

b. Not less than 1 twist per inch.

c. 22 or 24 gauge conductor with minimum insulation thickness of 0.01 inch.

It is important that the ground side of each twisted pair is grounded within a few inches of the driver to which it is connected. The mating connectors (ELCO part number 00-6007-036-980-002 or equivalent) must be wired by the customer. Strain relief should be provided as shown in Figure 2-3. Interface signals are thus routed directly to and from the printed circuit boards. Table 2-2 shows the input/output lines required.

CONNECTOR	LIVE PIN	GROUND PIN	SIGNAL
INPUT COMMANDS J101	J	8	SELECT (SLT)
	C	3	FORWARD (FWD)
	E	5	REVERSE (REV)
	H	7	REWIND (RWC)
	L	10	OFF LINE (OFL)
	K	9	WRITE ENABLE (WEN)
	B	2	OVERWRITE (OVW)
	15	-	WRITE RESET (WRS) (part of overwrite option)

Table 2-2. Interface Connections

CONNECTOR	LIVE PIN	GROUND PIN	SIGNAL
OUTPUT INDICATIONS J101	T	16	READY (RDY)
	M	11	ON LINE (ON)
	N	12	REWIND (RWD)
	U	17	END OF TAPE (EOT)
	R	14	BEGINNING OF TAPE (BOT)
	P	13	FILE PROTECT (FPT)
	F	6	HI DENSITY (DEN)
	S	-	+5V (Optional)
WRITE INPUTS J102	A	1	WRITE DATA STROBE (WDS)
	C	3	WRITE RESET (WRS)
	E	5	THRESHOLD (THLD) (100X60 only)
	L	10	WRITE DATA PARITY (WDP) (WRITE DATA C FOR 7-TRACK)
	M	11	WRITE DATA 0 (WD0) (OMIT FOR 7-TRACK)
	N	12	WRITE DATA 1 (WD1) (OMIT FOR 7-TRACK)
	P	13	WRITE DATA 2 (WD2) (WRITE DATA B FOR 7-TRACK)
	R	14	WRITE DATA 3 (WD3) (WRITE DATA A FOR 7-TRACK)
	S	15	WRITE DATA 4 (WD4) (WRITE DATA 8 FOR 7-TRACK)
	T	16	WRITE DATA 5 (WD5) (WRITE DATA 4 FOR 7-TRACK)
	U	17	WRITE DATA 6 (WD6) (WRITE DATA 2 FOR 7-TRACK)

Table 2-2. Interface Connections (cont.)

CONNECTOR	LIVE PIN	GROUND PIN	SIGNAL
J102 (cont.)	V	18	WRITE DATA 7 (WD7) (WRITE DATA 1 FOR 7-TRACK)
READ OUTPUTS J103	2	B	READ DATA STROBE (RDS)
	1	A	READ DATA PARITY (RDP) (READ DATA C FOR 7-TRACK)
	3	C	READ DATA 0 (RD0) (OMIT FOR 7-TRACK)
	4	D	READ DATA 1 (RD1) (OMIT FOR 7-TRACK)
	8	J	READ DATA 2 (RD2) (READ DATA B FOR 7-TRACK)
	9	K	READ DATA 3 (RD3) (READ DATA A FOR 7-TRACK)
	14	R	READ DATA 4 (RD4) (READ DATA 8 FOR 7-TRACK)
	15	S	READ DATA 5 (RD5) (READ DATA 4 FOR 7-TRACK)
	17	U	READ DATA 6 (RD6) (READ DATA 2 FOR 7-TRACK)
	18	V	READ DATA 7 (RD7) (READ DATA 1 FOR 7-TRACK)

Table 2-2. Interface Connections (cont).

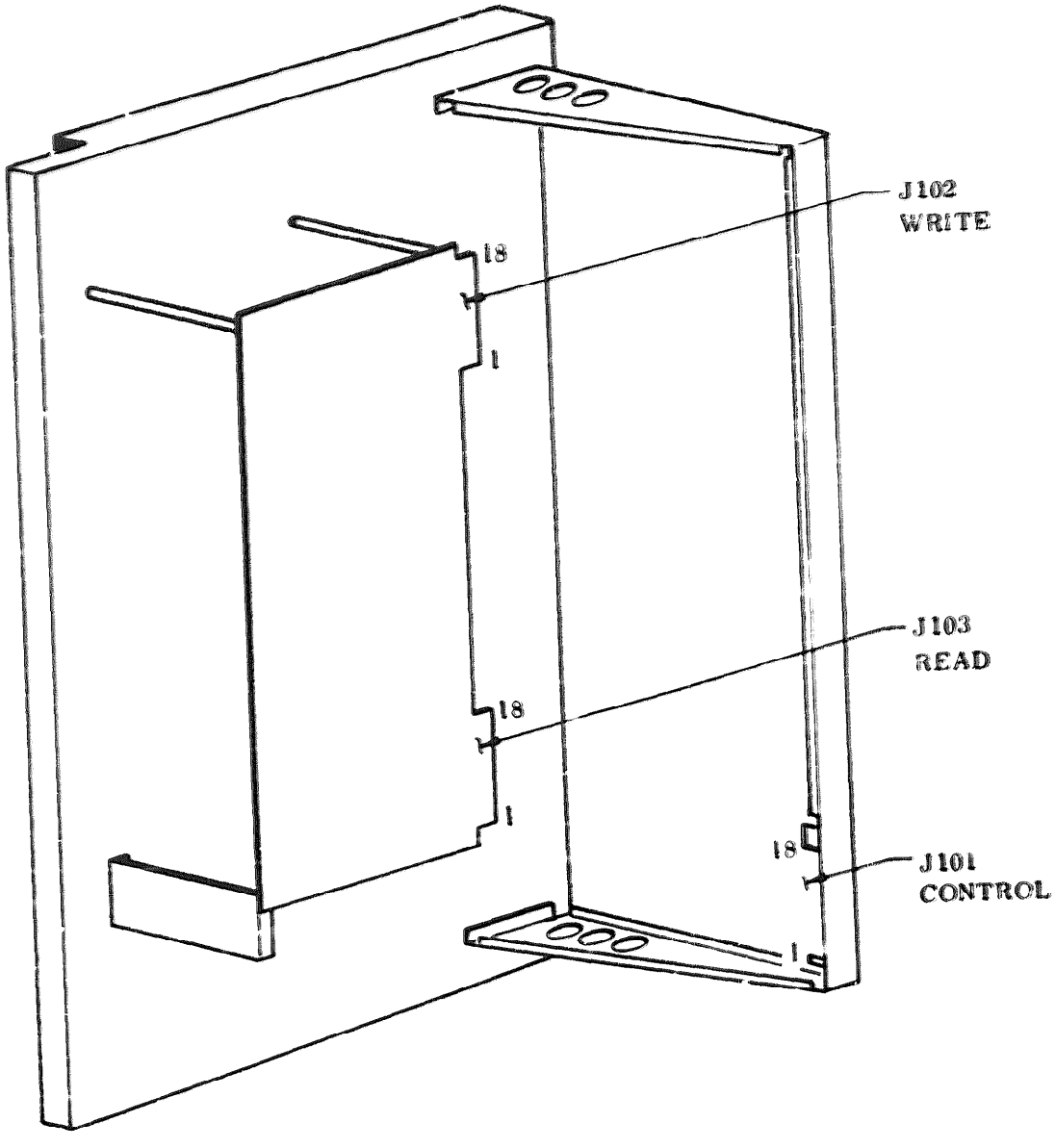


Figure 2-3. Interface Cable Installation

SECTION III

OPERATION

3-1. GENERAL

3-2. This section describes the controls and indicators and provides operation instructions for the Model 100X Recorder.

3-3. CONTROLS AND INDICATORS.

3-4. Figure 3-1 shows the controls and indicators. Control/indicator type, function, and the conditions required for enabling the function are given in Table 3-1.

NOTE

The head and guide cleaning procedures described in Section V must be performed daily to maintain recorder reliability.

3-5. LOADING TAPE (see Figure 3-2).

a. Pull out the reel locking lever on the supply hub. Ensure that the tape reel has a write enable ring installed if write mode is to be utilized. Place the reel of tape on the hub such that tape will unwind when the reel is rotated in a clockwise direction. Press the reel evenly and firmly against the hub's back flange and push in the locking lever. Spin the reel counter-clockwise while looking along its rim to ensure even mounting.

b. Install an empty reel on the take-up hub in the same manner as the loaded reel was mounted in a.

c. Actuate POWER pushbutton. POWER indicator will light and compliance arms will be driven to their full-up position.

d. Thread tape along the path shown in Figure 3-2. Wrap several turns onto the take-up reel such that tape will be wound on the reel when the reel is rotated in a clockwise direction. Check that tape is correctly seated on the guides and properly threaded through the photosensor and head assembly.

C A U T I O N

Ensure that tape is positio ed correctly on all guides or tape damage may result.

e. Close front cover to protect the tape and transport from dust.

Figure 3-1. Control Panel

CAUTION

The dust cover must remain closed at all times when tape is on the take-up reel. Data reliability may be impaired by contaminants if the cover is left open.

f. Actuate LOAD pushbutton and observe that tape is tensioned. (See Figure 3-3. The delay at this point is required to allow the arm retractor mechanism to clear the compliance arms. Actuate LOAD pushbutton again. Tape will advance until BOT tab is positioned at photosensor. LOAD indicator will light indicating recorder is ready for use.

3-6. UNLOADING TAPE.

N O T E

Recorder must be in off-line mode (ON LINE indicator not lit).

a. If power is off, actuate POWER pushbutton and proceed as follows: If power is on, start at step c.

b. Actuate LOAD pushbutton to tension tape.

c. Actuate REWIND pushbutton. REWIND indicator will light. If tape is at load point, tape will rewind until tension is lost. If tape is not at load point, rewind ceases when the BOT tab is reached. The BOT tab is then positioned automatically at the photo sensor and the LOAD indicator will light. Actuate REWIND pushbutton a second time to complete the unload sequence.

N O T E

A manual rewind command will override the load sequence. This can be used to return the tape to the load point in the event the load sequence is inadvertently initiated after the BOT tab has passed the photo sensor.

CONTROL OR INDICATOR	TYPE	FUNCTION	CONDITIONS
POWER	Alternate Action Pushbutton/Indicator	Switches line power on and off. Lights red to indicate power is on.	Fuse installed. Line cord connected.
LOAD	Momentary Action Pushbutton/Indicator	Initial actuation energizes motors, servo system, and tensions tape.	Power restored after being off. Loss of tape tension.
		Second actuation advances tape to load point.	Motors and servo system energized, tape tensioned by initial actuation.
		Lights to indicate BOT tab is positioned at photosensor.	
ON LINE	Momentary Action Pushbutton/Indicator	Switches recorder to on-line mode. Lights to indicate recorder is on line.	Initial LOAD or REWIND actuation. Recorder in off-line mode (ON LINE indicator off).
		Switches recorder to off-line mode. Indicator goes out to indicate recorder is off line.	Recorder in on-line mode (ON LINE indicator lit).
REWIND	Momentary Action Pushbutton/Indicator	Rewinds tape to load point. REWIND indicator lights during rewinding then goes out.	Recorder in off-line mode. (ON LINE indicator not lit.)
		LOAD indicator lights to indicate BOT tab is positioned at photosensor.	

Table 3-1. Controls and Indicators

CONTROL OR INDICATOR	TYPE	FUNCTION	CONDITIONS
REWIND (cont.)		Second actuation of REWIND pushbutton unloads tape.	
WRT EN (Write Enable)	Indicator	Lights to indicate write function may be performed.	Tape reel with write enable ring installed mounted on supply hub.
HI DEN (High Density)	Alternate Action Pushbutton/Indicator	Selects read density. Lights to indicate high density mode is selected. Note: See Section IV for optional configurations.	
FORWARD	Alternate Action Pushbutton/Indicator	Starts/stops tape forward motion. Lights to indicate transport in forward mode.	Recorder in off-line mode (ON LINE indicator not lit).
REVERSE	Alternate Action Pushbutton/Indicator	Starts/stops tape reverse motion. Lights to indicate transport in reverse mode.	Recorder in off-line mode (ON LINE indicator not lit.)

Table 3-1. Controls and Indicators (cont).

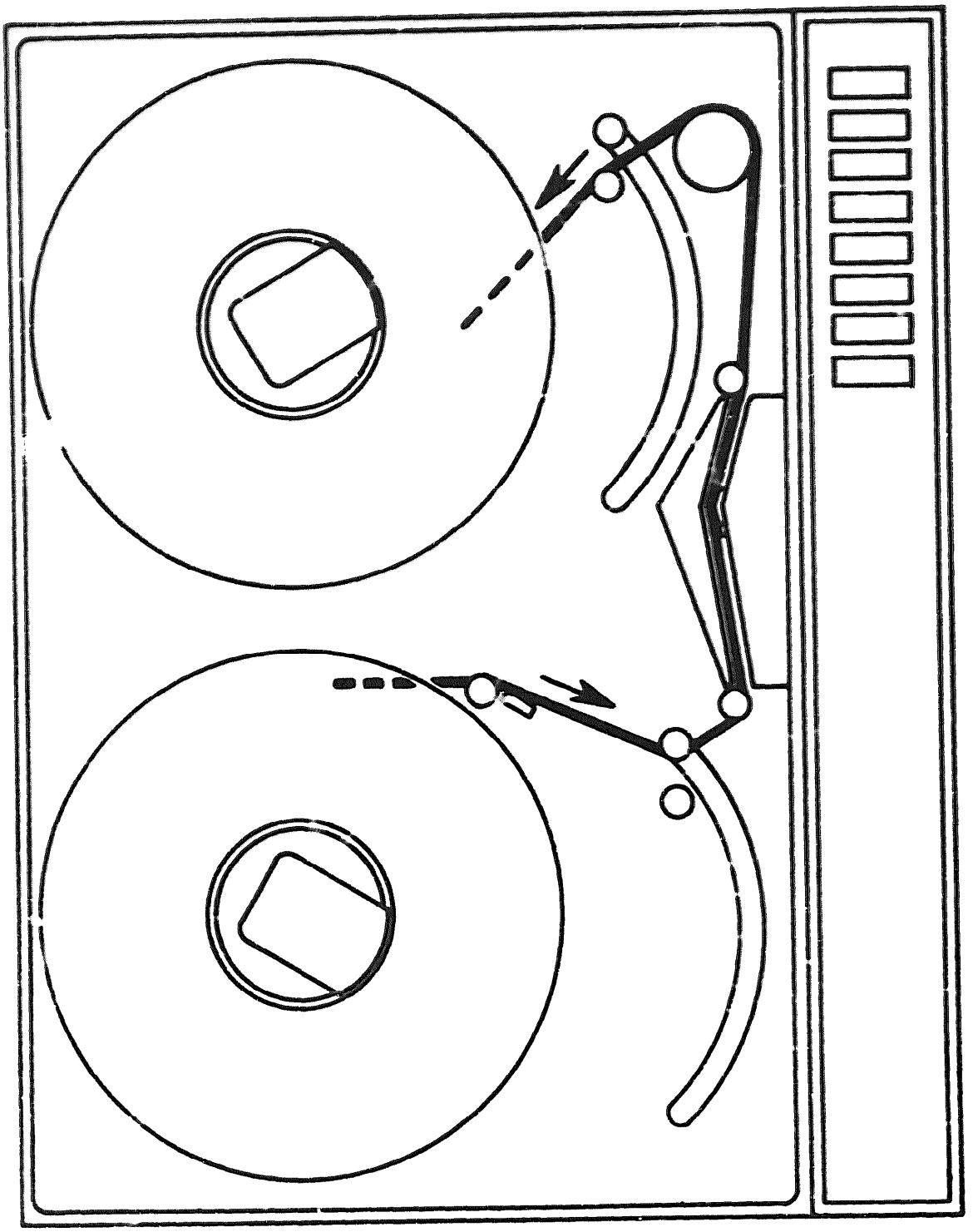


Figure 3-2. Tape Threading Path

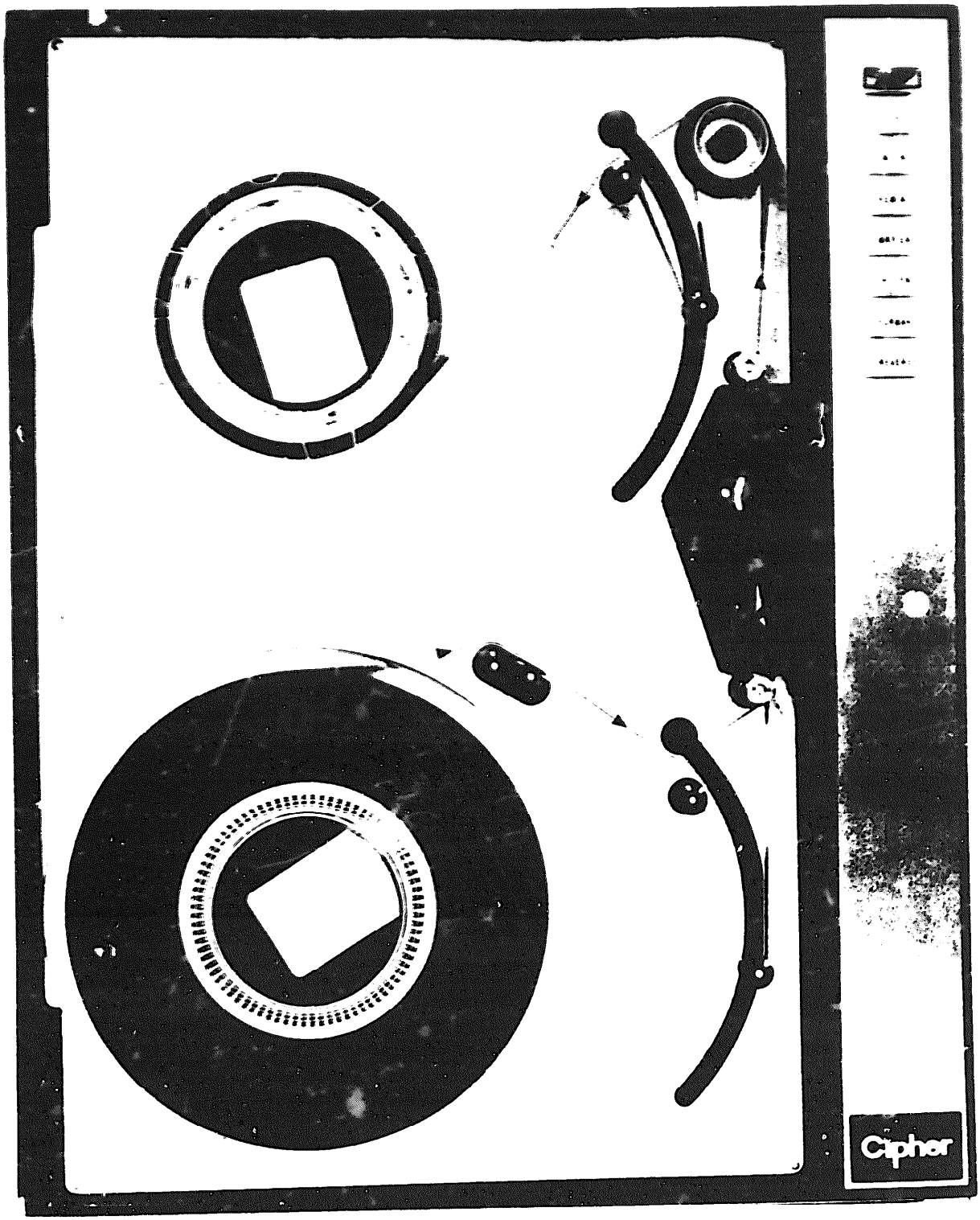


Figure 3-3. Operating Configuration (Tape Tensioned)

SECTION IV

THEORY OF OPERATION

4-1. GENERAL.

4-2. This section contains the basic concepts of digital recording, recorder applications, and principles of operation for the Model 100X Recorder. A thorough knowledge of this section will enhance the user's operational capabilities as well as aid in troubleshooting, if required.

4-3. BASIC CONCEPTS OF DIGITAL RECORDING.

4-4. Digital magnetic tape recording has grown in acceptance based on the greater use of digital techniques, lower-cost recorders, and a variety of recorders. Digital recording includes methods and equipment capable of recording information which has been expressed in a digital (binary) code (1's and 0's). The IBM-NRZI (non-return-to-zero interrupt) system is used most widely throughout industry.

4-5. Figure 4-1. depicts various codings, including the NRZI code. On magnetic tape, binary 1's are represented by transitions between saturation magnetism (+SAT and -SAT) produced by the corresponding write head current. When a written tape is passed across the tape head, a rate of change of flux occurs at the gap. The magnetic heads respond, producing the read voltage waveforms as illustrated in Figure 4-1. No change in flux represents a binary 0; no voltage is recovered from the head.

4-6. NRZI SYSTEM. In the NRZI System, recording is carried out by a saturation current driven through the head in a direction determined by a flip-flop which toggles for each one bit recorded. The NRZI System requires at least one bit to be recorded for all characters; otherwise, in an all zero (0) character, there would be no indication that a character was supposed to be in that location.

4-7. SEVEN-TRACK SYSTEM. In a seven-track system (Figure 4-2) six of the tracks are data channels while the seventh is the parity channel. Parity may be either odd or even: bits may be added to track C to make the sum of the bits in the character odd or even. Even parity is used with binary coded decimal (BCD) coding, while odd parity is used when operating in the binary mode.

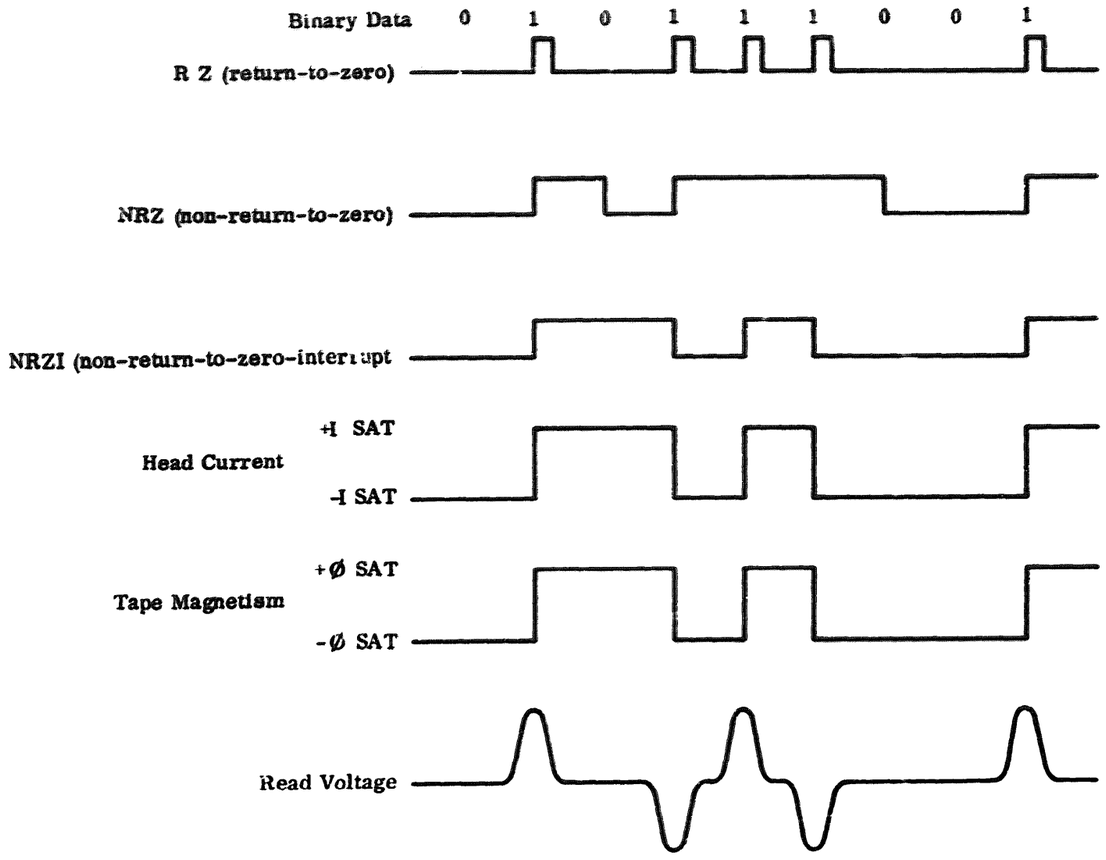
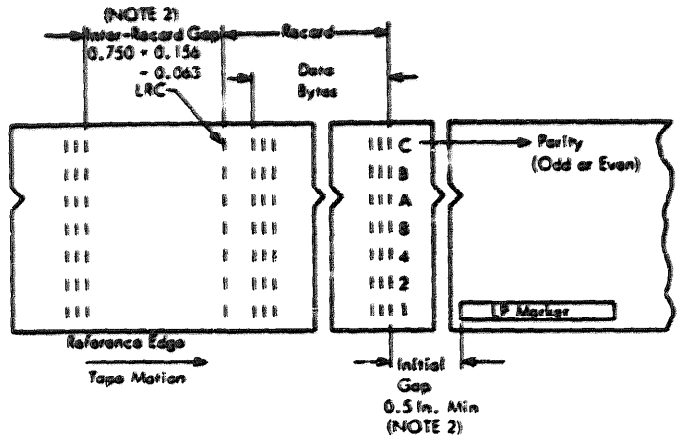


Figure 4-1. Magnetic Recording Waveforms



NOTES:
1. Tape is shown with oxide side down; NRZI recording. Bit produced by reversal of flux polarity. Tape fully saturated in each direction.
2. Tape to be fully saturated in the erased direction in the initial gap and the inter-record gap. Erasure such that an N seeking end of compass will point to start of tape.
3. LRCC - Longitudinal redundancy check character - odd or even-spaced four bits from data character.
4. Parity Bit - A vertical parity bit is written for each character.
5. Must conform to all 729 specifications (IBM).

Figure 4-2. Seven-Track Data Format

4-8. BINARY CODED DECIMAL (BCD).

4-9. The IBM eight-bit code and BCD relations are shown in Table 4-1. There are 63 combinations of the six-data bits available representing numerals, letters, and special symbols.

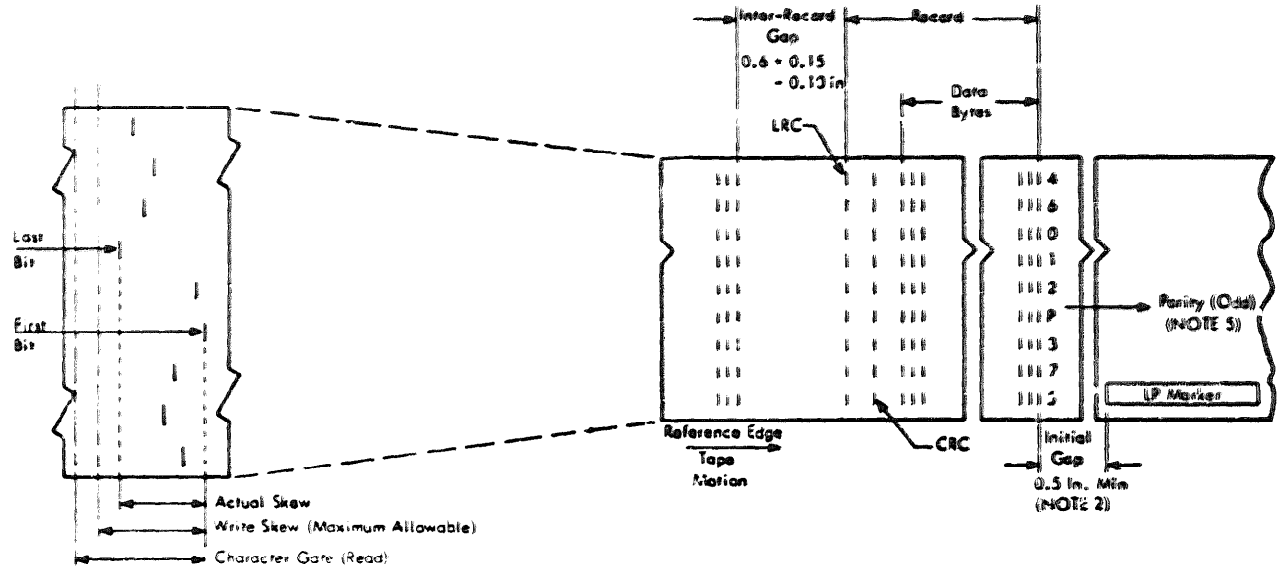
4-10. BINARY MODE In the binary mode, tape characters represent binary numbers. This mode is only used with numeric inputs. Thus, a six-bit character can represent a six-digit binary number 0 (000000) to 63 (111111). By using more than one character, larger numbers may be represented. In some cases, this results in considerable saving of space on the tape and in computer time. For example, the decimal number 56, two character spaces in BCD (0101-0110), but only one in binary (111000). Obviously, odd parity must be used because six zeros can be a perfectly valid portion of a binary number.

Calling Sequence	Graphics 8 Bit	Graphics BCD	Eight - Bit Code 0	1	2	3	4	5	6	7	BCD B	A	8	4	2	1
00	blank	blank	0	1	0	0	0	0	0	0	0	0	0	0	0	0
01	↑	↑	0	1	0	0	1	0	1	1	1	1	1	0	1	1
02	←	←	0	1	0	0	1	1	0	0	1	1	1	1	0	0
03	(	(	0	1	0	0	1	1	0	1	1	1	1	1	0	1
04	+	+	0	1	0	0	1	1	1	0	1	1	1	1	1	0
05	GM	GM	0	1	0	0	1	1	1	1	1	1	1	1	1	1
06	&	&	0	1	0	1	0	0	0	0	1	1	0	0	0	0
07	S	S	0	1	0	1	1	0	1	1	1	0	1	0	1	1
08	*	*	0	1	0	1	1	1	0	0	1	0	1	1	0	0
09	)	]	0	1	0	1	1	1	0	1	1	0	1	1	0	1
10	.	.	0	1	0	1	1	1	1	0	1	0	1	1	1	0
11	MC	MC	0	1	0	1	1	1	1	1	1	0	1	1	1	1
12	-	-	0	1	1	0	0	0	0	0	1	0	0	0	0	0
13	/	/	0	1	1	0	0	0	0	1	0	1	0	0	0	1
14	.	.	0	1	1	0	1	0	1	1	0	1	1	0	1	1
15	%	%	0	1	1	0	1	1	0	0	0	1	1	1	0	0
16	WS	WS	0	1	1	0	1	1	0	1	0	1	1	1	0	1
17	#	\	0	1	1	0	1	1	1	0	0	1	1	1	1	0
18	SM	SM	0	1	1	0	1	1	1	1	0	1	1	1	1	1
19	$	$	0	1	1	1	1	0	1	0	0	1	0	0	0	0
20	'	' =	0	1	1	1	1	0	1	1	0	0	1	0	1	1
21	@	@	0	1	1	1	1	1	0	0	0	0	1	1	0	0
22	▽	_	0	1	1	1	1	1	0	1	0	0	1	1	0	1
23	;	>	0	1	1	1	1	1	1	0	0	0	1	1	1	0
24	TM	TM	0	1	1	1	1	1	1	1	0	0	1	1	1	1
25	Δ	Δ	1	1	0	0	0	0	0	0	1	1	1	0	1	0
26	A	A	1	1	0	0	0	0	0	1	1	1	0	0	0	1
27	B	B	1	1	0	0	0	0	1	0	1	1	0	0	1	0
28	C	C	1	1	0	0	0	0	1	1	1	1	0	0	1	1
29	D	D	1	1	0	0	0	1	0	0	1	1	0	1	0	0
30	E	E	1	1	0	0	0	1	0	1	1	1	0	1	0	1
31	F	F	1	1	0	0	0	1	1	0	1	1	0	1	1	0
32	G	G	1	1	0	0	0	1	1	1	1	1	0	1	1	1
33	H	H	1	1	0	0	1	0	0	0	1	1	1	0	0	0
34	I	I	1	1	0	0	1	0	0	1	1	1	1	0	0	1
35	Ō	Ō	1	1	0	1	0	0	0	0	1	0	1	0	1	0
36	J	J	1	1	0	1	0	0	0	1	1	0	0	0	0	1
37	K	K	1	1	0	1	0	0	1	0	1	0	0	0	1	0
38	L	L	1	1	0	1	0	0	1	1	1	0	0	0	1	1
39	M	M	1	1	0	1	0	1	0	0	1	0	0	1	0	0
40	N	N	1	1	0	1	0	1	0	1	1	0	0	1	0	1
41	O	O	1	1	0	1	0	1	1	0	1	0	0	1	1	0
42	P	P	1	1	0	1	0	1	1	1	1	0	0	1	1	1
43	Q	Q	1	1	0	1	1	0	0	0	1	0	1	0	0	0
44	R	R	1	1	0	1	1	0	0	1	1	0	1	0	0	1
45	RM	RM	1	1	1	0	0	0	0	0	0	1	1	0	1	0
46	S	S	1	1	1	0	0	0	1	0	0	1	0	0	1	0
47	T	T	1	1	1	0	0	0	1	1	0	1	0	0	1	1
48	U	U	1	1	1	0	0	1	0	0	0	1	0	1	0	0
49	V	V	1	1	1	0	0	1	0	1	0	1	0	1	0	1
50	W	W	1	1	1	0	0	1	1	0	0	1	0	1	1	0
51	X	X	1	1	1	0	0	1	1	1	0	1	0	1	1	1
52	Y	Y	1	1	1	0	1	0	0	0	0	1	1	0	0	0
53	Z	Z	1	1	1	0	1	0	0	1	0	1	1	0	0	1
54	0	0	1	1	1	1	0	0	0	0	0	0	1	0	1	0
55	1	1	1	1	1	1	0	0	0	1	0	0	0	0	0	1
56	2	2	1	1	1	1	0	0	1	0	0	0	0	0	1	0
57	3	3	1	1	1	1	0	0	1	1	0	0	0	0	1	1
58	4	4	1	1	1	1	0	1	0	0	0	0	0	1	0	0
59	5	5	1	1	1	1	0	1	0	1	0	0	0	1	0	1
60	6	6	1	1	1	1	0	1	1	0	0	0	0	1	1	0
61	7	7	1	1	1	1	0	1	1	1	0	0	0	1	1	1
62	8	8	1	1	1	1	1	0	0	0	0	0	1	0	0	0
63	9	9	1	1	1	1	1	0	0	1	0	0	1	0	0	1

Table 4-1. Eight Bit Code- BCD Relationship

4-11. NINE-TRACK CODING. The nine-track tape in the IBM System 360 uses a modified ASCII code. (See figure 4-3.) Parity in the nine-track 800 bpi system is always odd. Writing data in the binary mode is possible in this system when programmed properly. Two (2) four-bit numerics may be written per byte with consequent doubling of effective data rate.

4-12. LONGITUDINAL REDUNDANCY CHECK CHARACTER (LRCC) A longitudinal parity bit is written at the end of each record. Writing this character is accomplished by returning the write head current to the reference condition. Since the reference condition is established before the first character of the record and reestablished by



NOTES:
1. Tape is shown with oxide side down. NRZI recording. Bit produced by reversal of flux polarity. Tape fully saturated with each direction.
2. Tape to be fully saturated in the erased direction in the initial gap and the inter-record gap. Erasure such that an N seeking end of compass will point to start of tape.
3. CRCC - Cyclic redundancy check character. Parity of CRCC is determined by the number of data characters in record. Odd number of data characters-even CRCC, etc. CRCC used only in System/360, 800 bpi. CRCC spaced four bits from data characters.
4. LRCC - Longitudinal redundancy check character - always odd parity. Spaced four bits from CRCC.
5. Parity Bit - A vertical parity bit is written for each character containing an even number of bits.

Figure 4-3. Nine-Track Data Format

writing the LRCC, an even number of one bits in each track is written for each record. Upon reading the tape, the number of ones read in each track may be counted. If the sum is odd, an error is indicated. The LRCC is spaced four (4) character spaces from the end of the block.

4-13. CYCLIC REDUNDANCY CHECK CHARACTER (CRCC). Nine-track, 800 bpi, System 360 tapes include a CRCC located at the end of each record before the LRCC. The CRCC is generated by applying a complex equation of the data within the block. This character makes the probability of an undetected error almost zero. The CRCC may be used with computer read to determine which track contains the error.

4-14. The information supplied by the CRCC, combined with that of the LRCC and vertical parity may be used to correct detected errors. Errors including more than one track within the same record are detected but not correctable.

4-15. LOST CHARACTER CHECK.

4-16. The lost character requirement limits the instantaneous variation of byte spacing on the tape being read. The Cipher Model 100X Recorder assures the byte spacing tolerance to be well within the limits set by the lost character check.

4-17. PRINCIPALS OF OPERATION.

4-18. The Cipher Model 100X Recorder is composed of four main assemblies (see Figure 4-4). The transport assembly, which includes the tape drive components and the compliance arm system; the Read/Write system, consisting of a head assembly and a Read/Write board; a Control/Servo board containing the transport control circuitry, the reel and capstan motor servos, and the power supply regulator circuits; and a power supply consisting of the power transformer, mounted on the rear of the mounting plate, the power supply circuit board, and the front-panel mounted power switch and indicator. The schematic diagrams in Section VII are to be used along with the circuit descriptions in this section. A description of the major logic elements used in the recorder, the available logic options, and a detailed discussion of recorder operation are provided in the following paragraphs.

4-19. NAND/NOR GATES

4-20. Multiple NAND gate packages are used for all logic gating (see IC data in Section VII.). The individual devices may be used as either NAND or NOR gates, however, depending upon the logic function. When used as a NAND gate, the true output is normally an electrical low (0 to +0.2V) and requires both inputs to be high (+4V).

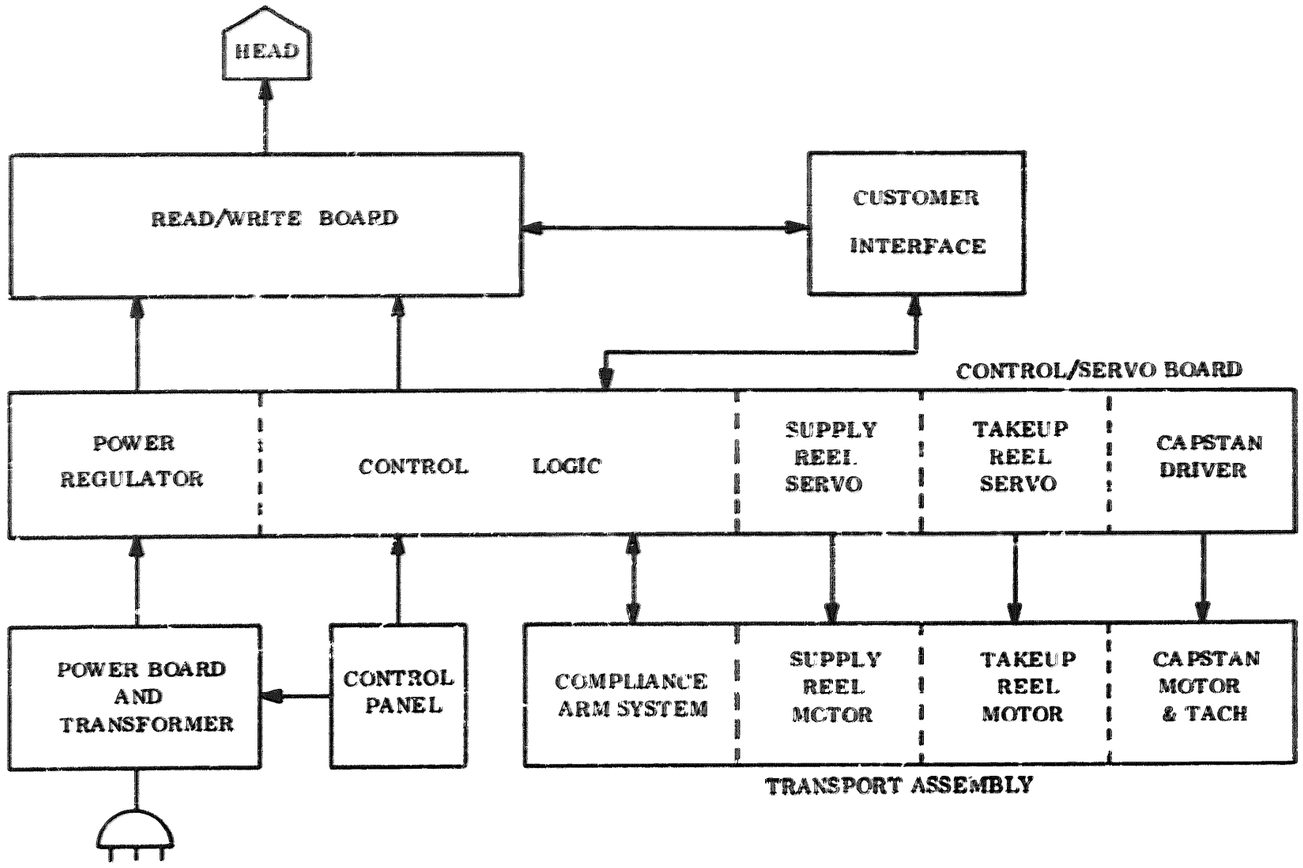


Figure 4-4. Recorder Organization

When used as a NOR gate, the true output is normally an electrical high which requires one or more inputs to be low.

4-21. J-K FLIP-FLOPS

4-22. This flip-flop operates on a "Master-Slave" principle. A logic diagram of the flip-flop is shown in Figure 4-5 The flip-flop is designed so that the threshold voltage of AND gates 1 and 2 is higher than that of AND gates 3 and 4. Since operation depends exclusively on voltage levels, any waveform of the proper voltage level can trigger the J-K flip-flop.

4-23. Assume that the trigger voltage is initially low. As the trigger voltage goes high, AND gates 3 and 4 are disabled. Subsequently, AND gates 1 and 2 are enabled by the trigger pulse, the J and K inputs, and the information previously stored at the output of the slave unit.

4-24. The J and K input information at this time is transferred to the input of the master unit. As the trigger voltage goes low, AND gates 1 and 2 are disabled. AND gates 3 and 4 are then enabled and the information stored in the master unit is transferred to the output of the slave unit.

4-25. The direct set and direct clear inputs are used to set the flip-flop to a known state. A low input to direct set will set Q high and $\overline{Q}$ low. A low input to direct clear will set Q low and $\overline{Q}$ high.

4-26. RETRIGGERABLE MONOSTABLE MULTIVIBRATORS.

4-27. A retriggerable monostable multivibrator is utilized in many areas of the recorder's logic circuitry to generate precisely timed clock or gating pulses derived from up to four different inputs. The device is used in two ways as follows (see Figure 4-6

4-28. In the first method, either or both inputs to the NOR-gate portion are set low and one input to the NAND-gate portion is set high to enable the gate. When the second input to the NAND gate goes high, a positive pulse appears at the Q output. The duration of this pulse is determined by the timing circuit connected to pins 11 and 13. This timing circuit is composed of a resistor and capacitor for relatively short pulse durations. Longer times can be achieved by adding a diode to the circuit. An even longer pulse is formed when a large value electrolytic capacitor is used with a transistor to regulate the current and protect the device.

4-29. In the second method, both inputs to the NAND-gate portion are set high and the Q function is controlled by the inputs to the NOR-gate portion. When one of the NOR-gate inputs goes low, a positive pulse appears at the Q output. The duration of the pulse is determined in the same manner as described in the preceding paragraph. In

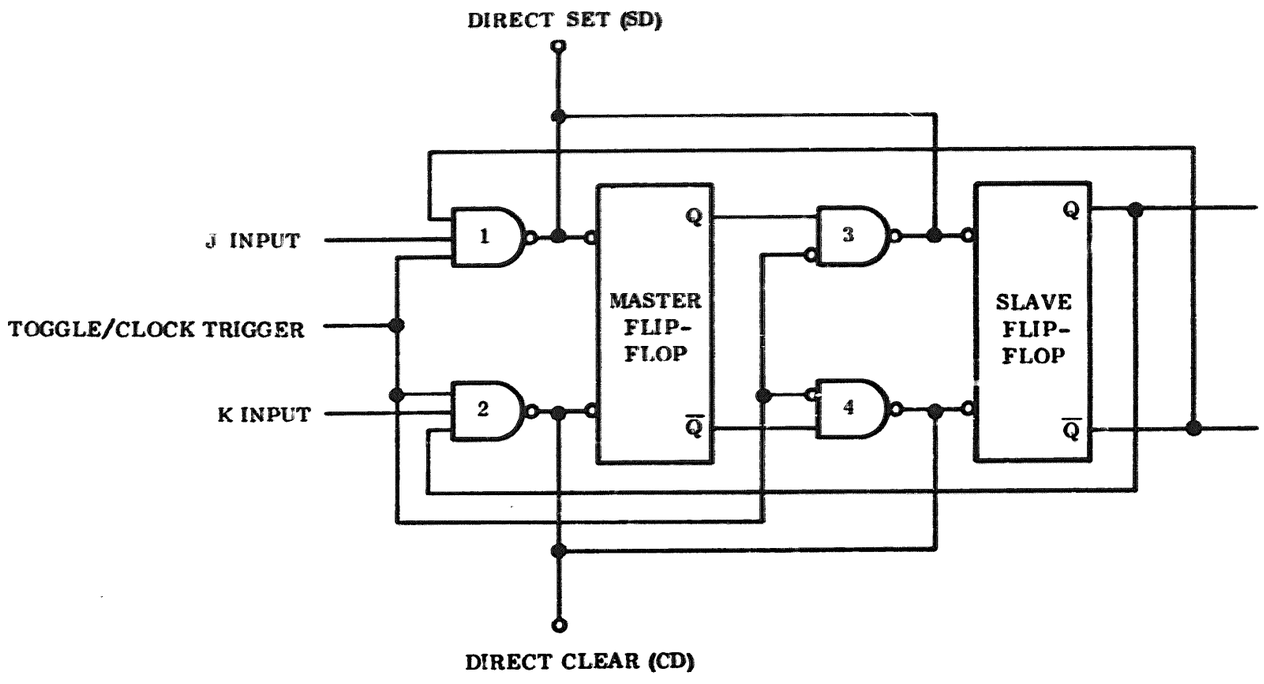


Figure 4-5. Simplified Logic Diagram, J-K Flip-Flop

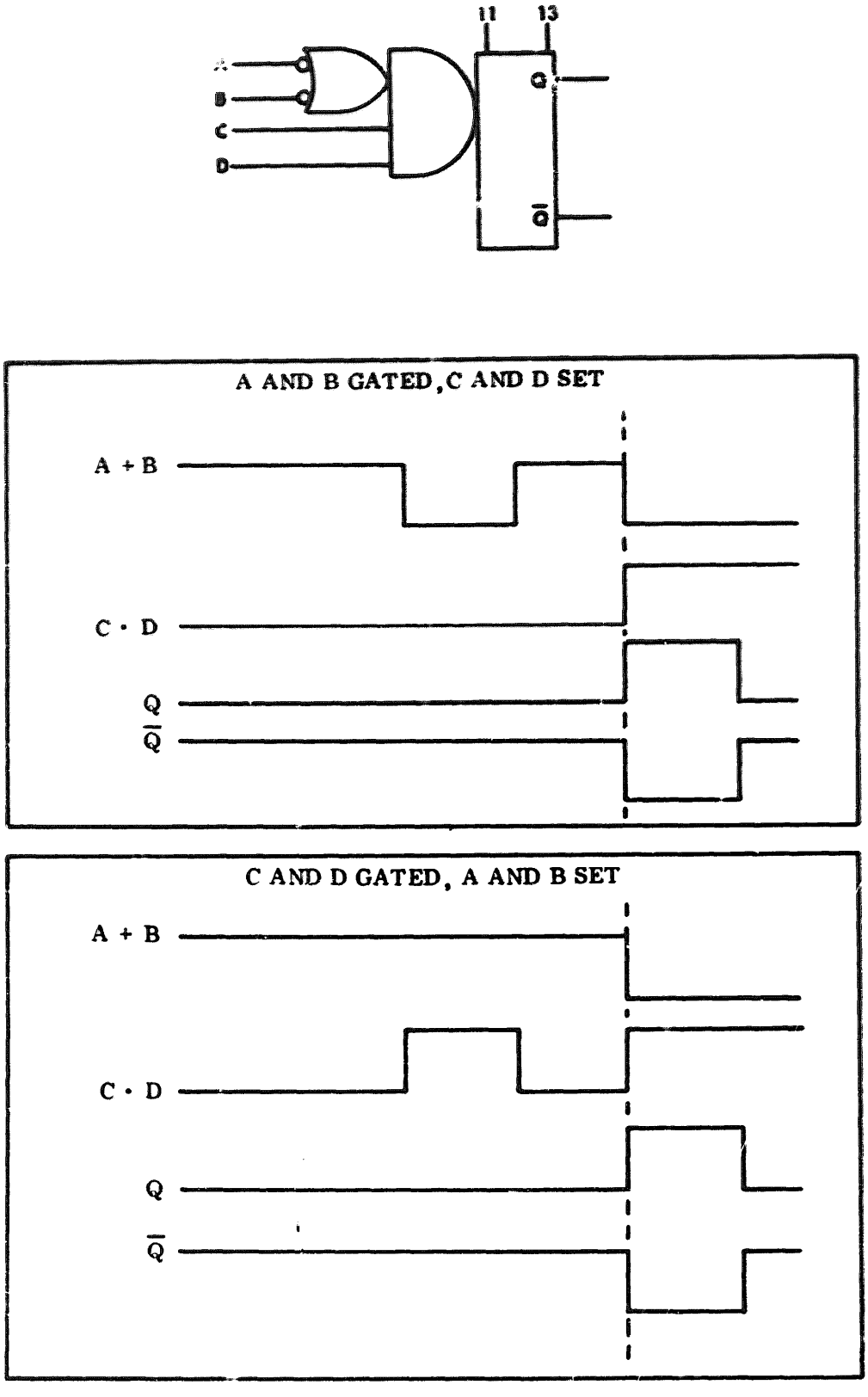


Figure 4-6. Monostable Multivibrator Characteristics

both cases $\bar{Q}$ will be the complement of Q. Both the Q and $\bar{Q}$ outputs may be utilized in the recorder's logic.

4-30. LOGIC OPTIONS.

4-31. Various logic options are available in the Model 100X Recorder. These options are selected by jumpers soldered into the Read/Write and Control/Servo boards (Tables 4-2 and 4-3). These optional logic configurations will be wired in at the factory in accordance with the customer's request.

FUNCTION	JUMPER	PURPOSE
STATUS INDICATIONS	A to B	When installed, provides status indications to interface when recorder is on line and selected. When not installed, status indications are provided whenever recorder is selected.
LOCAL/REMOTE DENSITY SELECT	C to F	Provides local density control, with indicator, on 7-track models.
	D to F	Provides remote density control, with indicator, on 7-track models.
	E to F	Used with fixed density models. Indicator always lit.
OVERWRITE	G to H	Installed with overwrite option. Note Write Reset jumper on Read/Write board.
ON LINE/READY	J to K	When installed, depressing ON LINE pushbutton will force Ready status in middle of tape.
REWIND/OFF LINE	L to M	When installed, will cause unit to revert to off-line status when Rewind is commanded remotely.
+5V SUPPLY	DIODE N to P	A diode can be installed (cathode to N, anode to P) to provide +5 volts for the customer's terminators.

Table 4-2. Control/ Servo Board Logic Options

FUNCTION	JUMPER	PURPOSE
WRITE DATA TIMING	A to C	Write data on trailing edge of WDS.
	A to B, C to D	Write data on leading edge of WDS.
WRITE RESET	H to J	Standard WRS path
	H to K	Used with Overwrite option on Read/ Write models. Only one Reset command required for either Overwrite or normal mode.
READ/WRITE WRS	N to R	Provides path for WRS in Read/Write models.
THRESHOLD COMMAND PATH	E to F	Standard path for Threshold command in Read/Write models.
	E to G	Standard path for automatic threshold command in Read After Write models.
SATURATION DELAY	L to M	Inhibits read gates while writing in Read/Write models.

Table 4-3. Read/Write Board Logic Options

4-32. HEAD ASSEMBLY.

4-33. The Model 100X Recorder is available with either a single-gap head for alternate read and write functions or a dual-gap head for read-after-write operation. A choice of seven or nine tracks is also provided. Track locations, track width, and gap separation are all IBM-compatible (see Table 4-4).

4-32. A cross-feed shield is provided to reduce the voltage induced in the read head when writing. This shield is composed of a copper and a ferrite flux block cemented to a hinge plate (see head assembly illustration in Section V

4-35. DATA RECORDING.

4-36. The following description applies to Read-After-Write (RAW) recorders. Read or Write (R/W) recorders are similar in operation except that the deskew circuitry is not used.

FUNCTION	SINGLE GAP READ/WRITE	DUAL GAP READ AFTER WRITE
TRACK LOCATIONS		
7 TRACK	0.070 ± 0.001 inch center to center	
9 TRACK	0.055 ± 0.001 inch center to center	
EFFECTIVE TRACK WIDTH		
7 TRACK	0.040 ± 0.001 inch	WRITE: 0.048 ± 0.001 inch READ: 0.030 ± 0.001 inch
9 TRACK	0.040 ± 0.001 inch	WRITE: 0.044 ± 0.001 inch READ: 0.040 ± 0.001 inch
PARALLELISM	± 500 microinches	± 200 microinches (Write to read)
GAP SEPARATION (WRITE-READ)	---	0.150 ± 0.005 inch
GAP LINE AZIMUTH PER SECTION	± 150 microinches maximum from reference perpendicular to mounting surface	
GAP SCATTER PER SECTION	100 microinches maximum	
CROSSTALK		
READ	20 db minimum	1% maximum of read voltage
VOLTAGE INDUCED IN READ WINDING WHILE WRITING AT 800 BPI, 12.5 IPS AND UP	---	5% maximum of read voltage

Table 4-4. Head Specifications

FUNCTION	SINGLE GAP READ/WRITE	DUAL GAP READ AFTER WRITE
INDUCTANCE	6 mH ± 20% (Full Winding)	WRITE: (EACH LEG) 500 μH maximum READ: (EACH LEG) 10 mH maximum
DC RESISTANCE	22 ohms ± 20% (Full Winding)	WRITE: (EACH LEG) 10 ohms maximum READ: (EACH LEG) 25 ohms maximum
WRITE CURRENT (100% SATURATION)	11 ma ± 20%	35 ma ± 20%
READ VOLTAGE	10 mv ± 20% @ 15 ips, 200 bpi	700 μv/inch/sec. ± 10%
READ PULSE WIDTH (200 BPI)	1650 μin maximum	1250 μin maximum
SELF ERASURE (READ SIGNAL REDUCTION AFTER 10 PASSES)	5% maximum	10% maximum
ERASE HEAD RESISTANCE	80 ohms	
ERASE CURRENT	50 ma	

Table 4-4. Head Specifications (cont.)

4-37. Five inputs to the write circuitry, in addition to the seven or nine data channels, are required for writing Figure 4-7. The customer supplies the Write Data Strobe (WDS), Write Reset (WRS) and Select inputs. The WDS triggers the internal write strobe monostable, IC102, which in turn strobes the data into the write deskewing circuit. The WRS senses the condition of the write flip-flops and clocks them to a reference condition to create the Longitudinal Redundancy Check Character (LRCC) at the end of each record. The Reset input is routed from the control logic and is synonymous with WRS. It is used only with the overwrite option as desired by the customer. Select, which is routed from the control logic is required to enable the WDS and WRS inputs. $\overline{\text{RUN}}$ and $\overline{\text{READ}}$ inputs are generated in the control logic and control the write register Direct Set (S_D) and Direct Clear (C_D) circuitry. The following description is keyed to track 0, but is applicable to all tracks. See timing diagram, Figure 4-8.

4-38. DATA INPUT. A low pulse or level applied to J102, pin M, in conjunction with the WDS, is considered to be a binary one. This low is inverted by IC100B and applied to the data gate, IC108C, to be strobed into the deskew monostable. The internal write strobe is derived from a monostable, IC102, which is triggered from the WDS applied to J102, pin A, inverted by IC103E. The internal strobe generator may be triggered by either the leading or trailing edge of the WDS (see Figure 4-8 for proper jumper connections). The $\overline{Q}$ output of IC102 is inverted by IC101A and applied as a high level strobe to the data gate, IC108C. With a binary one (high) also applied to the gate, a low pulse is generated at the output which is used to trigger the deskew monostable, IC122. Obviously, if a binary zero is to be generated, the data gate input will be low at the time of the write strobe, inhibiting the strobe and preventing the monostable from being triggered.

4-39. DESKEW MONOSTABLE. The deskew monostable is triggered by the low pulse from the data gate or the reset gate, IC108D. The trailing edge of the high going pulse output is time-variable through the use of potentiometer R119, skew adjust. The actual write clock is this trailing edge and compensates for mechanical skew inherent in the dual gap head. (See Write Skew Adjustment procedure in Section V

4-40. WRITE REGISTER. The write register, IC126A, is a J-K flip-flop (see description at beginning of Principles of Operation). The Q output is fed back to the K input and the $\overline{Q}$ output fed back to the J input. This insures reversal of the Q and $\overline{Q}$ output levels each time a clock is provided by the deskew monostable. The Q and $\overline{Q}$ outputs are inverted by IC125F and IC125C, respectively, and serve to switch the head drivers, Q100 and Q101, resulting in a flux reversal (binary 1) on the magnetic tape. The lack of an input to clock IC126A results in a binary zero being recorded on the tape (no flux reversal).

4-41. CHECK CHARACTER GENERATION (CRCC AND LRCC). In 9-track operation, the Cyclic Redundancy Check Character (CRCC) is written four character times after the last record block character in the same manner used for the data characters. The

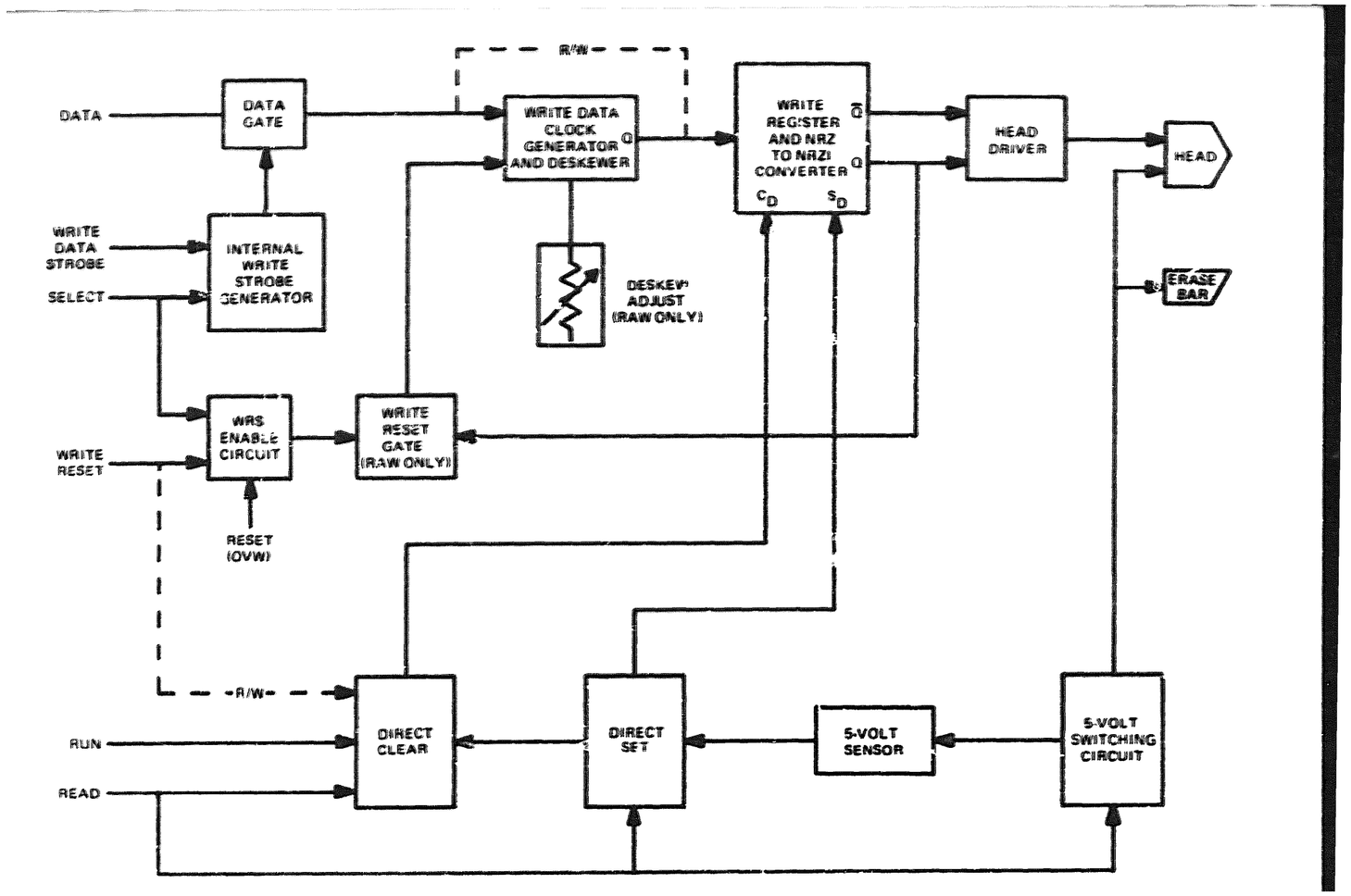


Figure 4-7. Data Recording Black Diagram

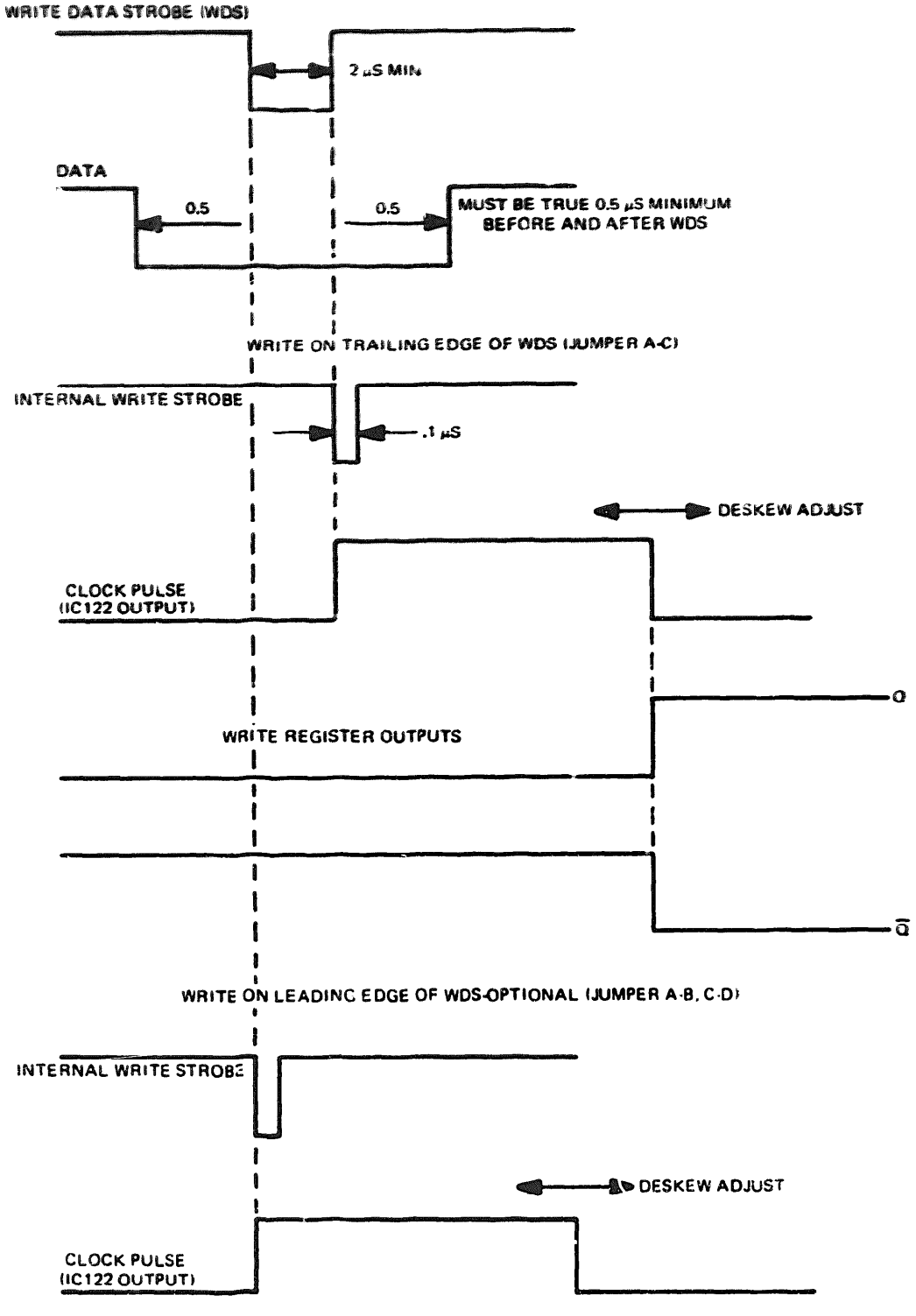


Figure 4-8. Data Timing Diagram

Longitudinal Redundancy Check Character (LRCC) occurs either four character times after the CRCC (9 track) or last record block character (7 track). The customer-supplied Write Reset (WRS) input applied through J102, pin C, is inverted by IC103D and routed to IC109B through jumper H-J. With the Overwrite option, the jumper may be installed from H to K and the Reset would then be generated from the control logic. The WRS is gated through IC109B, if enabled by Select, to the reset gate IC108D. If the reset gate input from Q of the write flip-flop is high, signifying an odd number of binary ones have been written, the WRS pulse will trigger the deskew monostable. This will create a write clock which will write an additional binary one and set the write flip-flop in a reference condition.

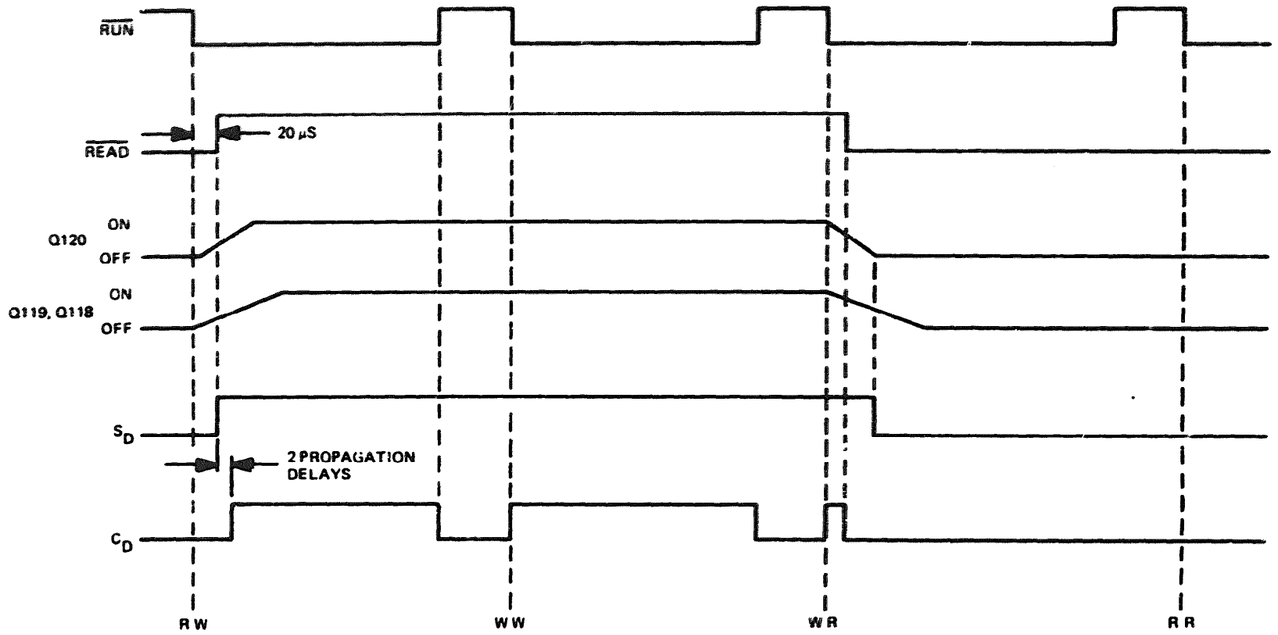
4-42. Write Current is supplied through a transistor switch, Q118, from a five-volt source and is ramped to prevent unwanted flux reversals from occurring. The $\overline{\text{READ}}$ input from the control logic determines when the write current is to be on or off. A false going $\overline{\text{READ}}$ level enables the current switch driver, Q119, and C109 charges through R165 which in turn allows Q118 to become fully saturated. The ramp time when switching from read to write is approximately 1.5 milliseconds. At the same time Q120 is turned on and the Direct Set (S_D), then the Direct Clear (C_D) inputs to the write register are allowed to go high, insuring the flip-flop is in the reference condition. When $\overline{\text{READ}}$ becomes true (low), Q119 turns off, turning off Q118 and Q120. The ramp is approximately 1.2 milliseconds long and the current path for C109 is through CR100. C_D becomes low at the time $\overline{\text{READ}}$ goes true and S_D becomes low when Q120 reaches the off condition. This insures that neither write driver (Q100 or Q101) can be switched during the read operation. The relationship of S_D and C_D when going from read to write, or write to read, is important. See Figure 4-9

4-43. NRZ TO NRZI CONVERSATION. The use of J-K flip-flops in the write register allows for input data to be presented in NRZ form. The Q and $\overline{Q}$ outputs are coupled back to the J and K inputs assuring that the flip-flop will toggle each time a clock is received causing a "1" to be written. Since the clock is independent of the data input, the data line may remain low or high for consecutive "ones" or "zeros". The only restriction is that the conversion of the data must occur at least 0.5 microsecond before or after the WDS (see Figure 4-8

4-44. DATA RECOVERY.

4-45. Five inputs are required to enable the read circuitry. Select, Read, and Run are derived from the control logic and routed through the write circuitry. Threshold is a customer-generated level routed through J102E on the read/write board. $\overline{\text{Hi Den}}$ comes from the control logic and is switched high or low either locally from the control panel or remotely fixed high for 9 track. The following description is keyed to track 0, but is applicable to all tracks. (See Figure 4-10.)

4-46. The input to the first stage of the read amplifier, IC1, is a low level, analog signal. The output from the head is 700 microvolts/inch/second ±20% (i.e. at a tape



NOTE THAT WHEN SWITCHING FROM READ TO WRITE C_D GOES HIGH AFTER S_D HAS GONE HIGH, AND WHEN GOING FROM WRITE TO READ C_D GOES LOW BEFORE S_D.

Figure 4-9. Direct Clear/Direct Set Timing Diagram

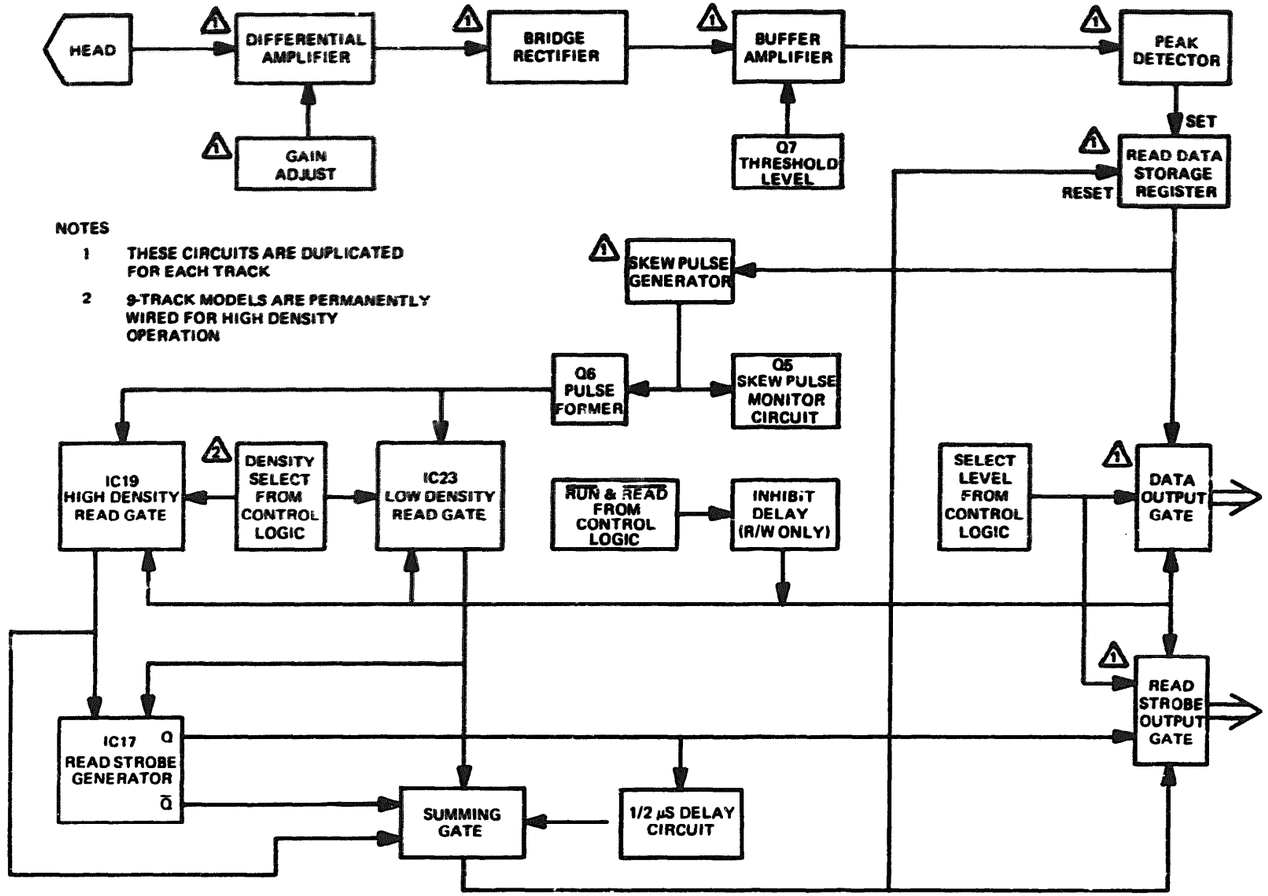


Figure 4-10. Data Recovery Block Diagram

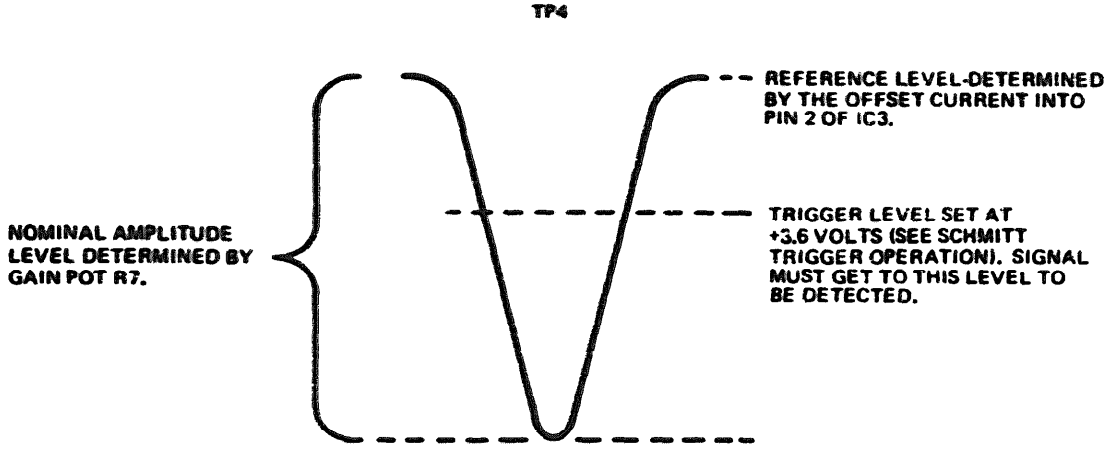
speed of 10 inches/second the input to the amplifier would be 7.5 millivolts, peak-to-peak). The first stage differential amplifier gain is controlled by a shunt feedback potentiometer, R7. The compensation components, C3, R4 and C4 are selected for a 100 kHz roll-off while C5, R6 and R7 determine the low frequency roll-off. The voltage level at TP1 will be approximately 1.3 volts peak-to-peak, however, the actual gain is adjusted to obtain the proper level at TP4 located in the peak detector.

4-47. The second stage, IC2, is an active filter. R9, R10, C6 and C7 determine the 3-db point which is the high-band cutoff. The 3-db frequency is 100 kHz for all tape speeds in the range of 25 to 45 ips. For lower speed units, the 3-db point is set at 3 times the maximum fundamental analog frequency, which is 1.5 times the data rate. The signal to noise ratio becomes more of a factor at lower tape speeds because of the lower head output level. The effective gain of the second stage is eight and is determined by R13 and R17. This gain is required to reduce the effect of the dead-band created by the fullwave rectifying action of CR9 thru CR12. The voltage at TP2 will be approximately 12 volts peak-to-peak. The voltage at TP3 will be approximately 1.3 volts peak-to-peak, due to the voltage divider action of R13 and R17.

4-48. The buffer amplifier, IC3, serves the purpose of isolation and threshold offset provisioning. The threshold level is determined by the offset current from Q7 into the inverting input of IC3. The output of IC3 is fed into a Schmitt trigger (peak detector).

4-49. THRESHOLD. An understanding of threshold helps in reasoning why the peak detector is used. The threshold is defined in terms of percentage and is that part of a nominal signal that must be reached in order to be detected as a bit of data. This percentage is determined by the reference point, trigger point, and overall amplitude of the signal (see Figure 4-11).

4-50. SCHMITT TRIGGER. The schmitt trigger circuit detects the peak of the rectified analog signal from IC3. As the voltage to the common emitter output of Q1 and Q2 (TP4) drops from the reference level, Q1 is turned off and capacitor C14 is being discharged through Q2(see Figure 4-12) When the voltage at TP4 drops below the +3.6 volt level, transistor Q3 is enabled through CR13, which will allow the circuit to trigger later. Q4 is off at this time since base current is not being supplied by Q3. Peak detection takes place when the output of Q2 at TP4 reaches its lowest level and starts to go positive. Q2 is now turned off and capacitor C14 is charged through Q1. Q1 and CR13 now supply base current to the enabled Q3, turning it on. Q3 then supplies base current to Q4 which generates a negative pulse through C15 to set the read data storage register (IC18A and B). The register will remain set until the reset pulse generated by IC 4A in the Read Gate Network is received. When the output of Q1 (TP4) goes above +3.6 volts, Q3 is turned off through CR14 which in turn removes the base current from Q4. When the output of Q1 reaches its highest point Q1 will turn off. The cycle is now ready to repeat for the next bit of data.



$$\% \text{ THRESHOLD} = \frac{\text{REFERENCE LEVEL - TRIGGER LEVEL}}{\text{AMPLITUDE}}$$

$$\text{i.e. } 20\% \text{ THRESHOLD} = \frac{6.5\text{V} - 3.6\text{V}}{X}$$

$$X = \frac{2.9}{.2} = 14.5\text{V}$$

WITH THE REFERENCE LEVEL AT + 6.5 VOLTS AND A TOTAL AMPLITUDE REQUIRED OF 14.5 VOLTS, GAIN WOULD BE ADJUSTED SO THE NEGATIVE PEAK WOULD ATTAIN - 8 VOLTS.

Figure 4-11. Threshold Data

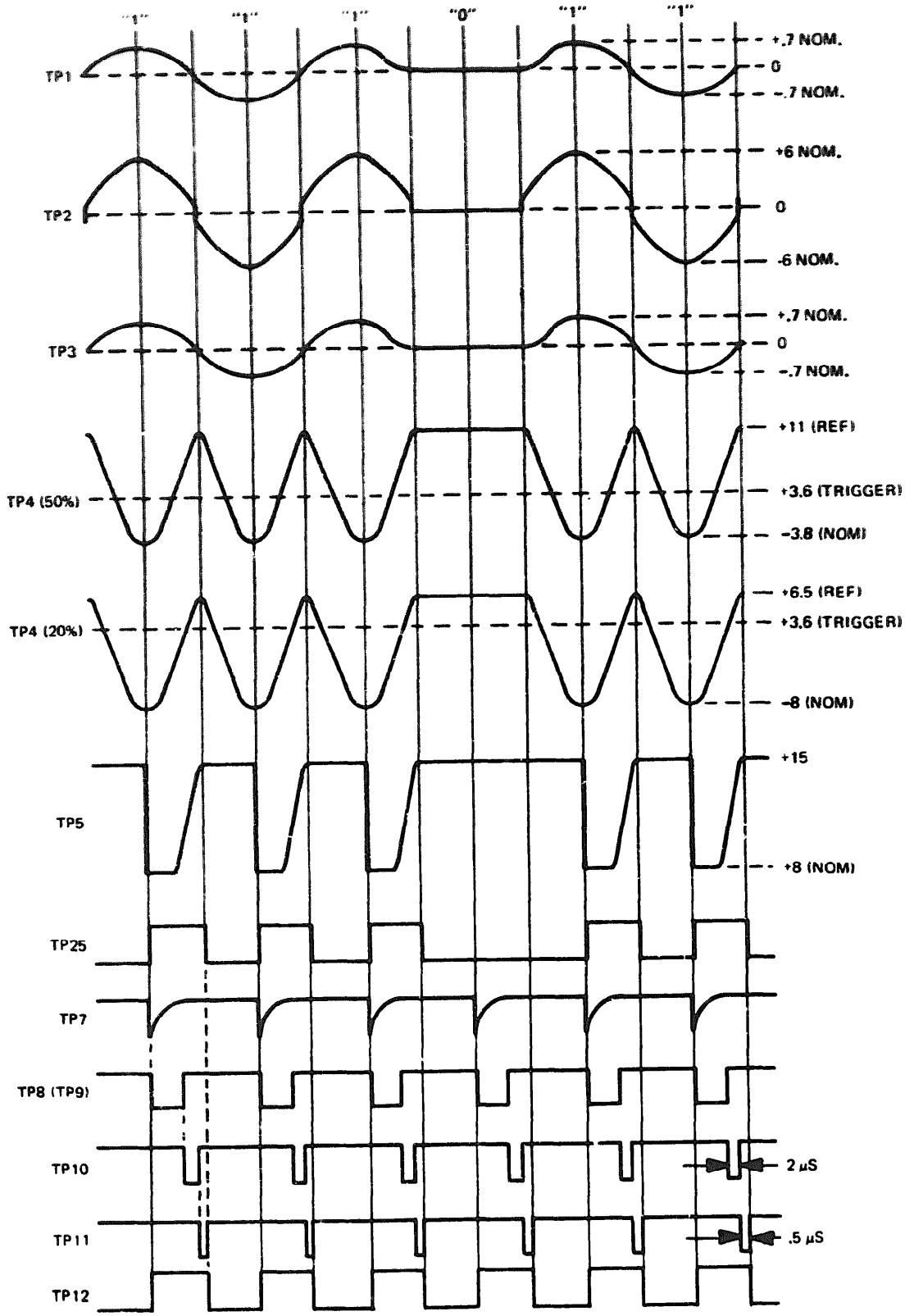


Figure 4-12. Data Recovery Timing Diagram

4-51. The negative pulse from the schmitt trigger is capacitively coupled to the read data storage register through C15. R28 and R30 form a voltage divider which holds the quiescent voltage high on the input to IC18A when data is not present. The negative data pulse to the read data storage register makes its output high. This high level is applied to the input of IC7A. If the Select level from the control logic and the Run level from IC14B are both high, the data output gate, IC7A, is enabled and transfers the data bit out.

4-52. The output from the read data storage register is also inverted by IC16F and applied through C17 to the skew pulse generator (CR15, CR16). The outputs of each channel's skew pulse generator are tied together and applied to the base of both Q5 and Q6. Q5 is an emitter follower which provides the skew pulses at TP7 to be used for deskew alignment of the head read gap. Q6 is a pulse former with its output inverted by IC22A to become the Read Gate Trigger. The negative-going edge of this trigger agrees with the peak of the read signal.

4-53. READ GATES. Seven-track models with the dual-density capability have two read gates, one each for low and high-density operation. Nine-track models are permanently wired in a high-density configuration, using read gate IC19. Read gate IC19 is enabled by the High Density input from IC22C and the Run input from IC14B. In Read/Write models jumper L-M is installed to delay the enabling inputs to the read gates. This allows the first stage amplifier time to recover from saturation during the write to read transition. The delay is created by IC10 and will vary in time relative to the start/stop time of the transport. The delay must be less than that of the start/stop time.

4-54. The read gate output is adjusted with R40 or R42 to a time that is 50% minus 2.5 microseconds of the normal byte to byte time. The trailing edge of the read gate output triggers the read strobe generator, IC17, which is set for 2 microseconds. The read gate output is also coupled back to the input, to prevent retriggering by subsequent skew pulses, and routed to the summing gate, IC14A. The Q output of the read strobe generator is fed to the read strobe output gate, IC8B, and to a delay monostable, IC20, which is set for 0.5 microsecond. The $\overline{Q}$ output of both IC17 and IC20 are routed to the summing gate. The summing gate output is routed to the read strobe output driver, IC8B, and to the reset input of all the read data registers.

4-55. CONTROL LOGIC STATE DECODER.

4-56. The State Decoder, IC39 on the Control/Servo board, is a 3 to 8 bit decoder which provides recorder status data to the various command control circuits in the control logic. These recorder configuration levels are used to enable and disable gates in the recorder's control logic and thus maintain the proper sequence of commands as well as preventing improper commands.

4-57. There are eight outputs representing eight possible logic configurations, one of which must be low at all times (see Figure 4-13). Three inputs to the decoder determine its output state. These inputs are received from the Q outputs of three J-K flip-flops; IC34B, IC34A, and IC35A. These low or high values are the same as those present on the J inputs of the flip-flops immediately before the clock pulse is received from IC40. The transfer of these values is triggered by the low-going edge of the clock pulse. The decoder maintains each state until the next one is clocked in.

4-58. STATE O, STANDBY. This is the initial state that follows the application of power to the recorder as well as the reset state. The Power-On Reset circuit of Q12 and Q13 works in conjunction with C5 and R5 on the power supply board to delay the resetting of the J-K flip-flops until all other logic circuits are stable. The Power-On Reset line to IC38B goes low, causing a low to be supplied via IC33E to the Direct Clear inputs on the three J-K flip-flops, IC34B, IC34A, and IC35A. This causes their Q outputs to go low which sets the decoder to the STANDBY state. In addition, IC38B, can also be triggered to produce a reset command by a broken tape or the compliance arms tripping the limit switches.

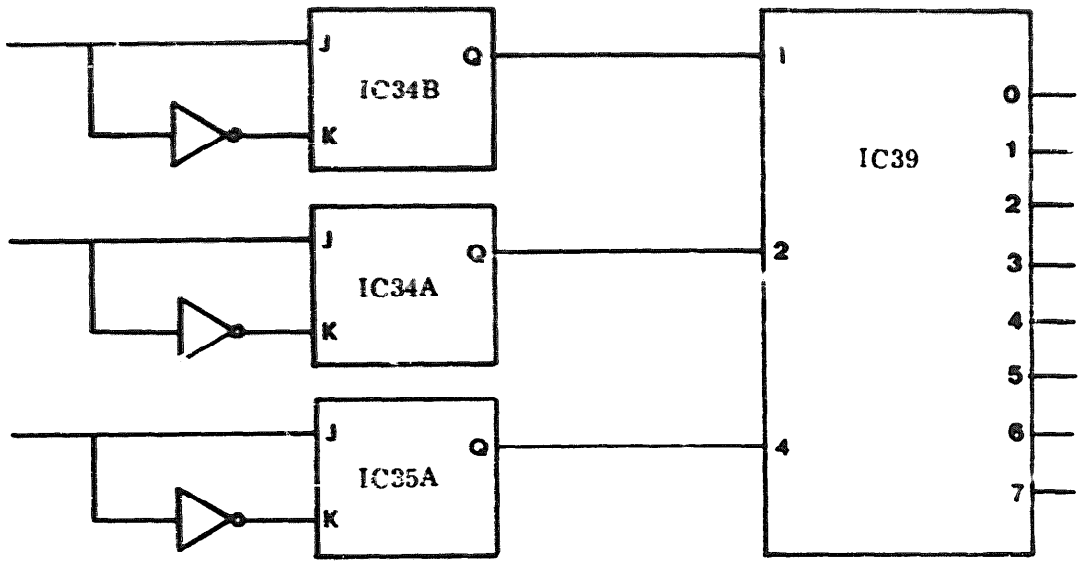
4-59. STATE 1, STOP. This state results from the first actuation of the LOAD Control (A2) on the front panel. The servo system and drive motors are energized causing the tape to be tensioned but motion commands are not enabled. See figure 4-14.

4-60. The state decoders digital 4 and 2 inputs remain at zero as originally set in the standby state. All inputs to IC29C and IC38A remain high.

4-61. The BOT and LOAD inputs to IC24C are not true making its level into IC29A high. The REWIND level into IC29A is also high. The logic being in the standby state makes the STANDBY level true, or low. This low input to IC29A causes its output to be high and makes the J input of IC34B high. Actuating the LOAD control (A2) triggers the internal logic clock pulse generator (IC40) causing the high to be transferred from the J input to the Q output of IC34B. In this manner the digital 1 input of the state decoder is set to one. This binary code (001) is the stop state and causes the STOP line to become true.

4-62. STATE 2, LOAD. Actuating the LOAD control a second time starts the tape moving forward to the load point. When the BOT tab is sensed by the photosensor assembly, tape motion ceases, and the recorder enters the ready state.

4-63. The state decoder's digital 4 input remains at zero as originally set in the standby state. Actuating the LOAD control while in the stop state causes the load control input to IC38A to go low. Since the other three inputs remain high, the output of IC38A goes high. This is applied to the J input of IC34A where it is stored as a binary one until the flip-flop is clocked. This will become the digital 2 input to the state decoder.



INPUTS			OUTPUT STATE	NAME
4	2	1		
0	0	0	0	STANDBY
0	0	1	1	STOP
0	1	0	2	LOAD
0	1	1	3	READY
1	0	0	4	REWIND
1	0	1	5	DELAY
1	1	0	6	UNLOAD
1	1	1	7	RESET

Figure 4-13. State Decoder.

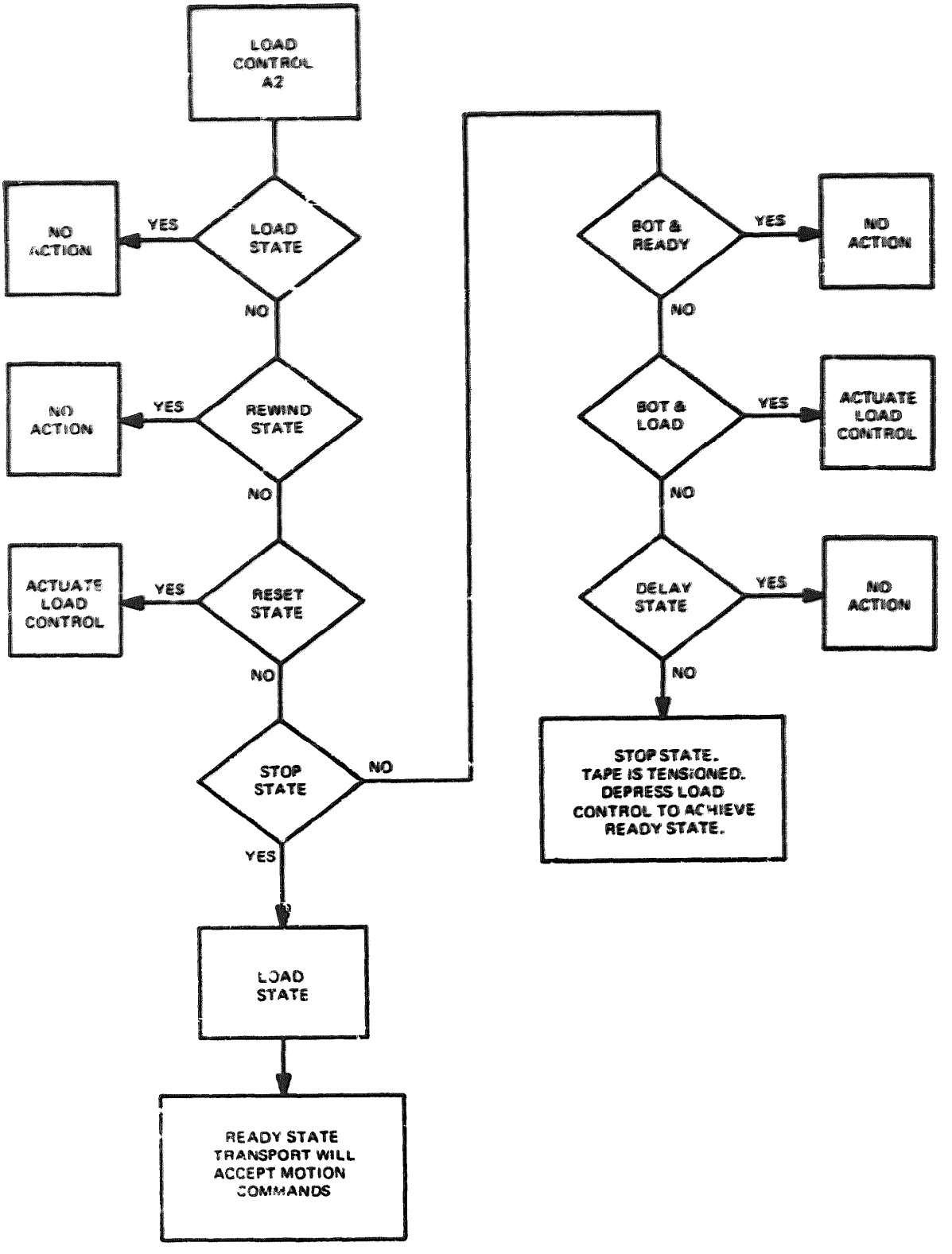


Figure 4-14. Load Sequence Chart

4-64. The three inputs to IC29A are high which cause its output to be low. This low is applied to the J input of IC34B where it is stored as a binary zero until clocking. This will be the digital 1 input to the state decoder. Actuating the LOAD control also triggers the internal logic clock pulse generator which incorporates a slight delay to allow for loading the J-K flip-flops. The clock pulse transfers the binary code, stored at the J inputs, to the Q outputs of the J-K flip-flops where they serve to set the state decoder. This binary code (010) is the load state and causes the LOAD line to become true.

4-65. STATE 3, READY Sensing of the BOT tab during the load sequence places the recorder in the ready state. The ready state allows the logic circuitry to accept both local and remote motion commands when other criteria are met. (See motion command section.)

4-66. When the BOT tab is sensed during the load sequence, the BOT line becomes true and is applied to IC24C as a high level. The LOAD level is inverted by IC24D and is also applied to IC24C as a high level. With these two inputs high, the output of IC24C goes low and is applied to IC29A. Because the recorder is not in the standby or rewind state, the remaining inputs are high. Thus the output of IC29A goes high and is applied to the J input of IC34B to await clocking. This will be the digital 1 input to the state decoder. The digital 2 and 4 inputs remain the same as in the load state.

4-67. The internal logic clock pulse generator is triggered by the output of IC36C which goes low when the BOT tab is sensed. The state decoder is now in the ready state (binary code 011).

4-68. STATE 4, REWIND. Either a remote or local rewind command rewinds the tape back onto the supply reel until the BOT tab is sensed. At this point the decoder cycles through the delay and load states to the ready state. Actuating the local REWIND control (A4) will unload the tape.

4-69. The remote rewind command gate, IC3C, requires the recorder to be on line, selected, and in the ready state as well as not at BOT. The low output of IC3C is used to actuate IC30D which triggers the internal logic clock pulse generator, IC40, which in turn clocks the J-K flip-flops controlling the state decoder, IC39.

4-70. The local rewind control gate, IC18C, requires the recorder to be off line, and in either the stop, ready, or load states. The low output of IC18C will also actuate IC30D and clock the J-K flip-flops as in the remote sequence.

4-71. The state decoder's digital 4 input is a binary one during rewind. This is accomplished by holding two of the inputs to IC29C high and switching the rewind input low. All inputs to IC38A and IC29A are held high which results in a binary zero being presented to the state decoder's digital 2 and digital 1 inputs. This binary code (100) represents the rewind state.

4-72. STATE 5, DELAY. The transport continues to rewind tape onto the supply reel until the BOT Tab is sensed. At this point the BOT lines go true which changes the state decoder input to binary 101, the delay state. This delay allows the transport to come to a complete stop before a new motion command is accepted.

4-73. With the delay lines true, the state decoder input becomes binary 010, the load state. With the load lines true, the binary code becomes 011, the ready state. The transport will now accept motion commands. Actuating the REWIND control at this time will unload tape.

4-74. STATE 6, UNLOAD. With the transport in the ready state, actuating the REWIND control will change the state decoder's binary input to 110, the unload state. When the last of the leader has passed through the photo sensor, both the BOT and EOT sensors are activated. These two signals are anded at IC20C and used to actuate the reset gate, IC38B. This reset pulse is applied to the Direct Clear inputs of the three state decoder flip-flops setting their Q outputs low. This forms the binary code 000 returning the recorder to the standby state.

4-75. STATE 7, RESET. A logic error creating an undefined state in which the binary code 111 is presented to the state decoder results in the reset state. The $\overline{\text{RESET}}$ line going low actuates the reset gate, IC38B. The high output of IC38B is inverted by IC33E and routed to the Direct Clear inputs of the three state decoder flip-flops, IC35A, IC34A and IC34B. This makes their Q outputs low, forming a binary 000 input to the decoder and returning the logic to the standby state.

4-76. The high output of IC38B is also inverted by IC33F and used to disable transistor Q16. When Q16 is turned off, the ground normally supplied to the reel motor relay, K2 on the reel servo portion of the control-servo board, is removed. De-energizing K2 places both reel motors in their dynamic braking state and maintains the motors in a de-energized condition until a new command is issued. In addition, if the recorder is in the On-Line mode, going to the reset state will return it to Off Line.

4-77. COMMAND LOGIC.

4-78. There are two methods for commanding transport operation. The Off-Line mode, in which transport operation is controlled manually by means of the front panel controls, and the On-Line mode, in which the transport is controlled by computer-generated signals. A J-K flip-flop, IC35B, determines the On-Line status of the transport. See Figure 4-15.

4-79. The external Off-Line command, applied at J101-L and enabled by the Select and Ready levels at NAND gate IC9D, sets the On-Line/Off-Line flip-flop, IC35B, to the Off-Line state. This Off-Line command is applied to IC35B as a Direct Clear reset. When low, IC35B is effectively locked in the Off-Line mode and the front panel control (A3) will have no effect.

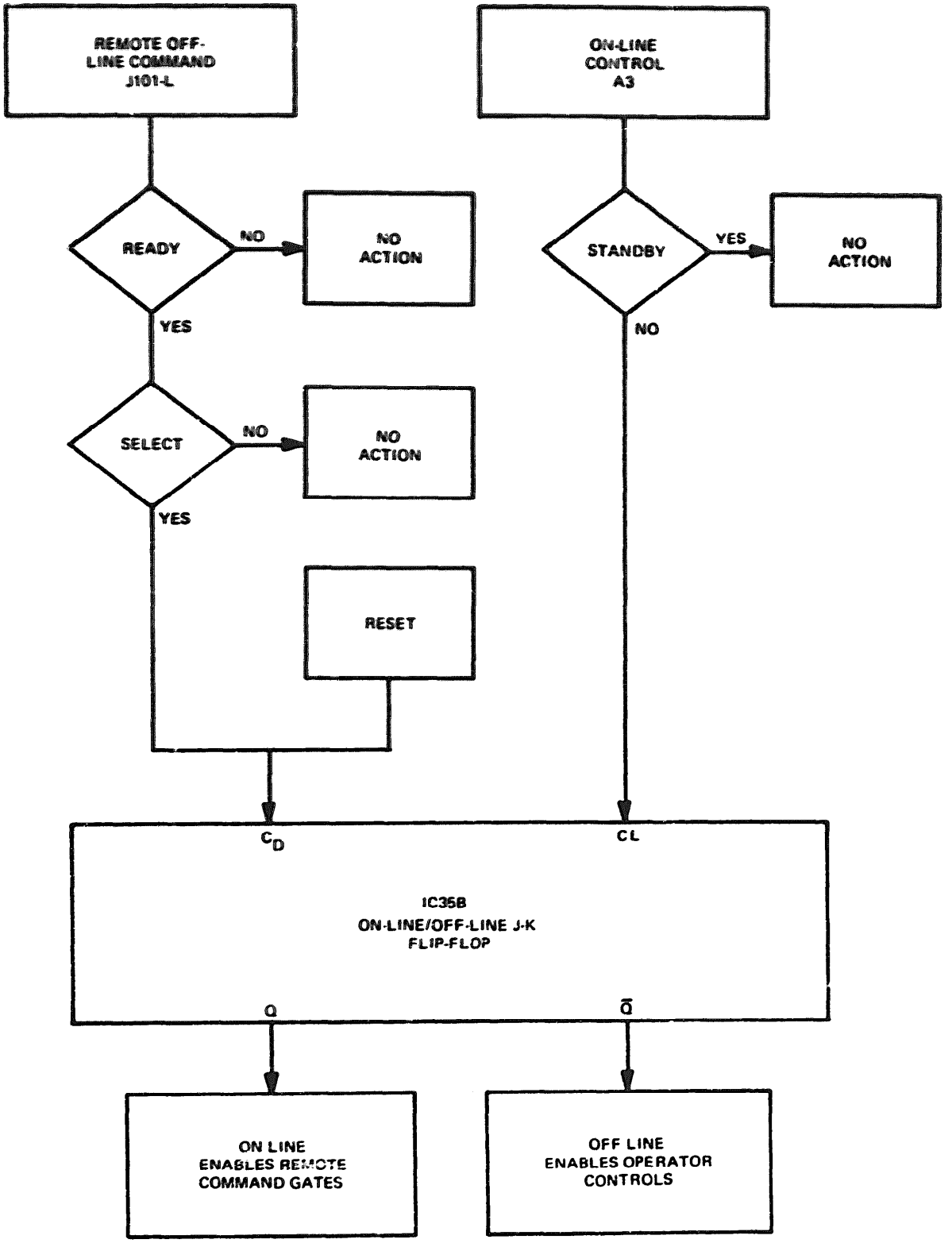


Figure 4-15. Local/Remote Operation Flow Chart.

4-80. The On Line control-indicator (A3) provides a clock pulse to IC35B which is gated through IC9A when the system is not in the Standby mode. When switching from the Off-Line to the On-Line mode, the high level appearing on the Off-Line circuit and connected to the J input of IC35B is transferred across to the Q output when the clock pulse is received, thus making the On-Line circuit high. When switching from On-Line to Off-Line, the low level appearing on the Off-Line circuit is transferred from the J input to the Q output when IC35B is clocked, thus making the On-Line circuit low.

4-81. FORWARD COMMAND CIRCUIT.

4-82. Forward tape motion may be commanded by the FORWARD pushbutton on the local control panel when the recorder is in the Off-Line condition. Forward tape motion may also be commanded remotely, through the interface, when the recorder is On Line. NOR gate IC37B is the link between these two control sources (see Figure 4-16).

4-83. REMOTE FORWARD COMMAND. The remote forward command is a low level applied to pin C of J101. R16 and R17 supply a positive collector voltage to this line for the user's output device. Inverter IC1B inverts the negative logic input to provide a high true to the two-input NAND gate IC11B. The second high input required by IC11B is the command gate enable level derived from the three-input NAND gate, IC3A. IC3A requires all three inputs to be high; the On-Line level from IC35B, the Ready level from the state decoder IC39, and the Select level from IC19C. When these conditions are met, the output of IC3A goes low. This low level is inverted by IC1A and fed to IC11B thus enabling it. The low true output of IC11B is routed to the two-input NOR gates IC37B and IC5D.

4-84. The low input to IC5D causes its output to go high and trigger the monostable multivibrator, IC15. IC15 is used to clock the Overwrite and Write Enable flip-flops, IC13A and B. The low input to NOR gate IC37B results in its output becoming high. This high is the true condition of the forward command level and is discussed further following the description of Local Forward Command.

4-85. LOCAL FORWARD COMMAND. The switch portion of alternate action pushbutton/indicator A7 applies a high, when actuated, to NAND gate IC26B. IC26B requires two additional inputs to be high, the Ready level from the state decoder (IC39) and the Off-Line level from J-K flip-flop IC35B. When these conditions are met, the output of IC26B goes low, the true state. IC31F inverts this level and applies it as a true high input to the two-input NAND gate IC37A. If the EOT output of IC20D is also high, the output of IC37A becomes true and is applied to NOR gate IC37B as a low, thus enabling it.

4-86. The true output of IC37B is high. This high level is applied to NAND gate IC44A. If the reverse level applied to inverter IC43A is low (false), its output becomes high and enables IC44A. This command redundancy prevents both Forward and Reverse from being commanded simultaneously. The low output of IC44A activates

NOR gates IC45B and IC45A. The output of these two gates are the FORWARD and RUN signals, respectively, that control the capstan drive logic.

4-87. CAPSTAN DRIVER. The Forward and Run signals are anded at IC303B on the capstan driver portion of the circuitry. The low (true) output of IC303B is inverted by IC304A and used to activate the forward switch driver, Q309. This, in turn, activates the forward switch, Q301. A positive reference voltage is provided by zener diode CR301. This reference is stabilized at 6.2 volts by the amplifier circuit of IC301A. The positive 6.2 volt output of IC301A is routed to the inverting input of IC301B to provide the negative reference level for the reverse and rewind circuits. This positive output is also routed through the forward speed adjust potentiometer, R312, and the forward switch, Q301, to the inverting input of IC305A. (see Figure 4-17.) Amplifier IC305A serves to isolate the forward/reverse command circuit from the ramp shaping circuit. Its output is a negative voltage level for the forward mode and is routed through the ramp adjust potentiometer, R333, to switch Q312. Q311, the rewind switch, is off during forward and reverse operation.

4-88. Switch Q312 is controlled by the flip-flop circuit of IC302C and D. With the Run input true (high) and the $\overline{\text{Rewind}}$ input false (high), the output of the flip-flop at IC302D is low. This low is inverted by IC304B and used to activate switch driver Q307 which, in turn, activates switch Q312. The output of Q312 is applied to the inverting input of gain determining amplifier, IC305B. The output of IC305B is then applied to the inverting input of amplifier IC306B. IC306B and its associated circuitry form the ramp generator. Feedback capacitor C315, together with ramp adjust potentiometer R333, determine ramp time. The output of IC306B (TP302) is negative for the forward mode. This ramp generator output is routed to the reel servo loops to initiate the response of the supply and take-up reels.

4-89. The ramp level is summed with the output of the tachometer (TP301) and the resulting error voltage is applied to the inverting input of amplifier IC306A. The output of IC306A is fed through a notch filter network to IC307B where it is again inverted. Feedback from the power driver is routed through a compensation network consisting of R353, R382 and C314 and summed with the notch filter input to IC307B. The enable switch, Q319, determines whether or not the capstan motor can be driven. Q319 is a FET switch controlled by the enable line from the control logic circuitry. When the enable line is at zero volts, the switch is on and the input to the motor driver from IC307B is shunted to ground. When the enable line is at -15 volts, the switch is off and the motor driver can be activated.

4-90. The output of IC307B is a negative voltage level for forward motion. This negative level activates the capstan motor forward driver circuitry of Q316, Q317, and Q318, which applies negative power through J9 to the capstan motor, resulting in forward tape motion. The power driver output is also routed through an amplifier, IC307A, and a bridge rectifier with a 6.2 volt zener diode, to provide current limiting feedback.

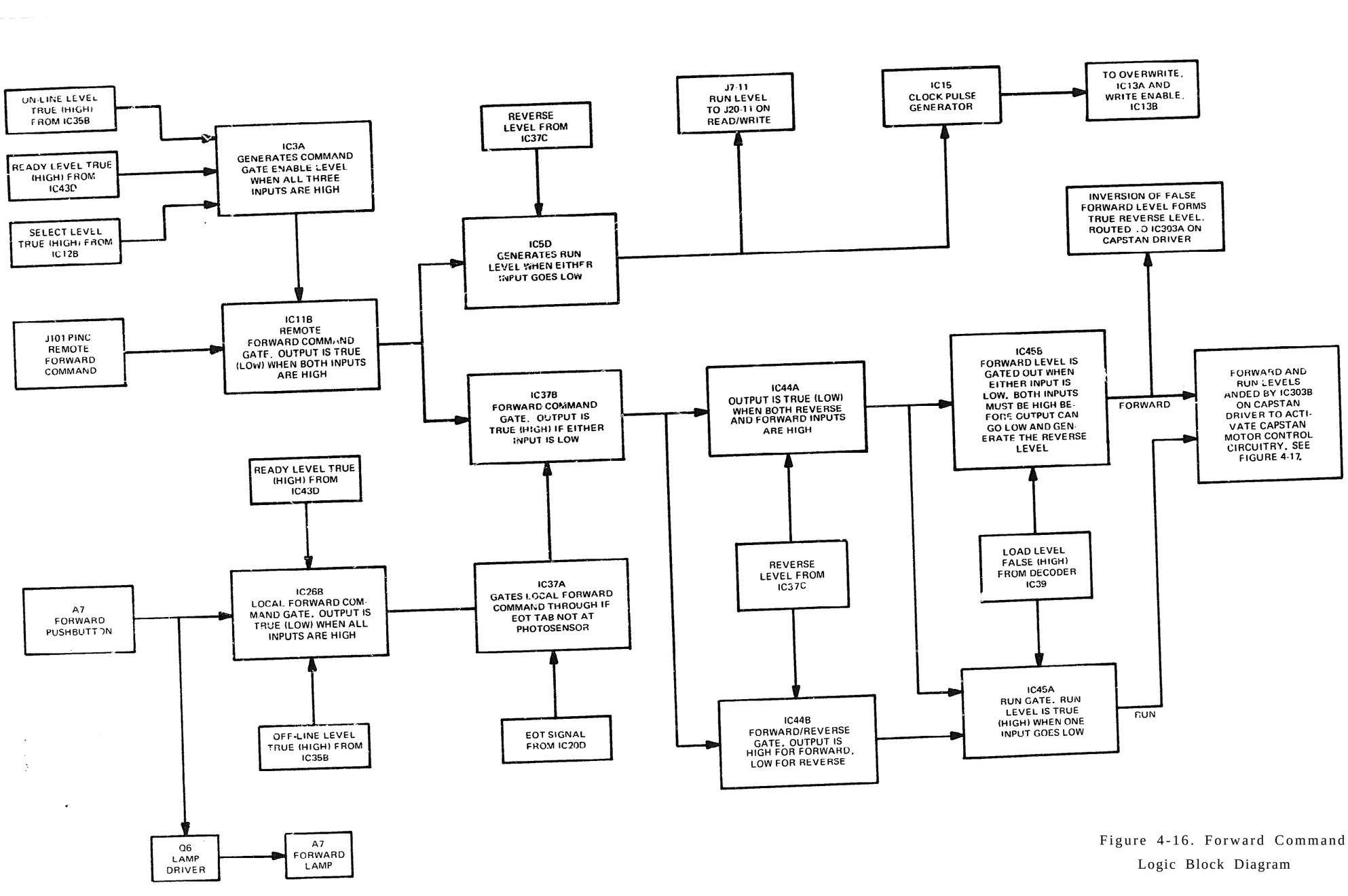


Figure 4-16. Forward Command Logic Block Diagram

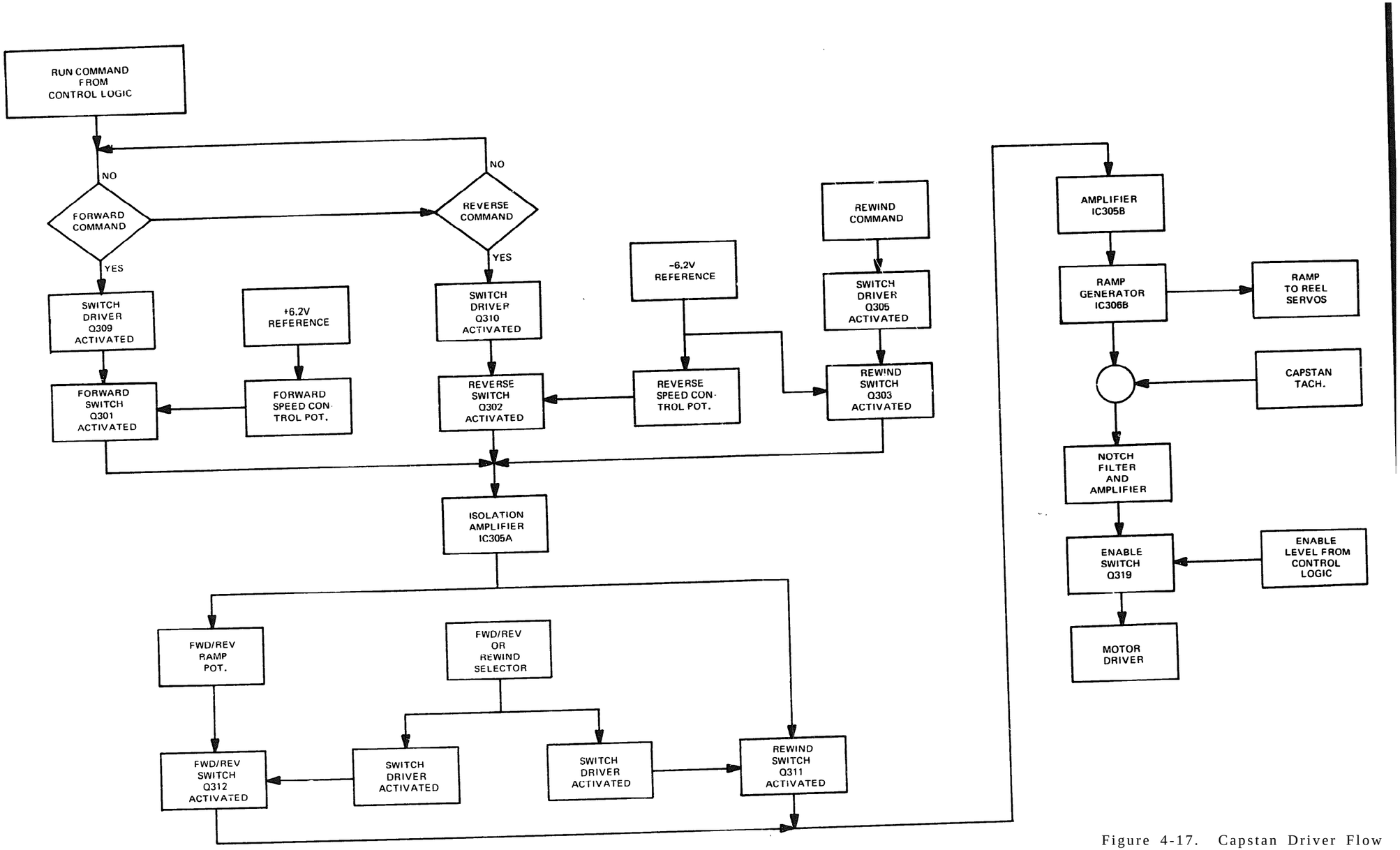


Figure 4-17. Capstan Driver Flow Diagram

4-91. REEL SERVOS. Both the supply and take-up reel servos use similar circuitry and operate in the same manner (see Figure 4-18). The following circuit description pertains to the supply servo but can be applied to the take-up servo as well. The last two digits of the reference designators are the same for each servo. The first digit, however, is a two (i.e. 2xx) for the supply servo and a four (i.e. 4xx) for the take-up servo.

4-92. Compliance Arm Position Sensor. The reel motor is controlled by the photosensor assembly (figure 4-19) which varies the current input to IC201A as a function of compliance arm position. The photosensor assembly consists of a lamp, solarcell, and a slotted disc. The disc is attached to the compliance arm spindle and rotates with it, acting as a rotary shutter to vary the amount of light falling on the solarcell. This changes the current flow through the photo diode, which changes the input to amplifier IC201A.

4-93. The photosensor lamp is supplied with positive current through lamp driver Q201. Q201 is controlled by the base current applied by amplifier IC201B. The output of IC201B is controlled by the negative voltage level set by the compliance arm position adjust potentiometer, R202. The source of this voltage level is the negative reference voltage supplied by IC301B on the capstan driver portion of the circuitry. Adjusting R202 varies lamp intensity which changes the solarcell current input to IC201A and causes the servo system to change the compliance arm position. This adjustment is used to center the arm in its arc of travel (see Section V).

4-94. As tape is taken from, or added to, the compliance system by the capstan drive, the compliance arms move to maintain tape tension. This movement is detected by the photosensor assembly resulting in a change of the current input to IC201A. The output of IC201A is applied to the inverting input of amplifier IC202B. The ramp level from IC306B on the capstan driver is applied to the positive input of IC202B. This input is negative for the forward mode and positive for reverse. The ramp serves as a prestart signal to initiate reel motion in the required direction prior to the compliance arm motion sensors command, during stop and start operations. This prestart increases the amount of effective compliance provided by the system.

4-95. The Enable level from the control logic circuitry is required to be at -15 volts for the FET switch Q208 to be off and not ground the motor driver input. This requires that the system not be in standby, and that the retraction arm is in its down position. (Down limit switch is closed.) The output of IC202B is a positive voltage for forward motion and negative for reverse. When positive, transistors Q204, Q202, and Q203 are turned on, which supplies a positive voltage to the motor resulting in clockwise reel motion (forward mode). When negative, transistors Q205, Q206, and Q207 are turned on which supplies a negative voltage to the motor resulting in counterclockwise reel motion (reverse mode). Power for the supply and take-up reel motors is supplied through the contacts of relay K2. Relay K2 is energized when the

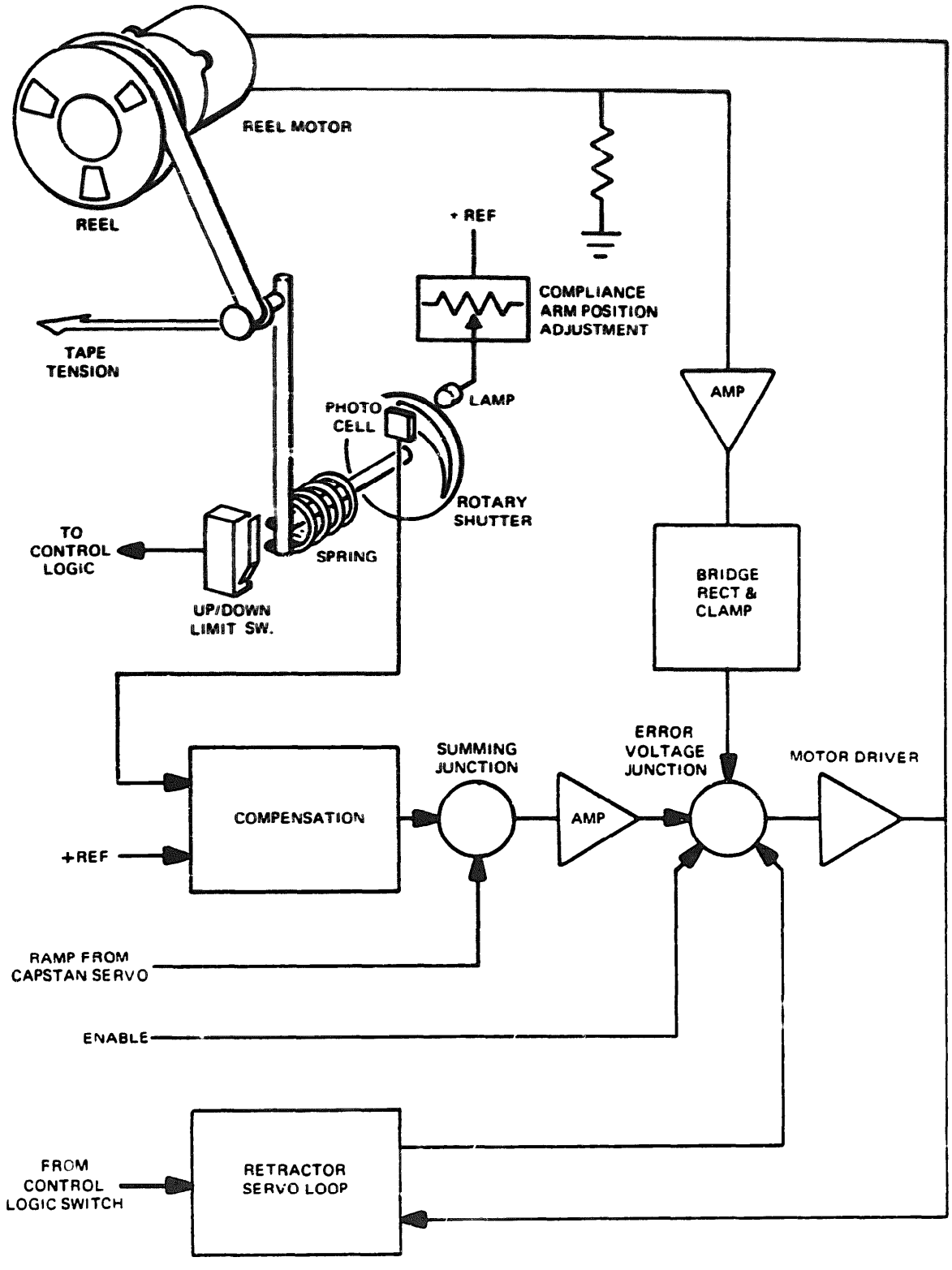
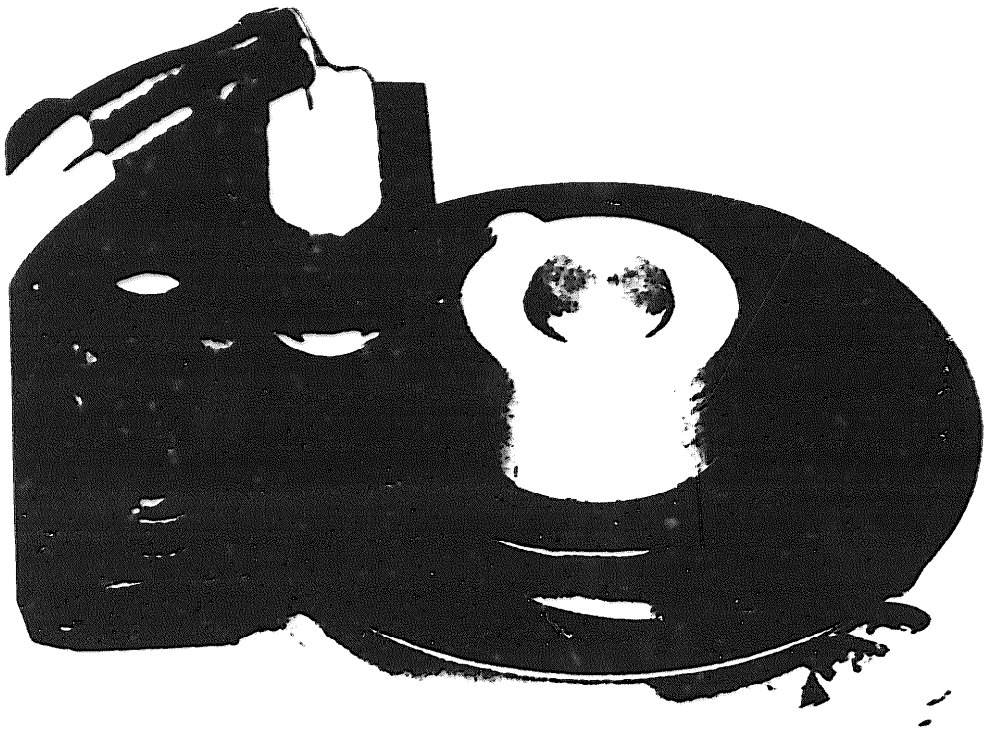
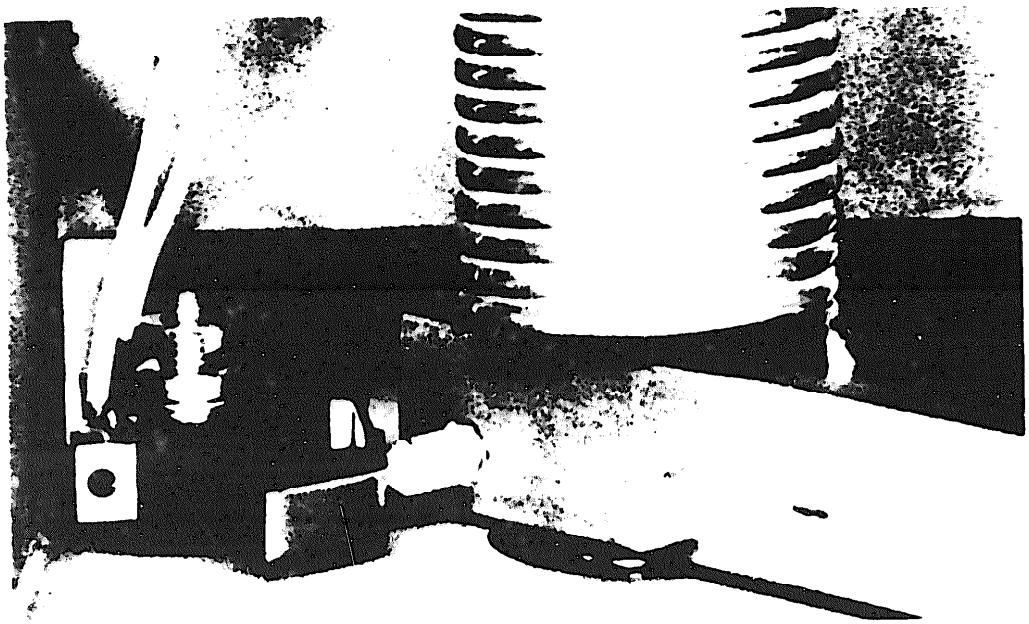


Figure 4-18. Reel Servo Block Diagram



MOTION SENSOR



LIMIT SWITCH

Figure 4-19. Compliance Are Motion Sensor Assembly and Limit Switch

ground side of the coil is completed through transistor Q16 in the control logic circuit. Q16 is on when the logic is not in a standby mode.

4-96. A limit switch, actuated by two nylon screws on the compliance arm, determines the maximum travel of the arm. When the switch is actuated, the output of IC48D of the control logic is routed to the reset gate, IC38B. If the system is not in the stop or standby mode, the control logic will be reset. The reset condition turns Q16 off which de-energizes K2. In the de-energized state the supply reel motor inputs are connected directly together while the take-up reel motor inputs are connected through a current limiting resistor, R436. This arrangement provides the transport with a dynamic braking action whenever power is lost or a reset occurs because of another cause (see description of reset state under Control Logic State Decoder).

4-97. Current limiting feedback is provided through amplifier IC202A and the bridge rectifier and zener diode network, CR204 through CR208. This feedback is taken from the motor power return line and is inserted at the input to the motor driver circuit (base of Q204 and Q205).

4-98. RETRACTOR SERVO LOOP (see Figure 4020.) A retractor servo loop is provided by Q209 and Q210 on the supply reel servo and Q409 on the take-up reel servo. Q14 on the control logic portion of the control/servo board supplies a ground to the base of Q210 to turn it on. This ground is supplied whenever the logic circuitry is in the standby mode and the retractor arm is down (down limit switch closed) or when in a mode other than standby and the retractor arm is up (up limit switch closed). The ground from Q14 is also routed to the retractor motor relay, K1, on the power supply board which, in turn, supplies power to the retractor motor. The retractor arm is driven up or down as determined by the position of the crank linkage to the motor. If the arm was down, it will be driven up, if up it will be driven down. This is the method by which the compliance arms are positioned up for easy tape threading and down for tensioning and compliance.

4-99. When Q210 on the supply reel servo is turned on, a positive voltage is applied to the motor driver input, activating Q204. Q209 on the supply reel servo and Q409 on the take-up reel servo are gain control amplifiers which take up tape slack when the compliance arms are coming up and hold the compliance arms up when the retractor arm is going down. The reel servo loop is not activated until the retractor arm is in the down position, at which point the retractor servo loop is deactivated. Figure 4-21 provides a timing diagram of retractor operation.

4-100. REVERSE COMMAND CIRCUIT. Reverse tape motion may be commanded by the REVERSE pushbutton on the local control panel when the recorder is in the Off-Line mode or remotely when the recorder is On Line. IC37C is the link between these two control sources in the same manner as IC37B is used in the forward command circuitry (see Figure 4-16). The control logic used for the reverse mode is similar to that previously described for the forward command path. The true (high) output of

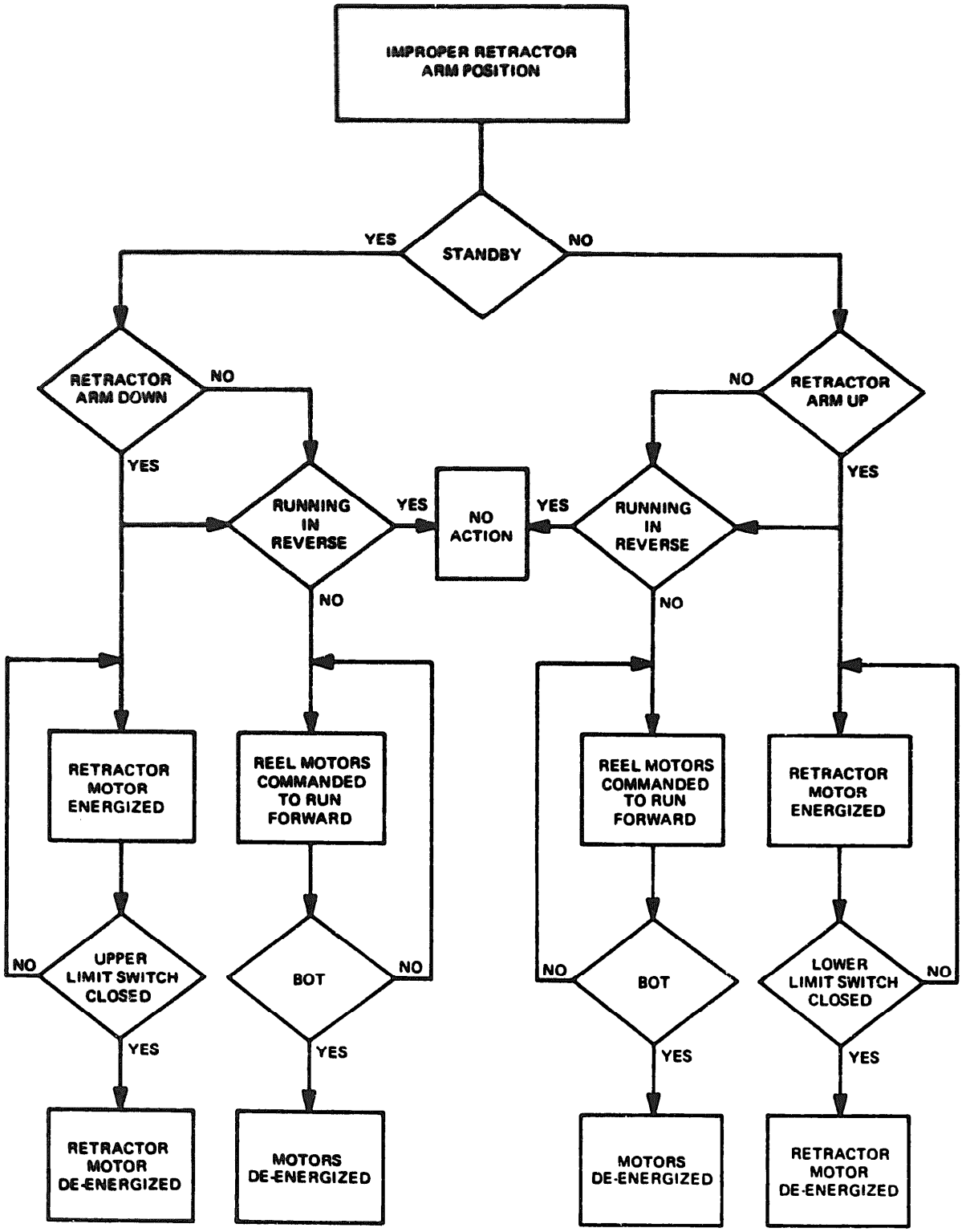


Figure 4-20. Retractor Servo Loop Flow Chart

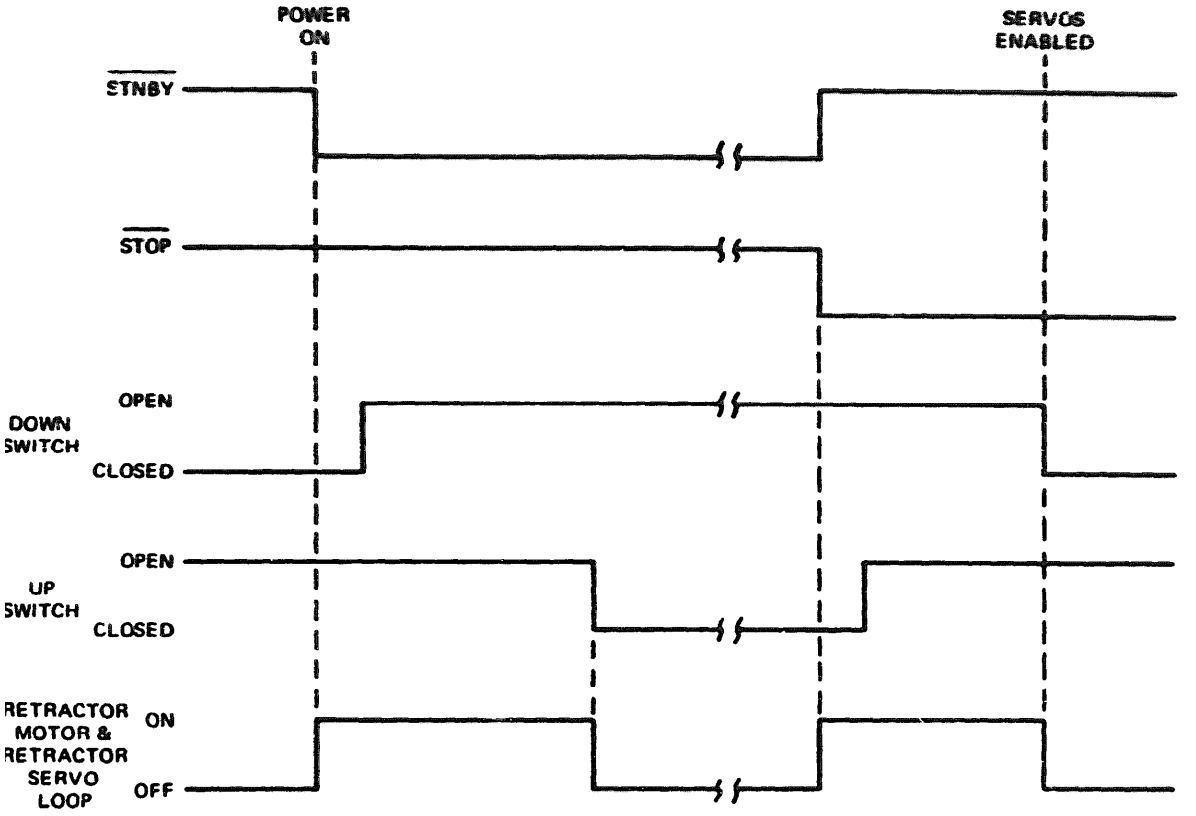


Figure 4-21. Retractor Motor Timing Diagram

IC37C is inverted by IC43A and applied to NAND gate IC44A. This low input to IC44A drives its output high, which when anded with the high Load line at IC45B produces a low output on the Forward line. This is inverted by IC47B to provide the high Reverse level required by the capstan driver.

4-101. The Reverse and Run signals are anded at IC303A in the capstan driver, inverted by IC304D, and used to activate switch driver Q310. Q310, in turn, turns on the Reverse switch, Q302. This applies the negative reference level from IC301B, as set by the reverse speed adjust potentiometer, R307, to IC305A. The remaining circuitry functions the same as in the forward mode with the exception that the voltage output of each stage is of opposite polarity. The input to the motor driver from IC307B is a positive voltage level for reverse operation. This activates the reverse motor driver circuitry of Q315, Q313, and Q314, which applies positive power through J9 to the capstan motor, resulting in reverse tape motion.

4-102. REWIND COMMAND CIRCUIT. The rewind mode may be commanded by the REWIND pushbutton on the local control panel when the recorder is Off Line. Rewind may also be commanded remotely when the recorder is On Line. IC30D in the control logic is the link between these two control sources. The output of IC30D is used to

trigger the internal control logic clock pulse generator, IC40, which clocks the Rewind state into the Decoder, IC39. See the description of the Rewind state under the Control Logic State Decoder section.

4-103. The true $\overline{\text{Rewind}}$ input to IC44C causes its output to go high. This high is inverted by IC43F and routed to the Capstan Driver as the $\overline{\text{RWD}}$ level. The low output of IC43F is also applied to IC45C causing its output to go high and activate switch Q15. Q15 then turns on switch driver Q104 on the power supply which activates switch Q103. Q103 applies +36 volts to the reel motor power input line which provides the high rewind speed.

4-104. The low $\overline{\text{RWD}}$ input into the Capstan Driver is inverted by IC304E and turns on switch driver Q305 which activates the rewind switch, Q303. Q303 then passes the negative reference voltage from IC301B to the input of IC305A. Fixed resistor R309 determines the rewind speed. The output of IC305A is a positive level for rewind operation and is routed through Q311 when it is activated by switch driver Q308.

4-105. The low $\overline{\text{RWD}}$ input from the control logic circuit is applied to IC302A and inverted by IC304F to turn off the stop mode offset switch Q304. $\overline{\text{RWD}}$ is also applied to IC302D making its output high which, when inverted by IC304B, turns off the Forward/Reverse switch Q312. The high output of IC302D is applied as an input to IC302C. The low Run level from the control logic is inverted by IC302B and becomes the second high input into IC302C. With both inputs high, the output of IC302C becomes low and activates switch driver Q308 after inversion by IC304C.

4-106. With Rewind switch Q311 turned on, the positive rewind level is transferred to the inverting input of IC305B. The ramp generator, notch filter, and motor driver circuits operate in the same manner for rewind as they do in forward. The take-up and supply reel servos also operate in the same manner as they do in the forward mode. The reel motor supply voltage is increased to 36 volts however, to provide a faster rewind speed. See the description of these circuits under Forward Command Circuit.

SECTION V

MAINTENANCE

5-1. GENERAL

5-2. **This section contains periodic maintenance information, removal and replacement instructions, and adjustment procedures. Table 5-1 contains the preventive maintenance schedule. Refer to Section VI for schematic diagrams.**

CAUTION

Equipment rack must be securely mounted if hinged mounting plate is to be swung open. Weight of components on open plate may upset an inadequately mounted rack.

5-3. FUSE REPLACEMENT

5-4. **A 3 ampere, type 3AG slo-blo fuse is located on the back of the power bracket, adjacent to the line cord.**

5-5. CLEANING.

5-6. HEAD AND GUIDES. **Clean the head and its associated guides, and the roller guides, with a lint-free nonabrasive wipe or a cotton swab moistened with isopropyl alcohol or head cleaner.**

CAUTION

Do not use rough or abrasive material to clean the head and guides. Use isopropyl alcohol or commercial head cleaner only. Other solvents, such as carbon tetrachloride, may dissolve the head lamination adhesive. Do not soak the guides with cleaner. Excess solvent may break down the bearing lubricant.

MAINTENANCE OPERATION	FREQUENCY (HOURS)	QUANTITY TO MAINTAIN	PROCEDURE PARAGRAPH
Clean Head, Guides, Roller Guides, and Capstan	daily	-	5-6 5-7
Clean Tape Cleaner	500	1	5-8
Check Skew, Tape Tracking and Speed	500	-	5-21 thru 5-24 5-32
Check Head Wear	2,500	1	5-33
Replace Reel Motors and Capstan Motor	10,000	3	5-37

Table 5-1. Preventative Maintenance Schedule

5-7. CAPSTAN. Clean the capstan with a lint-free, nonabrasive wipe and a non-solvent degreaser such as freon.

C A U T I O N

Do not use alcohol or head cleaner to clean the capstan. Excessive alcohol will be absorbed by the capstan causing swelling and a change in tape speed.

5-8. TAPE CLEANER. Clean the tape cleaner as follows:

a. Remove the single mounting screw.

b. Remove the four screws holding the blade to the housing.

c. Blow out the accumulated debris and clean the blade and housing with isopropyl alcohol. Ensure that the blade is free of lint.

d. Assemble the blade in the housing and reinstall the tape cleaner. Adjust the tape cleaner so that tape will be wrapped symmetrically around the cleaning surface, i.e., entry angle and exit angle are equal.

5-9. HOUSING. The dust door and control panel may be cleaned, as necessary, with Miller-Stephenson Chemical Co. MS-260, Windex, or an equivalent commercial grade glass cleaner.

CAUTION

Do not use rough or abrasive material to clean the plastic dust door as permanent scratches may result.

5-10. POWER SUPPLY ADJUSTMENTS.

5-11. The potentiometers used in these adjustments are located on the power regulator portion of the Control/Servo board. Adjustments are made with the recorder running forward and writing (see write skew adjustment procedures).

5-12. +5 VOLT SUPPLY. Measure voltage at TP105 with respect to TP102. Adjust R124 to obtain +5 ± 0.05 volts.

5-13. +10 VOLT SUPPLY Measure voltage at TP101 with respect to TP102. Adjust R114 to obtain +15 ± 0.15 volts.

5-14. VOLT SUPPLY. Measure voltage at TP104 with respect to TP102. Adjust R119 to obtain -15 ± 0.15 volts.

NOTE

Tape speed should be checked, and corrected if necessary, following power supply adjustments.

5-15. BOT/EOT AMPLIFIED ADJUSTMENT.

5-16. BOT ADJUST. The beginning-of-tape sensor circuit is adjusted as follows:

a. Turn on recorder power.

b. Monitor voltages at TP18 and the wiper of R64 (TP21).

c. Without blocking the photosensor assembly reflector, adjust R64 until the voltage at TP18 is high, then adjust until the voltage goes low. Record the voltage present on the wiper of R64 (TP21).

d. Block the photosensor assembly reflector with a piece of magnetic tape or other suitable material. Adjust R64 until the voltage at TP18 goes high. Record the voltage present on the wiper of R64 (TP21). If the voltage does not go high, record as zero.

e. Adjust R64 to obtain a voltage on its wiper (TP21) equal to the average of the two voltages recorded above $\left(\text{R64 setting} = \frac{V_1 + V_2}{2}\right)$.

5-17. EOT ADJUST. The end-of-tape sensor circuit is adjusted as follows:

a. Turn on recorder power.

b. Monitor voltages at TP19 and the wiper of R60 (TP20).

c. Without blocking the photosensor assembly reflector, adjust R60 until the voltage at TP19 is high, then adjust until the voltage goes low. Record the voltage present on the wiper of R60 (TP20).

d. Block the photosensor assembly reflector with a piece of magnetic tape or other suitable material. Adjust R60 until the voltage at TP19 goes high. Record the voltage present on the wiper of R60 (TP20). If the voltage does not go high, record as zero.

e. Adjust R60 to obtain a voltage on its wiper (TP20) equal to the average of the voltages recorded above $\left(\text{R60 setting} = \frac{V_1 + V_2}{2}\right)$.

5-18. CAPSTAN SERVO ADJUSTMENT.

NOTE

Check read azimuth in accordance with the head adjustment procedure. Correct, if necessary, before performing capstan servo adjustments.

5-19. DC OFFSET ADJUST. With power applied (POWER indicator lit) but the transport not in motion, monitor TP 303 with respect to TP 305 on the Control/Servo board. Adjust offset potentiometer R379 to obtain zero voltage at TP 303.

5-20. RAMP LINE COURSE ADJUST. This adjustment is made while starting and stopping transport motion and observing the ramp in both forward and reverse modes.

The ramp is observed on an oscilloscope monitoring TP 302 with respect to TP 102 on the Control/Servo board.

a. Alternately start and stop the transport at a rate which is convenient for observing the ramp.

b. Adjust ramp potentiometer R333 to obtain the applicable ramp time specified in Table 5-2.

c. Check the ramp in the reverse mode and readjust if necessary.

N O T E

Readjustment of ramp time may be required following speed adjustment.

5-21. FORWARD SPEED COURSE ADJUST. Adjust forward speed as follows:

a. Monitor the tachometer output voltage at TP301 on the capstan servo portion of the control/servo board.

b. With the recorder in the off-line mode (ON LINE indicator not lit) depress the FORWARD pushbutton.

TAPE SPEED (IPS)	TP301 VOLTS	RAMP TIME (MS)	DATA RATE (CH/S AT 800 BPI)		
			NOMINAL	MINIMUM	MAXIMUM
12.5	0.44	30	10K	0.90K	1.10K
18.75	0.66	20	15K	14.85K	15.15K
25	0.88	15	20K	19.80K	20.20K
37.5	1.32	10	30K	29.70K	30.30K
45	1.58	8.33	36K	35.64K	36.36K
75	2.64	5	60K	59.40K	60.60K
REWIND 150	5.26	500	-	-	-

Table 5-2. Capstan Servo Adjustment Parameter.

c. Adjust forward potentiometer R312 until the voltage at TP301 is as specified in Table 5-2.

d. Depress the FORWARD pushbutton to stop tape motion.

5-22. REVERSE SPEED COURSE ADJUST. Adjust reverse speed as follows:

a. Monitor voltage at TP301.

b. With the recorder in the off-line mode (ON LINE indicator not lit) depress the REVERSE pushbutton.

c. Adjust reverse potentiometer R306 until the voltage at TP301 is as specified in Table 5-2.

d. Depress the REVERSE pushbutton to stop tape motion.

5-23. FINE SPEED ADJUST. Measure and adjust tape speed as follows:

a. Load a known-density master skew tape on the transport (see Section III). Connect a counter to TP23 (9-track) or TP21 (7-track) on the Read/Write board.

b. With the recorder in the off-line mode (ON LINE indicator not lit) depress the FORWARD pushbutton and adjust the counter to trigger on the positive-going edge of the data pulse.

c. Adjust forward speed control potentiometer R312 on the capstan servo portion of the control/servo board to obtain the appropriate data rate listed in Table 5-2. (For densities other than 800 bpi, compute the frequency by multiplying density and tape speed and adding a one percent tolerance: f = BPI X IPS ± 1%.)

d. Depress the FORWARD pushbutton to stop tape motion.

e. Depress the REVERSE pushbutton.

f. Adjust reverse speed control potentiometer R306 to obtain the appropriate data rate listed in Table 5-2.

g. Depress the REVERSE pushbutton to stop tape motion.

h. Readjust ramp time in accordance with paragraph 5-20.

5-24. SPEED ACCURACY VERIFICATION. **Tape speed can be accurately verified as follows:**

a. **Set up the recorder to write all ones as follows:**

1. **Ground the data input terminals L through V on J102 for 9-track recorders. On 7-track recorders, ground terminals L and R through V.**

2. **Ground terminals J and K on J101 to make the Select and Write Enable lines true.**

3. **Supply a negative-going +5 to 0-volt pulse from a signal generator to the WDS input, J102A. The pulse rate should be as indicated in** Table 5-4.

b. **Load and tension a blank tape with a write enable ring installed.**

c. **With the recorder in the on-line mode (ON LINE indicator lit) depress the FORWARD pushbutton.**

d. **Write ones for a minimum of one second. Remove the tape from the transport and immerse in CBS Magna-see or equivalent.**

e. **Measure the byte-to-byte spacing on the tape and compare with the value in Table 5-4 corresponding to the speed being checked.**

f. **Readjust speed as necessary to bring pulse width within 1% tolerance.**

5-25. READ AMPLIFIER ADJUSTMENT

5-26. THRESHOLD LEVER. **See Section IV for a description of threshold limits. Threshold may be adjusted to user's requirements.**

5-27. READ GATE. **The following procedure applies to dual-density recorders. Single-density recorders have only one read gate adjustment.**

a. **Load a low density tape on the transport in accordance with Section III.**

b. **Connect an oscilloscope to TP8 and ground.**

c. **With the recorder in the off-line mode (ON LINE indicator not lit) depress the FORWARD pushbutton and select the high density mode (HI DEN indicator lit).**

d. Set high-density potentiometer R40 fully counterclockwise and then adjust to obtain the applicable low-going pulse width listed in Table 5-3.

e. Connect the oscilloscope to TP9 and ground. Select the low density mode (HI DEN indicator not lit).

DENSITY (BPI)	SPEED (IPS)	DATA RATE (CH/S)	BYTE TO BYTE PERIOD (μs)	READ GATE (μs)	READ GATE TOLERANCE (μs)
800	75	60K	16.7	5.8	±0.06
	45	36K	27.8	11.4	±0.1
	37.5	30K	33.3	14.1	±0.1
	25	20K	50	22.5	±0.2
	18.75	15K	66.6	30.8	±0.3
	12.5	10K	100	47.5	±0.5
556	75	41.7K	24.5	9.7	±0.1
	45	25K	40	17.5	±0.2
	37.5	20.85K	48.7	21.8	±0.2
	25	13.9K	72	33.5	±0.3
	18.75	10.4K	96.2	45.6	±0.5
	12.5	6.95K	143.6	69.3	±0.7
200	75	15K	66.6	30.5	±0.3
	45	9K	111.1	53.1	±0.5
	37.5	7.5K	133.3	64.1	±0.6
	25	5K	200	97.5	±1.0
	18.75	3.75K	266.7	130.8	±1.0
	12.5	2.5K	400	197.5	±2.0

Table 5-3. Read Amplifier Parameters

SPEED (IPS)	PULSE RATE (CH/S)	BYTE-TO-BYTE SPACING (INCHES) ±1%
12.5	1	12.5
18.75	1	18.75
25	1	25
37.5	2	18.75
45	2	22.5

Table 5-4. Speed Check Values

f. Set low-density potentiometer R42 fully counterclockwise and then adjust to obtain the applicable pulse width listed in Table 5-3.

5-28. COMPLIANCE ARM SYSTEM ADJUSTMENTS.

5-29. ARM POSITION. Load and tension a tape on the transport in accordance with Section III.

N O T E

In the event the 2.5 to 3.5-vdc lamp voltage is exceeded, the recorder must be returned to the factory for repair.

a. Supply Arm – Adjust R202 to center arm in its arc of travel. Measure motion sensor lamp voltage at TP202 to ensure it does not exceed a range of 2.5 to 3.5 volts dc.

b. Takeup Arm. Adjust R402 to center arm in its arc of travel. Measure motion sensor lamp voltage at TP402 to ensure it does not exceed a range of 2.5 to 3.5 volts dc.

5-30. COMPLIANCE ARM LIMIT SWITCH ADJUST. Two nylon screws, threaded through each compliance arm, are used to adjust the upper and lower switch point of the microswitch located in each arm assembly. Both compliance arms are adjusted in the same manner.

a. Adjust the right-hand screw in or out, as necessary, to cause the microswitch to actuate when the compliance arm is approximately 5 degrees from its full down position.

b. Adjust the left-hand screw to actuate the microswitch with the compliance arm approximately 20 degrees from its full up position.

5-31. REACTOR MOTOR SWITCH ADJUST. The two cam-actuated retractor motor switches are adjusted by carefully bending the actuating lever until the switch is actuated by the cam pin.

a. Adjust the up position switch to close when the retractor arm is in its full up position.

b. Adjust the down position switch to close when the retractor arm is in its full down position.

5-32. SKEW ADJUSTMENT.

5-33. Prior to making adjustments, visually check the head assembly for secure mounting and wear. Check head crown to ensure it is not worn down to the depth of the gutter.

5-34. HEAD AZIMUTH ADJUSTMENT. Read skew may be adjusted as follows for both Read-after-Write and Read/Write heads:

a. Load and tension an 800 bpi master skew tape in accordance with Section III.

b. Connect an oscilloscope to TP7 and ground on the Read/Write board.

c. With the recorder in the off-line mode (ON LINE indicator not lit), depress the FORWARD pushbutton.

d. Adjust the azimuth screws (Figure 5-1) on the head mounting plate such that the output of all tracks, as monitored at TP7, fall within 10^{-7} or less of the byte-to-byte period listed in Table 5-3. (See Figure 5-2.) The outer azimuth screw bears against the recorder mounting plate and pivots the head assembly outward. The inner azimuth screw threads into the recorder mounting plate and pulls the head assembly inward. The inner screw also serves to lock the adjustment.

5-35. The head azimuth adjustment serves to minimize skew in both the read and the write modes for single-gap, read/write heads. Dual-gap, read-after-write heads require an additional write deskew adjustment as follows.

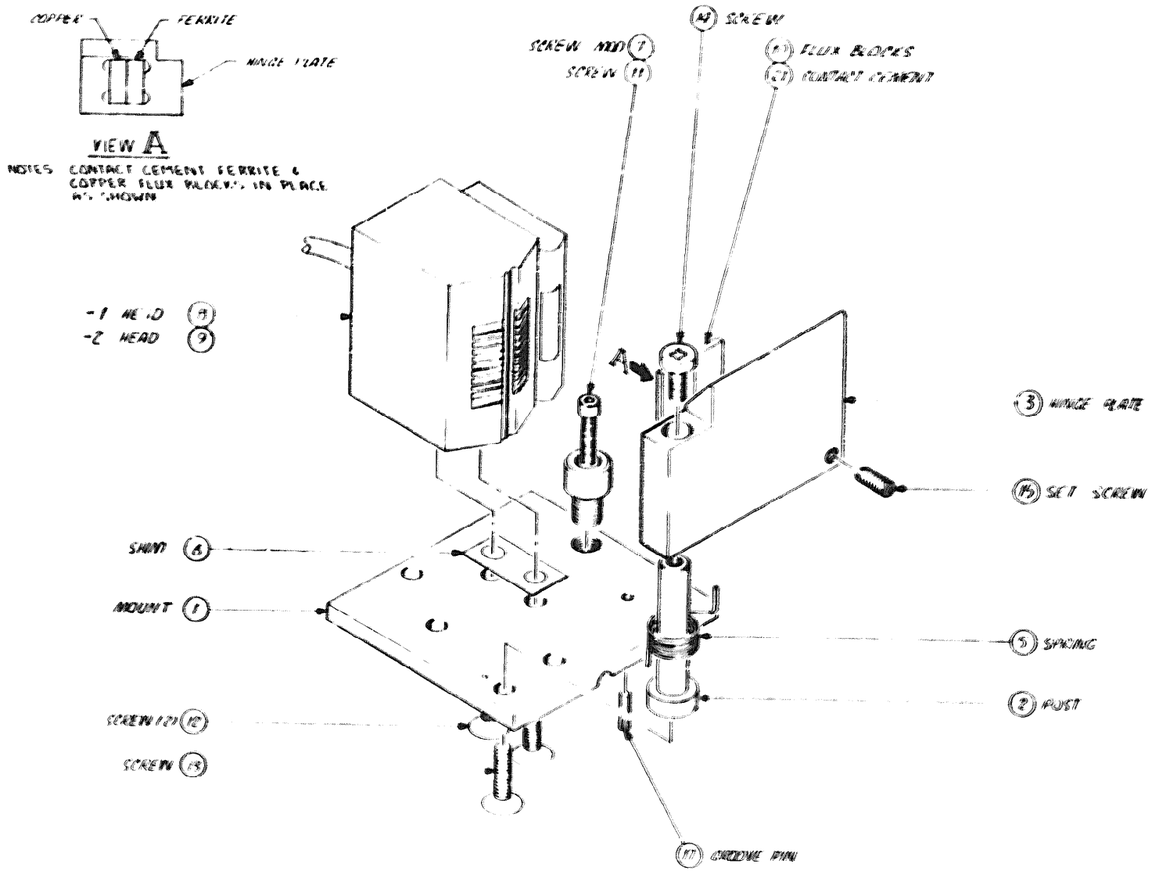


Figure 5-1. Head Assembly

5-36. WRITE SKEW ADJUSTMENT. Dual-gap, read-after-write heads require an electrical deskewing of the write tracks following the mechanical azimuth adjustment. This is accomplished as follows:

a. Load and tension a bulk tape with a write enable ring installed.

b. Connect an oscilloscope to the write deskew test point on the write portion of the Read/Write board corresponding to the track undergoing adjustment (see Table 5-5).

c. The adjustments are made while writing all ones on each track. This can be accomplished by external command or as follows:

1. Ground the data input terminals L through V on J102 for 9-track recorders. On 7-track recorders, ground terminals L and R through V.

2. Ground terminals J and K on J101 to make the Select and Write Enable lines true.

3. Supply a negative-going, 2-microsecond (+5 to 0 volts) pulse from a signal generator to the WDS input, J102A.

4. With the recorder in the on-line mode (ON LINE indicator lit) depress the FORWARD pushbutton.

7-CHANNEL MODEL TRACK NUMBER	9-CHANNEL MODEL TRACK NUMBER	WRITE DESKEW POTENTIOMETER	WRITE DESKEW TEST POINT
-	0	R119	TP102
-	1	R121	TP103
B	2	R123	TP104
A	3	R125	TP105
8	4	R127	TP106
4	5	R129	TP107
2	6	R131	TP108
1	7	R133	TP109
C	P	R135	TP110

Table 5-5. White Deskew Potentiometer and Test Point Identification.

d. Set the potentiometer corresponding to the track undergoing adjustment (see Table 5-5) to the middle of its range of adjustment as indicated by the pulse position displayed on the oscilloscope.

e. Repeat steps b. through d. for each track.

f. Connect the oscilloscope to TP7 on the read portion of the Read/Write board.

g. While still writing ones, adjust one of the skew adjust potentiometers to move its pulse slightly ahead of the others (see Figure 5-3). Now adjust each of the other potentiometers to bring the remaining tracks into alignment with the isolated one.

5-37. REMOVAL AND REPLACEMENT.

5-38. Replacement parts and assemblies should be selected from the parts list in section VII. Parts can be removed and installed using standard tools and procedures, and the assembly drawings in Section VII. Printed circuit boards, however, require special precautions as follows:

a. Type and Use of Solder.

1. Use only 60-40 tin-lead solder with non-corrosive and non-conductive flux.

2. Do not heat solder for more than 10 seconds.

3. Use alcohol or a commercial flux-removing solvent to remove flux residue.

b. Do not use a soldering iron rated at more than 40 watts or 900° F.

c. After a component has been removed from the board, clear all solder from connections (plated-through hole) with a commercial solder sucker. (Soldapullt desoldering tool, Edsyn Co., or equivalent.)

d. Use only exact replacement parts. (Refer to Section VII.)

e. Do not alter wiring or layout.

f. When soldering, always use a heat sink (alligator clip, long nose pliers, etc.) to prevent excessive heat from damaging components, especially semi-conductors.

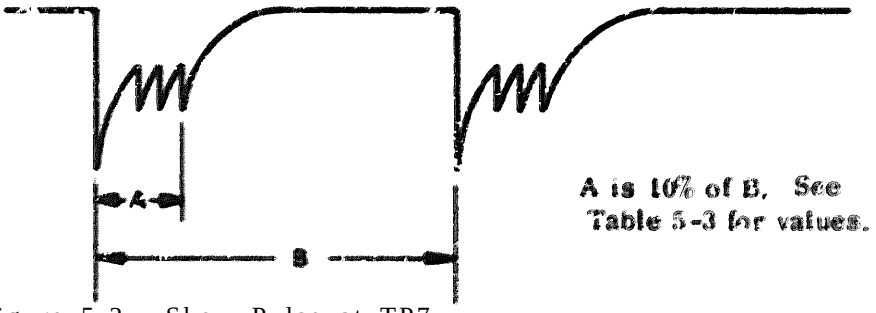


Figure 5-2. Skew Pulse at TP7

Figure 5-3. Isolated Track Pulse at TP7.

NOTE Oscilloscope screen intensity must be high to observe these pulses.

5-39. MULTIPLE LEAD COMPONENTS.

5-40. To remove and replace two- or three-lead components, observe the previous precautions and remove the defective component. Bend the leads on the replacement component to the correct shape and install. (Heat may be applied to either side of the board.)

5-41. MULTI-PIN COMPONENTS.

CAUTION

These components require special care during removal due to possible damage to the printed circuit board.

5-42. To remove and replace multi-pin components (including integrated circuits), remove the defective component by carefully cutting each lead close to the defective component using a jeweler-type diagonal cutter. Remove the remaining lead ends from the board, observing the previous precautions.

SECTION VI

TROUBLESHOOTING

6-1. GENERAL.

6 - 2 . This section contains instructions for determining the cause of the more common tape recorder malfunctions. If a malfunction occurs which cannot be isolated with these instructions, use standard troubleshooting procedures in conjunction with the diagrams in Section VII.

6-3. TROUBLESHOOTING.

NOTE

Before performing any troubleshooting, check to see that the equipment is connected properly and that all associated equipment is in good operating condition.

6 - 4 . In order to locate a malfunction. the troubleshooter should establish a logical approach to the problem. It is important that he follows the operation instructions and understands the theory of operation.

6 - 5 One of the first approaches to locating the malfunction should be to visually inspect the unit for damaged components. Many times mechanical malfunctions can be isolated by listening for unusual noises while the recorder is operating. When a defective component is located, identify it by referring to Section VII to get the part number and/or its value. If a replacement part is available, substitute it for the suspected defective part.

NOTE

If replacement of the defective component requires major alignment, it is recommended that the unit be returned to Cipher Data Products for factory repair and adjustment.

6-6. COMMON PROBLEMS. Table 6-1 lists the common problems associated with recorder operation, together with the probable cause and remedy.

6-7. SYSTEM TROUBLESHOOTING. Table 6-2. used in conjunction with the schematic diagrams in Section VII, provides an aid to the isolation of faults and their remedy.

TROUBLE	PROBABLE CAUSE	REMEDY
Reel flanges scrape tape	Reels improperly mounted	Reinstall reel evenly. (See Section III)
BOT and EOT markers not sensed	Dirt covering reflective strip or sensor	Clean sensor or reflective strip
Reels continue to rotate after tape leaves photosensor	Upper compliance arm limit switch out of adjustment or faulty	Readjust or replace limit switch
Tape fails to pull properly through machine or spills	Improper tape threading	Rethread tape. (See Section III)
Excessive data dropout	Dirt on head or damaged tape	Clean head (See Section V) and/or install new certified computer tape
Recorder will not function at all	Defective fuse	Replace fuse
POWER switchlight does not illuminate	No primary power	Check for primary power
	Defective indicator lamp	Replace control/indicator A1
Machine does not accept commands	Improper interface	Check interface with DTL logic and correct as necessary
	More than one command true simultaneously	Enable only desired command - hold other inputs high

Table 6-1. Common Problems.

TROUBLE	PROBABLE CAUSE	REMEDY
Tape continues to advance during load mode	No BOT marker on tape	Affix marker to tape approximately 12 ft. from the physical beginning of tape. Place marker near reference edge on backing side of tape
Tape tensioned but does not advance when capstan turns	Tape not threaded over capstan properly	Rethread tape (See Section III)
Tape tensioned but slips	Dirty capstan	Clean capstan in accordance with Section V
Tape moves during a stop condition		Replace capstan assembly and realign servo
	Motor voltage not zero	Check capstan servo and adjust for zero offset. Repair if adjustment does not correct
Tape not tensioned or tape is spilled when ready mode is set	Improper tape threading	See Section III
	Real servo or motor malfunctioning	Replace motor or repair reel servo
Transport responds to write commands but tape is not written	Write current not enabled	Check for write enable ring on reel. Check write current command path to tape head. Check that read is not enabled
Computer does not read tapes correctly	Data format incorrect	Use correct format
	Record length exceeds computer memory capability	Use correct record length

Table 6-1. Common Problems (cont.)

TROUBLE	PROBABLE CAUSE	REMEDY
Tape does not tension and the capstan shaft rotates freely when the LOAD control is depressed for the first time after threading tape	LOAD control is not operative	Check operation of LOAD control A2. Replace if necessary
Tape is tensioned when the LOAD control is depressed, but tension is lost when control is released	Limit switch is not operative	Adjust as described in Section V. Possibly replace limit switch assembly
Tape unwinds or tension arm hits stop when the LOAD control is depressed for the first time	Tape is improperly threaded	Rethread tape (see Section III)
	+5 volts is missing from tension arm sensor	Check tension arm sensor lamps. Isolate problem if lamp is extinguished
	Fault in reel servo amplifier	Troubleshoot reel servo and repair as necessary
Tape "runs away" or rewinds when LOAD control is depressed for the second time	Fault in Control logic or capstan motor assembly	Repair Control/Servo board or capstan motor assembly
Tape runs past the BOT marker	BOT tab dirty or tarnished	Replace tab or increase sensitivity of photosensor amplifier (see Section V)
	Photosensor not properly adjusted	Adjust photosensor amplifier (See Section V)
	Photosensor or amplifier defective	Replace or repair photosensor assembly

Table 6-2. System Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Tape runs past the BOT marker (cont)	Logic fault (Load flip-flop does not reset)	Repair Control/Servo board
Transport does not move tape in response to Forward or Reverse commands	Interface cable fault or receiver fault	Check levels at outputs and inputs of receivers on Control/Servo board. Replace or repair cable or repair Control/Servo board
	Transport is not Ready	Bring tape to load point (see Section III)
	Fault in ramp generator or capstan servo amplifier	Repair Control/Servo or Power boards
Transport responds to remote FORWARD command, but tape is not written.	Write current is not enabled.	Check presence of Write Enable ring on supply reel, WRT EN indicator should be lit. Check for +5V at TP 111 on Write board while writing. If not present check for +5V at J20 pin 1. Also check J7 pin 1 on the Control/Servo board and TP105 on the power board.
	Write Enable signal is not correct.	Check receiver on Control/Servo board. Check for $\overline{\text{Run}}$ signal on Read/Write board. Repair Read/Write or Control/Servo board if faulty.
	Write Data or Write Data Strobe is not received correctly from interface.	Check presence of correct levels on Write portion of Read/Write board. Repair Write portion of Read/Write board or interface cable if faulty.

Table 6-2. System Troubleshooting (cont.)

TROUBLE	PROBABLE CAUSE	REMEDY
Transport responds to remote FORWARD command, but tape is not written (cont)	Heads not plugged in correctly.	Check J21 on Read/Write board.
Data are incorrectly written.	Incorrect data format.	Use correct format (see Section IV).
	Fault on one track due to failure in write circuits.	Check receiver and write amplifier on write portion of Read/Write board. Repair if faulty.
	Intermittent +5, $\overline{\text{Run}}$, or WRS.	Examine the signals and repair Control/Servo or Read/Write board as required.
	Write deskew circuit faulty.	Check skew adjustments (see Section V).
	Head and guides need cleaning.	Clean head and guides.
	Tape cleaner needs emptying.	Remove tape cleaner and clean.
Tape cannot be read.	Interface cable or transmitter fault.	Replace or repair interface cable or transmitter on Read/Write board.
	Head is not plugged in.	Check J22 on Read/Write board.
	Read skew out of adjustment.	Readjust in accordance with Section V.
	Head and guides need cleaning.	Clean head and guides.
	Tape cleaner needs emptying.	Remove tape cleaner and clean.

Table 6-2. System Troubleshooting (Cont.)

TROUBLE	PROBABLE CAUSE	REMEDY
Tape cannot be read (cont)	Read amplifier gains are incorrectly adjusted.	Check and adjust amplifier gains.
	On Read/Write model, faulty write amplifier may cause current to be passed through head while reading.	Check write amplifier output test points and repair Read/Write board as necessary.
	Read Data Storage Register faulty.	Check TP6 on Read/Write board. Check that duration of positive section of waveform is one-half bit time.
	Other component fault in read channel.	Check test point data. Repair Read/Write board.

Table 6-2. System Troubleshooting (Cont.)

SECTION VII

PARTS LIST, SCHEMATICS, AND ASSEMBLY DIAGRAMS

7-1. GENERAL.

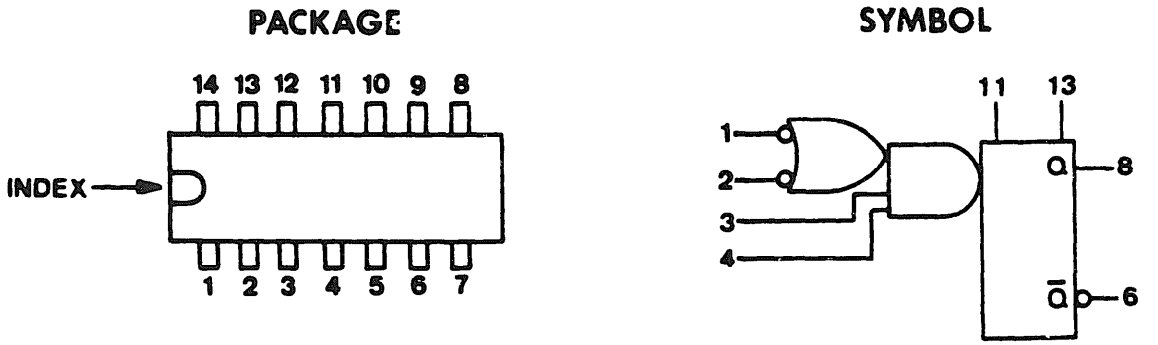
7-2. This section contains a list of the replaceable parts in the Cipher Model 100X Magnetic Tape Recorder and the associated schematics and assembly diagrams.

7-3. The parts list is provided to aid the user in obtaining replacement parts. For this purpose, reference designators, part descriptions, and part numbers are included. When ordering parts include the above information.

7-4. The schematics and diagrams are provided to aid the troubleshooter in locating and analyzing circuitry problems. The assembly diagrams are used to physically locate and identify components by their reference designator.

7-5. The symbols used in the schematics are shown in Figure 7-1. Integrated circuit packages containing more than one functional element are treated separately, each element being identified by a letter suffix. All gates are two-, three-, and four-input NAND gates, however, individual gates may be represented on the schematics by either the NAND or NOR gate symbol, depending on its function in the circuit. See Section IV for details of device operation.

RETRIGGERABLE MONOSTABLE MULITVIBRATOR



NOTE Pin 7 is ground, pin 14 is V_{cc}.

Figure 7-1. IC Data and Connections.

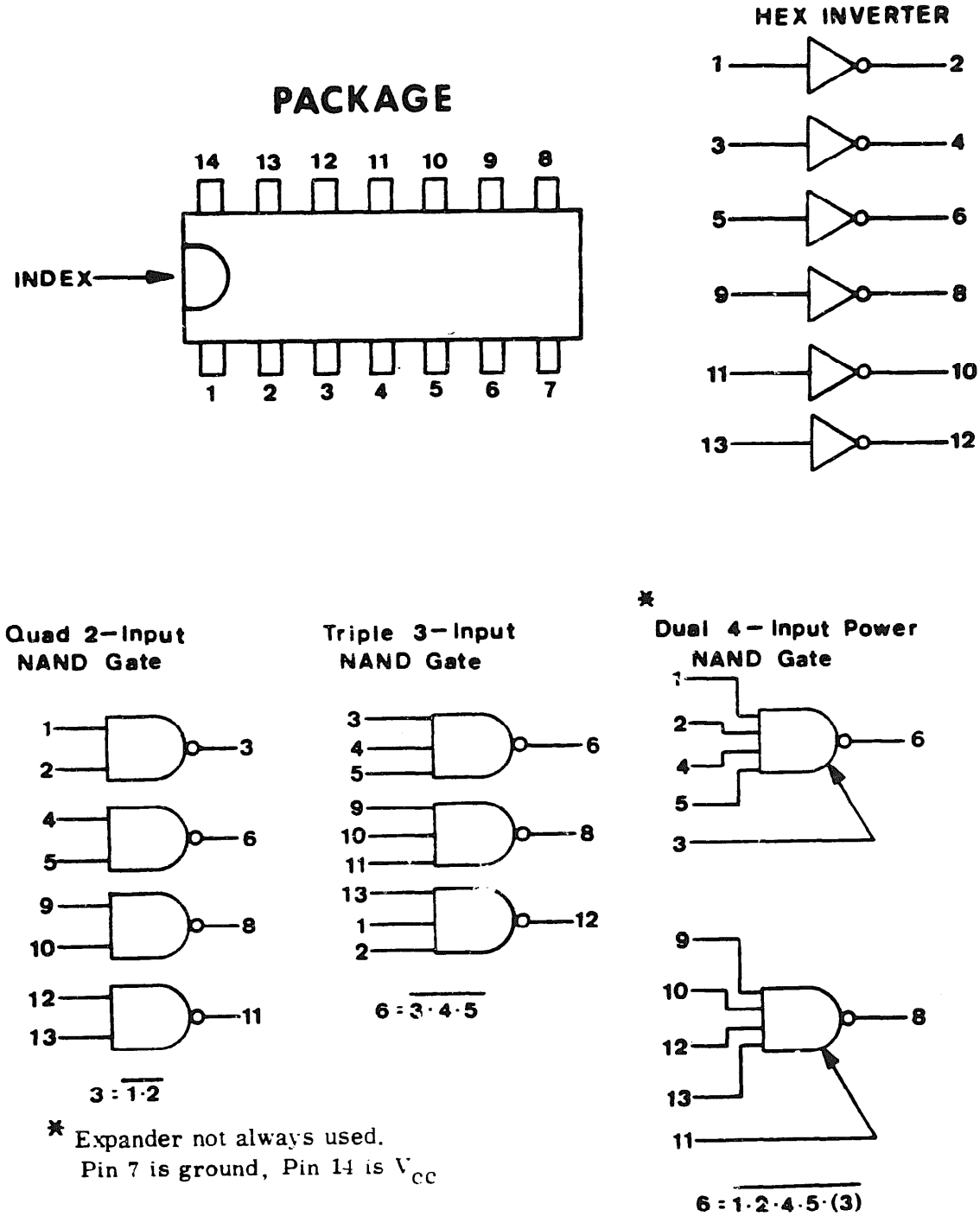
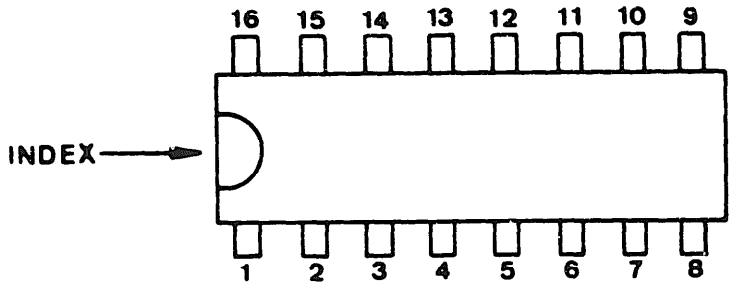
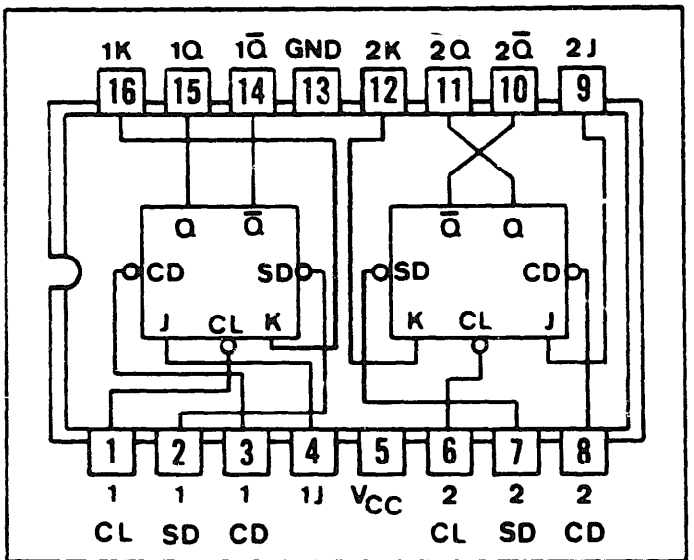


Figure 7-1. IC Data and Connections (cont)

PACKAGE





positive logic: Low input to preset sets Q to logical 1

Low input to clear sets Q to logical 0

Clear and preset are independent from clock

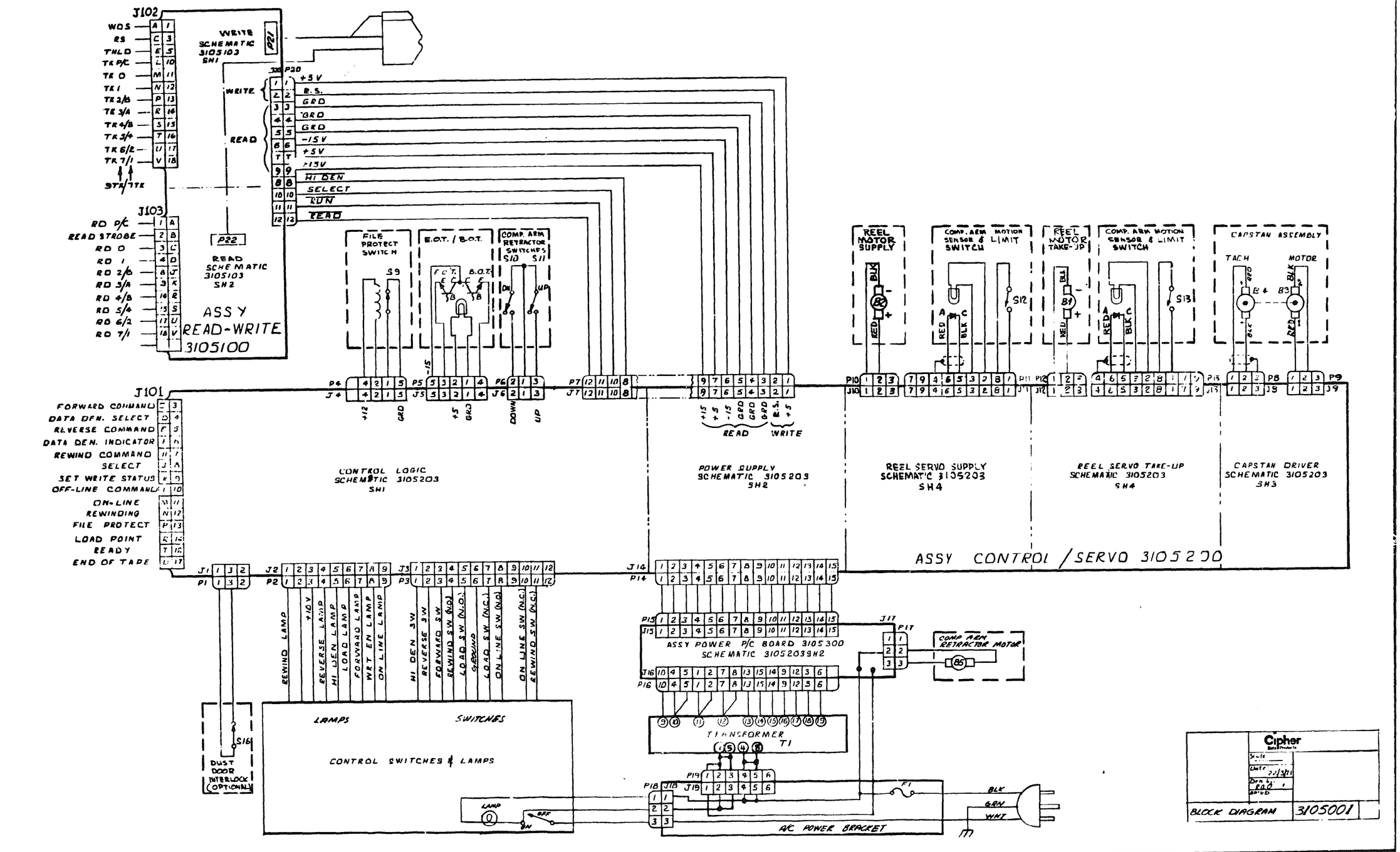
Truth Table (Each Flip–Flop		
t_n		t_n+1
J	K	Q
0	0	Q_n
0	1	0
1	0	1
1	1	$\bar{Q}_n$

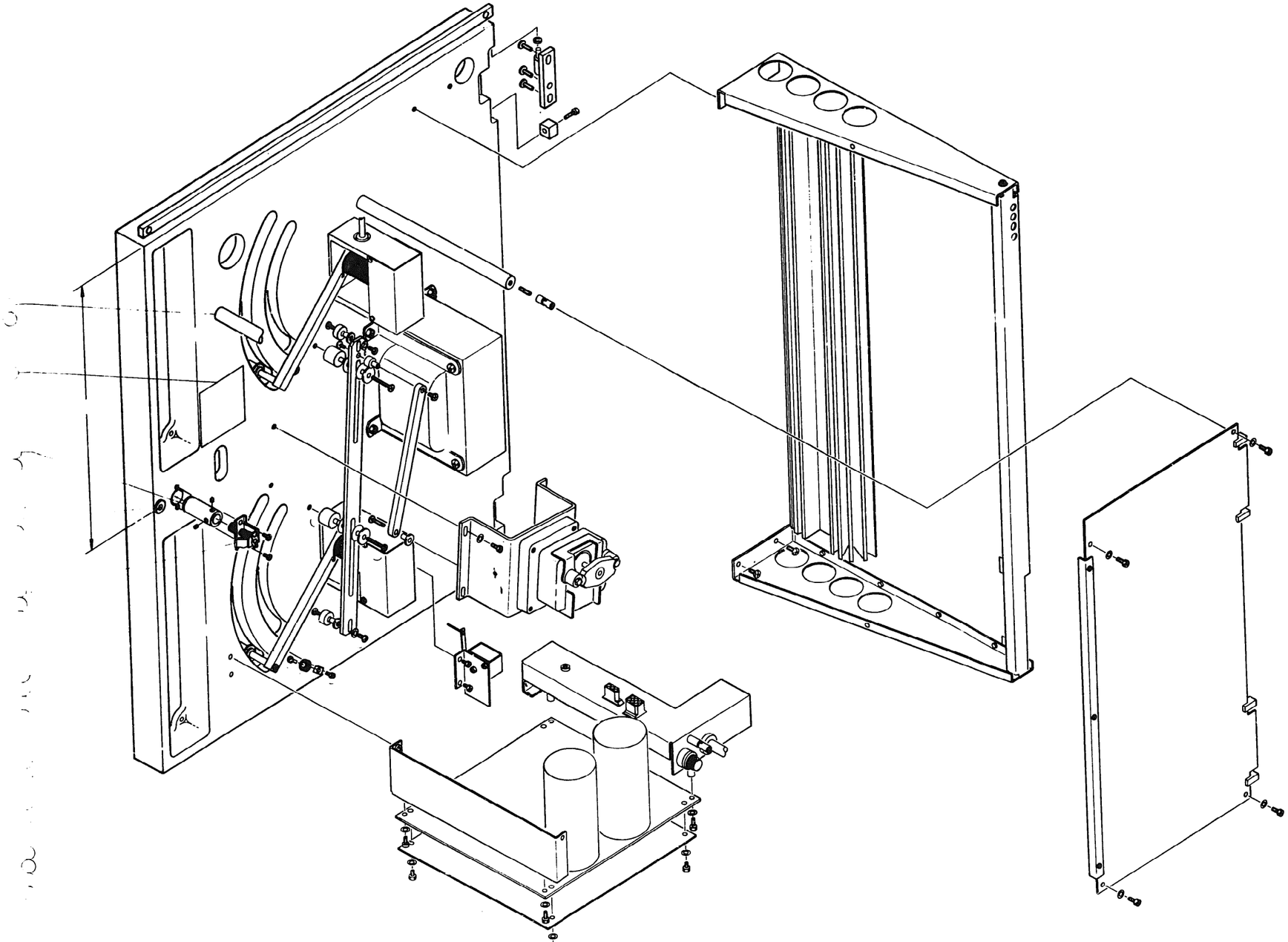
NOTES:

t_n = Bit time before clock pulse.

t_n+1 = Bit time after clock pulse.

Figure 7-1. IC Data and Connections (cont.)


J102
WDS
RS
TH LD
TR P/C
TR 0
TR 1
TR 2/5
TR 3/A
TR 4/8
TR 5/4
TR 6/2
TR 7/1
STR/TTR
WRITE SCHEMATIC 3105103 SH1
P21
P20
WRITE
READ
+5V
R.S.
GRD
GRD
GRD
-15V
+5V
+15V
HI DEN
SELECT
RUN
TEAD
J103
RD P/C
READ STROBE
RD 0
RD 1
RD 2/6
RD 3/A
RD 4/8
RD 5/4
RD 6/2
RD 7/1
P22
READ SCHEMATIC 3105103 SH2
ASS'Y READ-WRITE 3105100
FILE PROTECT SWITCH
S9
E.O.T. / B.O.T.
COMP. ARM RETRACTOR SWITCHES
S10
S11
UP
DN
REEL MOTOR SUPPLY
BLK
RED
B2
COMP. ARM MOTION SENSOR & SWITCH
LIMIT
S12
REEL MOTOR TAKE-UP
B1
S13
CAPSTAN ASSEMBLY
TACH
MOTOR
B4
B3
GRD
BLK
RED
J101
FORWARD COMMAND
DATA DEN. SELECT
REVERSE COMMAND
DATA DEN. INDICATOR
REWIND COMMAND
SELECT
SET WRITE STATUS
OFF-LINE COMMAND
ON-LINE
REWINDING
FILE PROTECT
LOAD POINT
READY
END OF TAPE
+12
GRD
+5
GRD
DOWN
UP
+15
+5
-15
GRD
GRD
R.S.
+5
READ
WRITE
CONTROL LOGIC SCHEMATIC 3105203 SH1
POWER SUPPLY SCHEMATIC 3105203 SH2
REEL SERVO SUPPLY SCHEMATIC 3105203 SH4
REEL SERVO TAKE-UP SCHEMATIC 3105203 SH4
CAPSTAN DRIVER SCHEMATIC 3105203 SH3
ASSY CONTROL / SERVO 3105200
REWIND LAMP
+10V
REVERSE LAMP
HI DEN LAMP
LOAD LAMP
FORWARD LAMP
WRT EN LAMP
ON LINE LAMP
HI DEN SW
REVERSE SW
FORWARD SW
REWIND SW (N.O.)
LOAD SW (N.O.)
GROUND
LOAD SW (N.C.)
ON LINE SW (N.O.)
ON LINE SW (N.C.)
REWIND SW (N.C.)
ASSY POWER P/C BOARD 3105300 SCHEMATIC 3105203SH2
COMP ARM RETRACTOR MOTOR
B5
TRANSFORMER T1
S16
DUST DOOR INTERLOCK (OPTIONAL)
LAMPS
SWITCHES
CONTROL SWITCHES & LAMPS
LAMP
OFF
ON
F1
BLK
GRN
WHT
A/C POWER BRACKET
Cipher
BLOCK DIAGRAM
3105001



PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3100001	Label		Cipher
3100010	Rack Mounting Hardware Package		Cipher
3100017	Threading Guide		Cipher
3100021	Top Plate (M/F 3100022 Casting)		Cipher
3100024	Extender, Top Plate Latch		Cipher
3100025	Facade		Cipher
3100026	Head Cover		Cipher
3100027	Cover		Cipher
3100029	Collar, Capstan		Cipher
3100031	Dust Door Frame, End		Cipher
3100032	Dust Door Frame, Latch Side		Cipher
3100033	Dust Door Frame, Hinge Side		Cipher
3100034	Dust Door Glass		Cipher
3100035	Spacer Plate, Latch		Cipher
3100036	Catch Pin, Dust Door		Cipher
3100037	Latch Modification		Cipher
3100040	Compliance Arm Assembly		Cipher
3100059	Cap, Capstan Sleeve		Cipher
3100060	File Protect Switch Assembly		Cipher
3100063	Guide Screw		Cipher
3100070-1	Head Assembly, 7 Tk Dual Gap		Cipher
3100070-2	Head Assembly, 9 Tk Dual Gap		Cipher
1300080-2	Head Assembly, 7 Tk Single Gap		Cipher
1800080-2	Head Assembly, 9 Tk Single Gap		Cipher

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3100079	Rolier Pin, Arm Retractor		Cipher
3100080	Arm Retractor Motor Assembly		Cipher
3100083	Connecting Rod, Arm Retractor		
3100084	Crank Pin, Arm Retractor		
3100085	Push Bar, Arm Retractor		
3100087	Standoff, Arm Retractor		
3100088	Push Pin, Arm Retractor		
3100091	Panel, Control Switches		
3100100	Reel Hub Assembly		
3100111	Shipping Frame - Steel		
3100140	Reel Motor Assembly		
3100150-1	Capstan Motor Assembly		
3105007	Name Plate		
318141	Power Bracket Assembly		
3105012	Bracket		
3100050	Switch Panel Assembly		
3105050	Cable Assembly - Pwr. Bd. to Cont/Servo		
3105060	Cable Assembly - R/W to Cont/Servo		
310570	Transformer Assembly		
3105100-1	Read/Write Assembly, 7 track		
3105100-2	Read/Write Assembly, 9 Track		
3105107-1	Standoff		
3105107-2	Standoff		
3105200-1	Control/Servo Assembly		
3105300-1	Power Supply Assembly		
3105304-1	Insulator - Power Supply		
3105400-1	Adapter Board Assembly		
3106200-1	EOT/BOT Assembly		

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
1000083-1	Washer, Single Edge Guide		
1000121-1	Base, Single Edge Guide		
1000122-1	Cap, Single Edge Guide		
1100102-1	Handle, Dust Door		
1300030	Reflector Assembly		
2600101-1C	Capstan Sleeve		
2400050-1	Tape Scraper Assembly		
1600170-1	Roller Tape Guide		
43-1-1-0	Latch		Southco
612	Bracket		Keystone
2192	Rubber Foot		H.H. Smith
2264-T-194	Washer, Teflon		Amatom
5702-58-48	Washer, Steel		Seastrom
9255-N-194	Spacer, Nylon		Amatom
353	Standoff, Hinge (6-32 X 3/4)		Keystone
1/8 thk x 1/2 dia.	Washer, Faucet (Black)		
1" x 1"	Hinge		
9257-A-194	Spacer, Alum		Amatom
C. 019	Spring		Lee Spring
9263-A-194	Spacer, Alum		Amatom
8228-A-0440	Standoff		Amatom
564B-03XA	Foam, Urethane, Adhesive Backed		Behr-Manning
4-40 X 1/4	Screw, Pan Hd. Phillips		
4-40 X 3/16	Screw, Pan Hd. Phillips		
4-40 X 3/8	Screw, Pan Hd. Phillips		
4-40 X 1/4	Screw, Soc. Hd. Cap.		
4-40 X 3/8	Screw, Soc. Hd. Cap.		
4-40 X 5/8	Screw, Soc. Hd. Cap.		
4-40 X 1-1/4	Screw, Soc. Hd. Flat 100° Black		
6-32 X 1/4	Screw, Pan Hd. Phillips		

ASSY NO. 31000000 - Continued TOP ASSEMBLY, MODEL 100X

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
6-32 X 3/8	Screw, Pan Hd. Phillips		
6-32 X 1/2	Screw, Pan Hd. Phillips		
6-32 X 5/8	Screw, Pan Hd. Phillips		
6-32 X 1	Screw, Pan Hd. Phillips		
6-32 X 1/4	Screw, Soc. Hd. Cap.		
6-32 X 3/8	Screw, Soc. Hd. Cap.		
6-32 X 5/8	Screw, Soc. Hd. Cap.		
6-32 X 1	Screw, Soc. Hd. Flat 82° Black		
6-32 X 1/2	Screw, Soc. Set		
10-32 X 1/2	Screw, Soc. Hd. Cap.		
10-32 X 1-14	Screw, Soc. Hd. Cap.		
# 4	Washer, Flat		
# 6	Washer, Flat		
# 10	Washer, Flat		

ASSY NO. 3100010 RACK MOUNTING HARDWARE PACKAGE

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3100019	Filler Strip		Cipher
3100023	Safety Block		Cipher
3100130	Assembly, Hinge Block		Cipher
2319-N-194	Spacer, Nylon		Amatom

ASSY NO. 3100130 ASSEMBLY, HINGE BLOCK

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3100028	Hinge Block		Cipher
3/16" dia. X 1" long	Dowel Pin		
	Retaining Compound		Loctite Corp.

ASSY NO. 3100140 **REEL MOTOR ASSEMBLY**

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
4030-P21	Motor		Indiana Gen.
1396R-1	Connector, Block		Molex
1381-TL	Pin Terminal		Molex
	Ty-Rap		T & B

ASSY NO. 3100100 **REEL HUB ASSEMBLY**

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3100101	Base, Reel Hub (M/F 3100106 casting)		Cipher
3100102	Cap, Reel Hub (M/F 3100105 casting)		Cipher
3100103	Lock, Reel Hub (M/F 3100104 casting)		Cipher
3100107	Shim, Reel Hub		Cipher
1000104	Compression Ring		
5710-116-32	Washer, Steel		Seastrom
5710-116-90	Washer, Steel		Seastrom
3/16 X 1/2	Dowel Pin		
GP2-093 X 375-12	Groove Pin		G.P. Corp.
6-32 X 1/4	Set Screw, Socket Hd.		
P10-010	Lubriplate Procedure		Cipher

ASSY NO. 3100150 **CAPSTAN MOTOR ASSEMBLY**

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
2400072	Motor		Cipher
1396R-1	Connector	P8, P9	Molex

ASSY NO. 3100150 - Continued

CAPSTAN MOTOR ASSEMBLY

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
1381-TL	Pin Terminal Ty-Rap Shrink Tubing Flat Black Paint		T & B

ASSY NO. 3100040-1, 2

COMPLIANCE ARM ASSEMBLY
-1 SUPPLY, -2 TAKE-UP

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3100041	Bracket (M/F 3100039 Casting)		
3100042	Compliance Arm		
3100043	Shaft		
3100044	Spring Arbor		
3100045	Spring Adjustor		
3100047	Solar Cell Mount		
3100048	Cover Compliance Arm		
3100049	Sensor Mount		
3100051	Shutter, Disc		
3100052	Mount Disc		
3100053	Torsion Spring		
715	Lamp		
BE-XXX-CBP	Housing, Lamp		Shelly
E62-36-HB	Switch		Cherry
51CLVC	Solar Cell		
SFR1683PPEE	Ball Bearing 1/4 X 3/8		
07-1560-47-6	Terminal, Teflon Pressfit		Sealectro
2143	Grommet		H.H. Smith
1381-TL	Pin Terminal		Molex
1292R-2	Connector Block		Molex
2-56 X 1/2	Screw, Fl. Hd. Ph. 100°		
#2	Hex Nut		
#2	Lockwasher, Internal Tooth		

ASSY NO. 3100040-1, 2 - Continued — **COMPLIANCE ARM ASSEMBLY -1 SUPPLY, -2 TAKE-UP**

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
4-40 X 3/16	Screw, Pan Hd. Ph.		
4-40 X 3/16	Screw, Soc Set, Cup Point		Premier
4-40 X 1/4	Screw, Soc Hd. Cap.		
4-40 X 1/4	Screw, Bind Hd. Slotted		
4-40 X 3/4	Screw, Slotted Set, Nylon		
B8-1 Thru 4	Shim		PIC
	Ty-Rap		T & B
	Contact Cement		
1/16 dia.	Shrink Sleeving, Black		
22 GA	Wire		
EXE-28-736	Wire, 2 lead shielded		Thermax
(2) STJ	Lubriplate		
P10-004	Procedure		Cipher

ASSY NO. 3100080 — **COMPLIANCE ARM RETRACTOR ASSEMBLY**

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3100081	Bracket		
3100082	Crank		
3100086	Cam Disc		
	Motor, 18 RPM Dayton		W.W.
	Gear Motor		Grainger
E62-36-HB	Switch, Spst. N.C. 2-1/4" arm		Cherry
.093 dia. X	Roll Pin		
1/2 long			
2-56 X 1/2	Screw, flat hd. Phillips, 100°		
# 2	Nut		
# 2	Lockwasher, internal tooth		

COMPLIANCE ARM RETRACTOR ASSEMBLY

ASSY NO. 3100080 - Continued

PART NO,	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
4-40 X 3/16	Screw, socket set, cup point		Premier
10-32 X 3/8	Screw, bind head, slotted		
1381-TL	Pin Terminal		Molex
1396R-1	Connector block	P6, 17	Molex
22GA	Wire		
3/32 dia.	Shrink tubing		T & B
	Ty-Rap		
	Loctite		
P10-008	Procedure		
	Lubriplate		

ASSY NO. 3105010 ASSEMBLY, POWER BRACKET

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3105011-1	Bracket		Cipher
1396R	Connector, Receptacle	J18	Molex
1261R	Connector, Receptacle	J19	Molex
1381TL	Terminal, Pin .093 dia Female		Molex
342012	Fuse Holder		Little Fuse
17405-S	Power Cord		Beldon
SR-6P3-4	Strain Relief		Heyco
6-32 X 1-2	Screw, Soc. Hd. Cap-Cad		
6-32 X 1/4	Screw, Soc. Hd. Cap-Cad		
353	Standoff, Hinged (3/4" long)		Keystone
R4158	Terminal		Hollingsworth
4470	Terminal Kwik Disconnect		Keystone
4474	Boot, Plastic (yel)		Keystone
MDA-980-1	Diode	CR2	Motorola

ASSY NO. 3105010 - Continued ASSEMBLY, POWER BRACKET

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
20 GA	Wire, Stranded, Wht.		
20 GA	Wire, Stranded, Blk.		

ASSY NO. 3100060 FILE PROTECT SWITCH ASSEMBLY

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3100061	Bracket		Cipher
3100062	Pin		Cipher
3100064	Actuator Mod		Cipher
3100065	Solenoid Mod		Cipher
VS-119	Switch		Micro Switch
397	Spacer		Keystone
5555-G9	Grip Ring		Waldes Truarc
C109	Spring		Lee
4-40 X 3/16	Screw Soc. Hd. Cap		
4-40 X 3/4	Screw Soc. Hd. Cap		
4-40 X 3/8	Screw, Pan Hd. Phil		
4-40	Nut, Hex		Molex
1653R-1	Connector Block		Molex
1381-TL	Pin Terminal		
22GA	Wire		
1/8 Dia.	Shrink Tubing, Black		
P10-009	Procedure		Cipher

ASSY NO. 3100050 ASSEMBLY, SWITCH PANEL

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3100091	Panel, Control Switches		Cipher
01--56-4000	Switch, 1822, SPDT PP STP (POWER)		Molex
01-54-4000	Switch, 1825, SPDT MOM STP, (LOAD)		Molex
01-54-4000	Switch, 1825, SPDT MOM STP (ON LINE)		Molex
01-54-4000	Switch, 1825, SPDT MOM STP (REWIND)		Molex
01-54-4000	Switch, 1825, SPDT MOM STP (WRT EN)		Molex
01-51-4000-	Switch, 1822, SPDT PP STP (HI DEN)		Molex
01-51-4000	Switch, 1822, SPDT PP STP (FORWARD)		Molex
01-51-4000	Switch, 1822, SPDT PP STP (REVERSE)		Molex
3105020	Cable Assembly, Switches		
3105030	Cable Assembly, Switch Lamps		
3105040	Cable Assembly, Power Switch		

ASSY NO. 3105040 CABLE ASSEMBLY, POWER SWITCH

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
1396P-1	Connector, Plug (3 pin)	P 18	Molex
1380TL	Terminal, Pin .093 dia male		Molex
S08152	Terminal, Crimp .187		Hollings-worth
18AWG	Wire, Stranded PVC Jacket Blk		

ASSY NO. 3105040 CABLE ASSEMBLY, POWER SWITCH

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
18AWG	Wire, Stranded PVC Jacket Wht		
	Marker, E-Z Code (No.'s 31-33)		Westline

ASSY NO. 3105020 CABLE ASSEMBLY, SWITCHES

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
1360R-1	Connector, Receptacle (12 pin)	P3	Molex
1381TL	Terminal, Pin .093 dia. Female		Molex
508152	Terminal, Crimp .187		Hollings-worth
	Marker, E-Z Code		Westline
22AWG	Wire, Stranded PVC Jacket, Wht.		

ASSY NO. 3105030 CABLE ASSEMBLY, SWITCH LAMPS

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
1291R2	Connector, Receptacle (9 pin)	P2	Molex
1381T2	Terminal, Pin .093 Dia. Female		Molex
S08152	Terminal, Crimp .187		Hollings-worth
22AWG	Wire, Stranded, PVC Jacket, Wht.		
	Marker, E-Z Code (No.'s 21-29)		Westline

ASSY NO. 3100070-1, -2

ASSEMBLY, HEAD
-1 (7 Tk), -2 (9 Tk)

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3100071	Head Mount		Cipher
3100072	Post, Head Shield		Cipher
3100073	Hinge Plate, Head Shield		Cipher
3100075	Spring, Head Shield		Cipher
1000062	Shim, Head		Cipher
1300036	Screw Mod, Azimuth Adj.		Cipher
9900012	Dual Gap Head, 7 Tk		Magnusonics
9900013	Dual Gap Head, 9 Tk		Magnusonics
Supplied with head	Ferrite & Copper Blocks		Magnusonics
2-56 x 1/2	Screw, Cap. Hd., Hex Soc.		
4-40 x 1/4	Screw, Fl Hd. Phil. 100°		
4-40 x 3/8	Screw, Fl Hd. Phil. 100°		
4-40 x 3/16	Screw, Pan Hd. Phil.		
4-40 x 3/16	Screw, Soc. Set		
GP-062-375-12	Groove Pin, 1/16 dia. x 3/8		G.P. Corp.
	Contact Cement		
	Loc Tite		

ASSY NO. 3015400

ASSY, ADAPTOR, SINGLE GAP, 9 TK

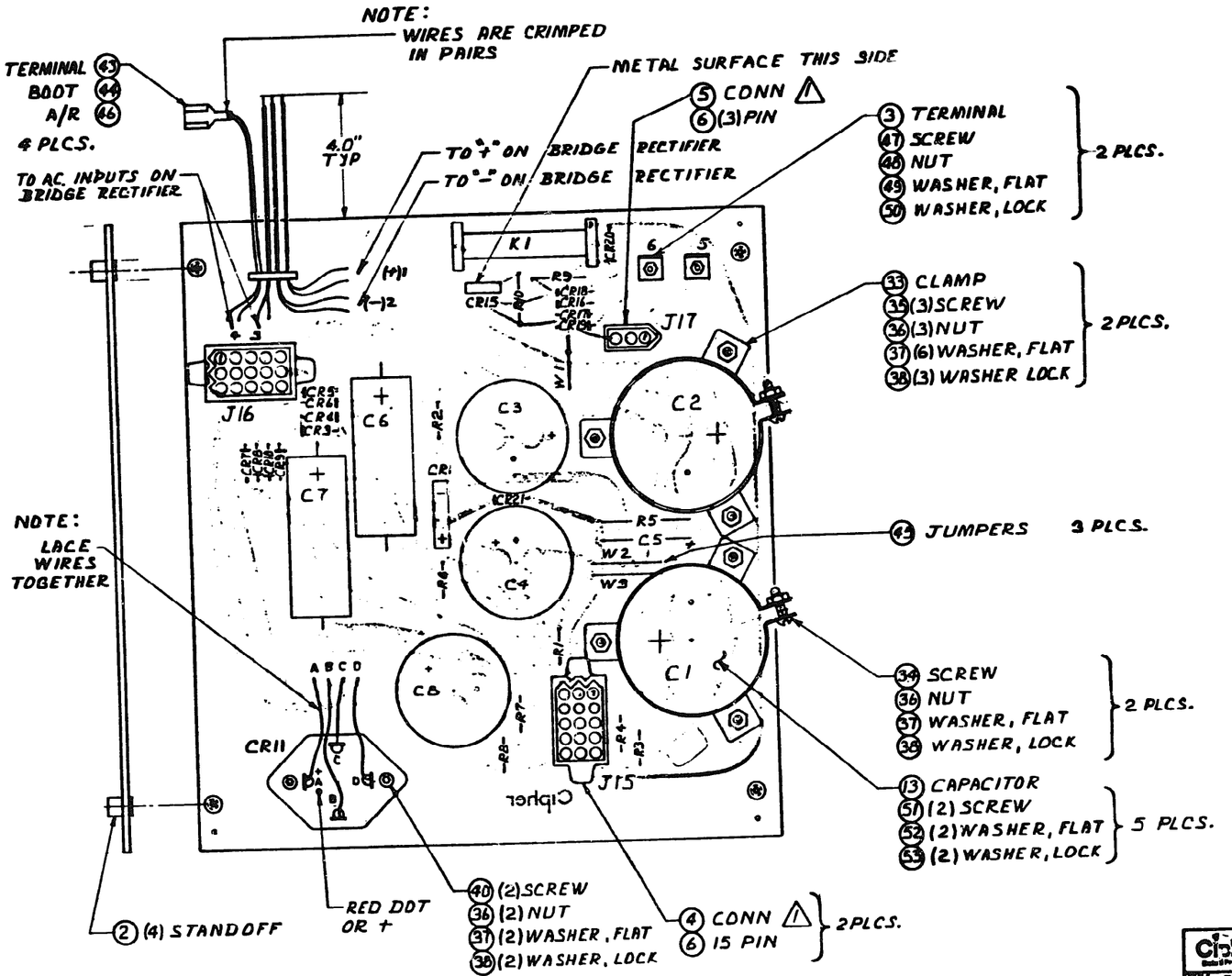
PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3105401-X2	P/C Board		Cipher
SRE-29-SD4JT	Connecter		AMPhenol
85931-5	Post, Mod 2		AMP
RCRO7	Resistor, 110 ohms, 1/4w, 5%	R1	
8215-A-0632	Standoff, Hex		Amatom

ASSY NO. 3105070 **ASSEMBLY, TRANSFORMER (115V)**

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3105071	Transformer	T1	Cipher
1375R	Connector, Receptacle	P16	Molex
1261P	Connector, Plug	P19	Molex
1381TL	Terminal, Pins .093 dia. Female	P16	Molex
1380TL	Terminal, Pins .093 dia. Male	P19	Molex

ASSY NO. 3106200 **EOT/BOT ASSEMBLY**

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3106201	P/C Board		Cipher
3100121	Light Shield		Cipher
L14E4	Transistor, Photo		
BEC-XXX-CBP	Housing Lamp		
715	Lamp		Keystone
612	Clip		
	Ty-Rap		T & B
4-40 X 1/4	Screw, pan hd. Phil.		
# 4	Washer, Split Lock		
22GA	Wire		
1/16 dia.	Shrink Tubing		
1/4 dia.	Shrink Tubing		
1381-TL	Contact, Crimp		Molex
1653R-1	Connector Block		Molex
P10-001	Procedure, EOT/BOT Assembly		



⚠1 CONNECTOR ITEMS 4 & 5 MUST BE INSTALLED FLUSH (.010 MAX GAP) TO P/C BOARD

NOTES:

Cipher Data Products			
SCALE FULL			
DATE 5/20/71			
DRAWN RAO			
TITLE ASSY- POWER SUPPLY		DWG. NO. 3105300	X2

ASSY NO. 3105300 ASSEMBLY, POWER SUPPLY

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3105301-1	P/C Board, Power Supply		Cipher
1546B	Standoff, Threaded		Keystone
1256	Terminal (Kwik Disconnect)		Keystone
1375P	Connector, Receptacle, (15 pin)	J15, 16	Molex
1396P-1	Connector, Receptacle, (3 pin)	J17	Molex
1376TL	Pins, Terminal Male .093 dia.		Molex
30D5505G050 BB2	Capacitor, Elect. 5 MFD 50V	C5	Sprague
39D108G025 G64	Capacitor, Elect. 1000 MFD 25V	C6, C7	Sprague
91C40HA33	Capacitor, Elect. 3000 MFD 40V	C3, 4	STM
91C15HA822	Capacitor, Elect. 8200 MFD 15V	C8	STM
91C25JC273	Capacitor, Elect. 27,000 MFD 25V	C1, 2	STM
IN4001	Diode	CR3-10, 20, 21	
IN4004	Diode	CR16-19	
MDA952-1	Rectifier, Bridge	CR11	Motorola
MDA970-2	Rectifier, Bridge	CR1	Motorola
MCR407-4	Transistor, SCR	CR15	
JRA1012	Relay	K1	Potter & Brumfield
RCR20	Resistor, Fix Comp., 82 ohms, 1/2w, 5%	R10	
RCR20	Resistor, Fix Comp., 1.8K, 1/2w, 5%	R1, 2,3,4,8,9	
RCR20	Resistor, Fix Comp., 10K, 1/2w, 5%	R6, 7	
RCR07	Resistor, Fix Comp., 12K, 1/4w, 5%	R5	

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
FJMR	Clamp, Capacitor		STM
G-32 X 1/2	Screw, Pan Hd., Phil-Cad		
6-32 X 3/8	Screw, Pan Hd., Phil-Cad		
#6-32	Nut, Radio-Cad		
# 6	Washer, Flat-Cad		
# 6	Washer, Split Lock Cad		
6-32 X 3/4	Screw, Soc. Hd., Cap-Cad		
4470	Terminal, Quick Disconnect		
4474	Boot, Plastic (Yel)		
20GA	Wire, Solid Buss	W1, W2, W3	
18GA	Wire, Stranded, Wht.		
4-40 X 3/8	Screw, Pan Hd., Phil-Cad		
#4	Nut, Radio-Cad		
#4	Washer, Flat-Cad		
#4	Washer, Split Lock-Cad		
10-32 X 3/8	Screw, Pan Hd., Phil-Cad		
#10	Flat Washer		
#10	Split Lock Washer		

POWER SUPPLY ASSY 3105300

PART OF CONTROL/SERVO ASSY 3105200

INPUT VOLTAGE	INPUT LINE	ON XMFR CONNECT
105	3 & 4	4-8 & 3-7
115	2 & 4	4-8 & 2-6
125	1 & 4	4-8 & 1-5
210	3 & 5	4-7
220	2 & 5	4-7
230	2 & 5	4-6
240	1 & 5	4-6
250	1 & 5	4-5

3. CIRCLED LETTERS (A)(K)(L) ARE COMMON TO LIKE LETTERS ON SH 1
2. ALL DIODES ARE IN914.
1. ALL RESISTORS ARE IN OHMS 1/4W, 5%

NOTE: UNLESS OTHERWISE SPECIFIED

Cipher

SCHEMATIC - POWER SUPPLY

3105203 SH2

A	REVISED P/L & ASSY PER ECR 44, 47, 46	10-71

(4) BRACKET
(187) (5) SCREW
(74) (5) FLAT WASHER
(191) (5) LOCK WASHER

(126) RELAY
(127) SOCKET
(128) CLIP

(5) STRUT
(187) (6) SCREW
(74) (4) FLAT WASHER
(191) (5) LOCK WASHER

(1) P/C BOARD

(6) RETAINER
(188) SCREW
(191) LOCK WASHER
(192) NUT
2 PLCS

BRACKET (3)
SCREW (4) (187)
FLAT WASHER (4) (74)
LOCK WASHER (4) (191)

INSTALL ALL CONNECTORS AS SHOWN

(136) DIODE
(198) (AR) WIRE
(199) (AR) SLEEVING

BUSHING
INSULATOR
TRANSISTOR
SCREW

TYP TRANSISTOR INSTALLATION

FLAT WASHER
LOCK WASHER
NUT

(2) (189) SCREW
(190) FLAT WASHER
(191) LOCK WASHER
(192) NUT

(2) HEATSINK

(185) HEATSINK
11 PLCS

(1) (151) TRANSISTOR
(181) INSULATOR
(182) (2) BUSHING
(3) (183) (AR) COMPOUND
(194) (2) SCREW
(195) (2) NUT
(196) (2) FLAT WASHER
(197) (2) LOCK WASHER
4 PLCS

(147) TRANSISTOR
(181) INSULATOR
(182) (2) BUSHING
(3) (183) (AR) COMPOUND
(194) (2) SCREW
(195) (2) NUT
(196) (2) FLAT WASHER
(197) (2) LOCK WASHER
2 PLCS

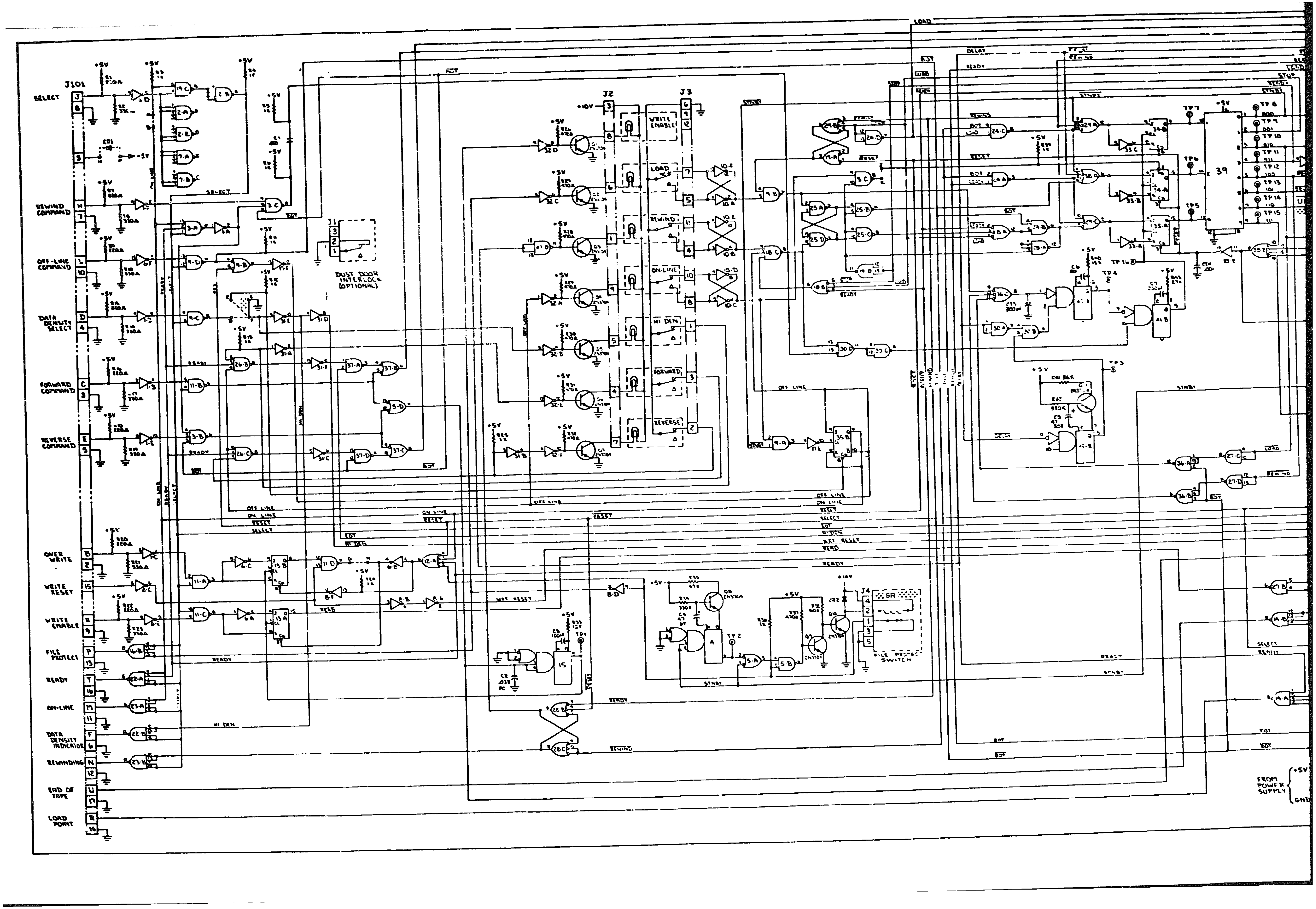
(148) TRANSISTOR
(181) INSULATOR
(182) (2) BUSHING
(3) (183) (AR) COMPOUND
(194) (2) SCREW
(195) (2) NUT
(196) (2) FLAT WASHER
(197) (2) LOCK WASH
5 PLCS

(3) USE MIN AMOUNT OF ITEM 183, COMPOUND, ON TRANSISTOR AND INSULATOR WHEN INSTALLING ON HEATSINK.
(2) MOUNT HEATSINK TO PCB WITH ITEM 189 SCREWS, BEING CAREFUL TO ALIGN HOLES IN HEATSINK WITH HOLES IN PCB.
(1) AFTER CHECKOUT OF +5 AND ±15 REGULATORS ADD THESE JUMPERS

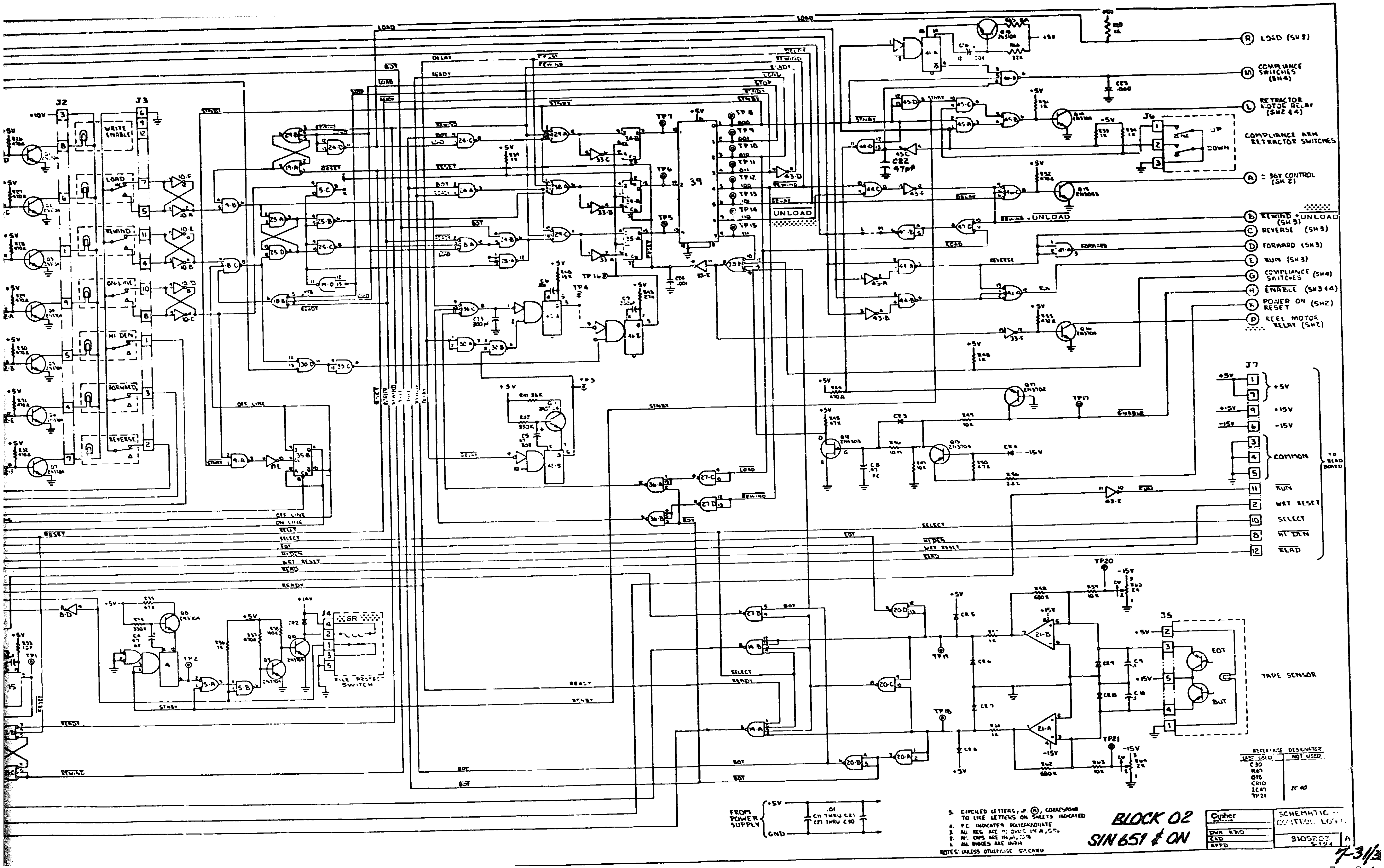
NOTES: UNLESS OTHERWISE SPECIFIED

SIN 651 & ON

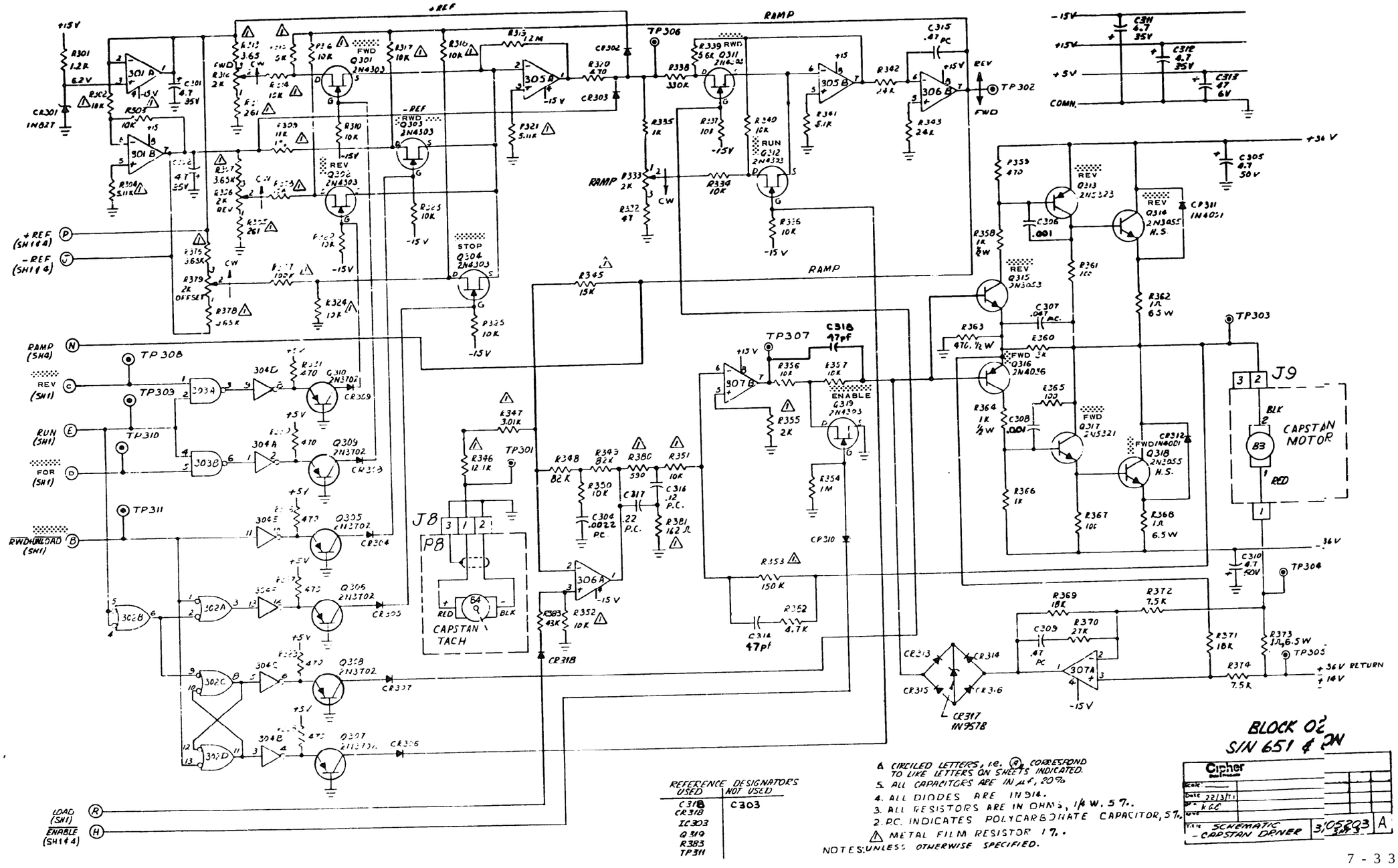
DR BY		
DATE 10-25-71		
CO	ASSY - CONTROL/SERVO	
ENG		
MFG FULL	3105200	A



J101
SELECT
REWIND COMMAND
OFF-LINE COMMAND
DATA DENSITY SELECT
FORWARD COMMAND
REVERSE COMMAND
OVER WRITE
WRITE RESET
WRITE ENABLE
FILE PROTECT
READY
ON-LINE
DATA DENSITY INDICATOR
REWINDING
END OF TAPE
LOAD POINT
J2
J3
J4
WRITE ENABLE
LOAD
REWIND
ON-LINE
HI DEN
FORWARD
REVERSE
DUST DOOR INTERLOCK (OPTIONAL)
FILE PROTECT SWITCH
SR
39
FROM POWER SUPPLY
+5V
GND

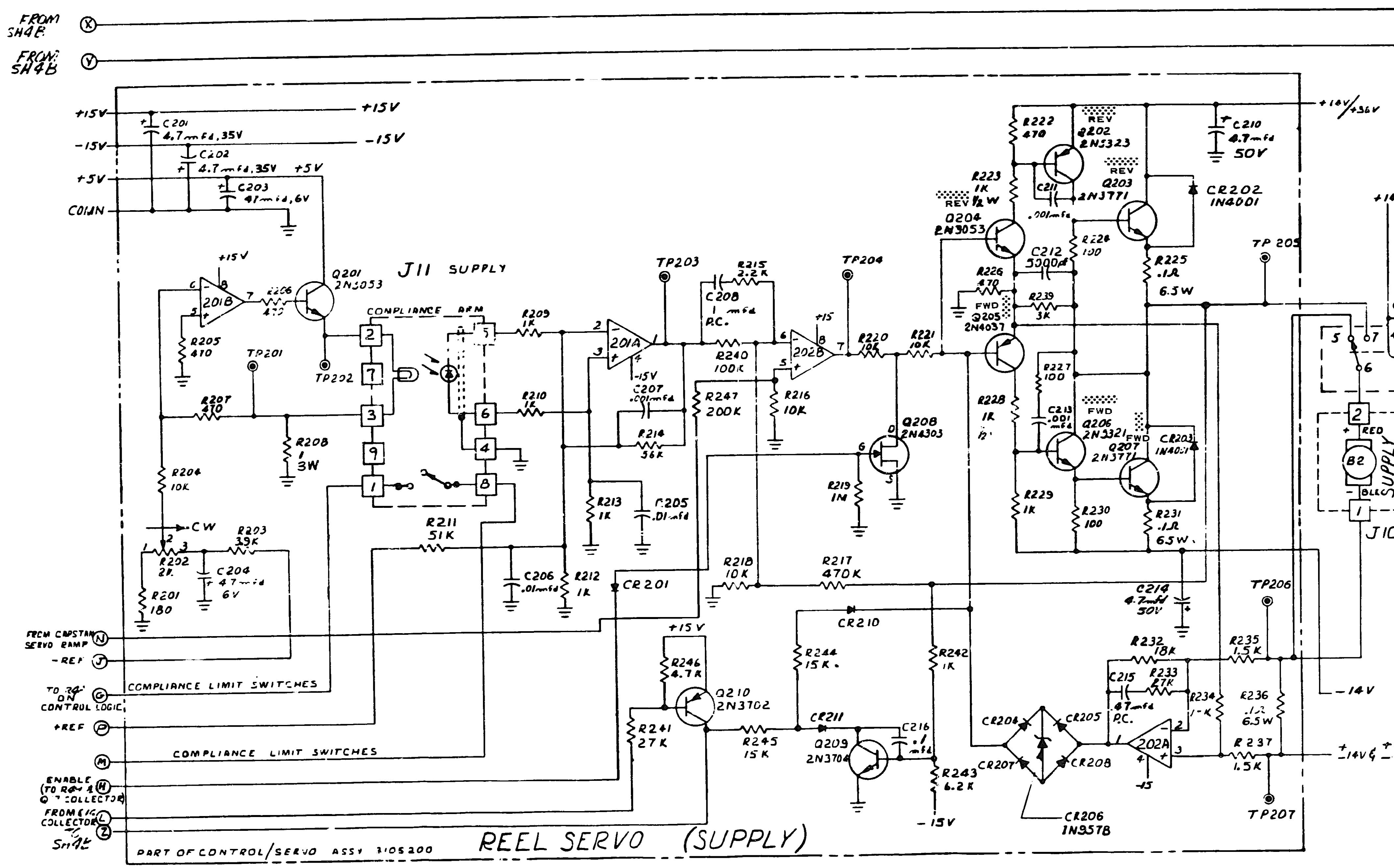


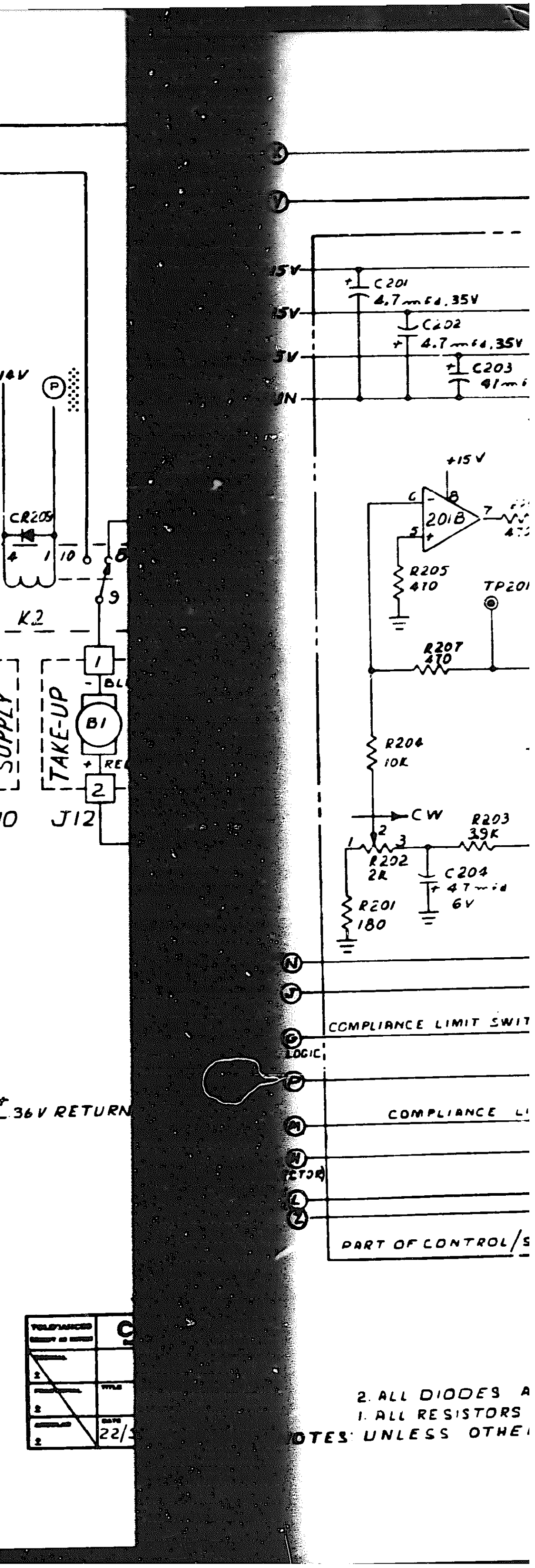
LOAD (SH 3)
COMPLIANCE SWITCHES (SH4)
RETRACTOR MOTOR RELAY (SHE 3 4)
COMPLIANCE ARM RETRACTOR SWITCHES
UP
DOWN
± 36V CONTROL (SH 2)
REWIND + UNLOAD (SH 3)
REVERSE (SH 3)
FORWARD (SH 3)
RUN (SH 3)
COMPLIANCE SWITCHES (SH4)
ENABLE (SH3 4 4)
POWER ON RESET (SH2)
REEL MOTOR RELAY (SH2)
UNLOAD
J2
J3
J4
J5
J6
J7
WRITE ENABLE
LOAD
REWIND
ON-LINE
HI DEN
FORWARD
REVERSE
+5V
+15V
-15V
COMMON
TO READ BOARD
RUN
WRT RESET
SELECT
HI DEN
READ
TAPE SENSOR
EOT
BOT
FILE PROTECT SWITCH
FROM POWER SUPPLY
GND
TP20
TP21
BLOCK 02
S/N 651 & ON
Cipher
SCHEMATIC



REFERENCE DESIGNATORS USED	NOT USED
C318	C303
CR318	
IC303	
Q319	
R383	
TP311	

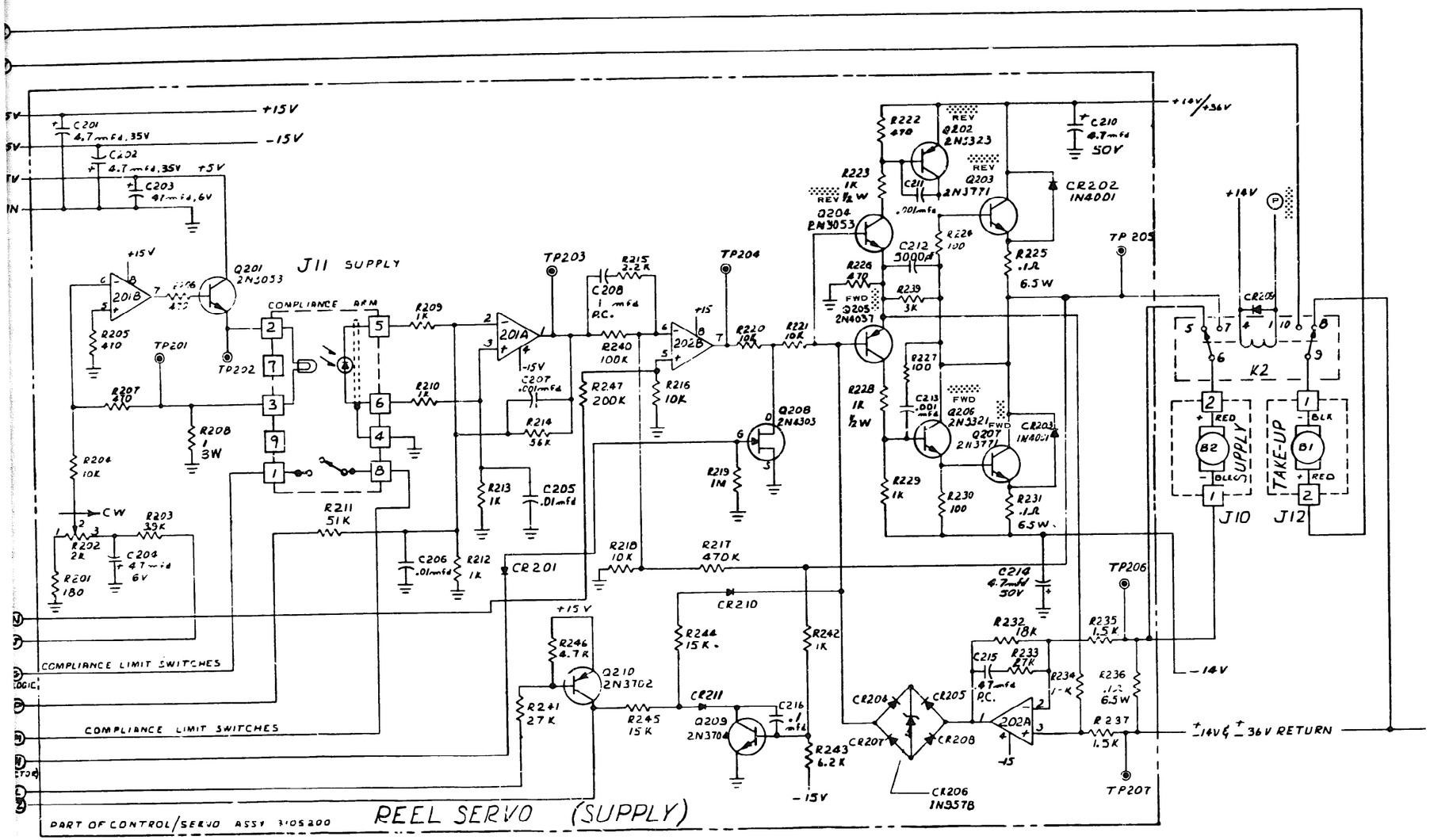
NOTES: UNLESS OTHERWISE SPECIFIED.
1. METAL FILM RESISTOR 1%.
2. P.C. INDICATES POLYCARBONATE CAPACITOR, 5%.
3. ALL RESISTORS ARE IN OHMS, 1/4 W, 5%.
4. ALL DIODES ARE IN914.
5. ALL CAPACITORS ARE IN μF, 20%
6. CIRCLED LETTERS, i.e. (P) CORRESPOND TO LIKE LETTERS ON SHEETS INDICATED.





2. ALL DIODES ARE IN 914
1. ALL RESISTORS ARE IN OHMS 1/4W, 5%
NOTES: UNLESS OTHERWISE SPECIFIED

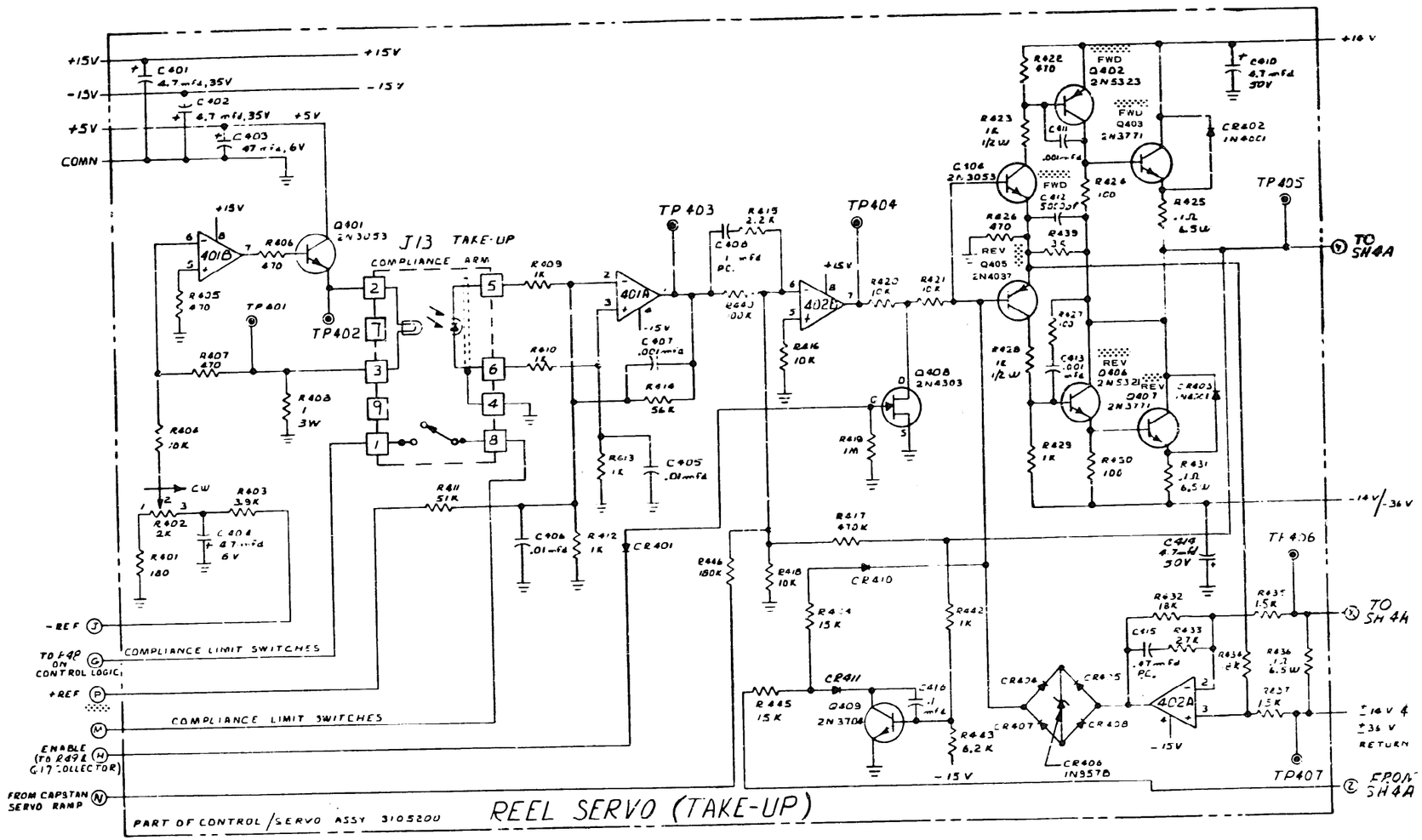
2. ALL DIODES A
1. ALL RESISTORS
NOTES: UNLESS OTHE



2. ALL DIODES ARE IN 914
1. ALL RESISTORS ARE IN OHMS 1/4W, 5%
OTES: UNLESS OTHERWISE SPECIFIED

S/N 636-UP

	Cipher		
	SCHEMATIC REEL SERVO		
	22/3/71	3105203	SH 4A



SCHEMATIC - REEL SERVO	
3105203	SH 3

ASSY NO. 31005200 CONTROL/SERVO ASSEMBLY

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3105201-1	P/C Board, Control Servo		Cipher
3105204	Heatsink		Cipher
3105212-1	Mounting Bracket		Cipher
3105212-2	Mounting Bracket		Cipher
3105213	Strut		Cipher
3105013	Retainer, P/C Connector		Cipher
60802-2	Test Point (Rolled Pin)		Amp
1292P-1	Connector Plug (9 pin)	J2, 11, 13	Molex
1360P	Connector Plug (12 pin)	J3, 7	Molex
1375P	Connector Plug (15 pin)	J14	Molex
1396P	Connector Plug (3 pin)	J1,6,8,9,10,12	Molex
1653P-1	Connector Plug (15 pin)	J4, 5	
1376TL	Pins, Terminal, Male .093 dia.		Molex
IN827	Diode	CR301	
IN914	Diode	CR2-10, 100-102, 105-107, 201,204, 205,207-211,302-310, 313-316,401,404,405, 407,408,410,411.	
IN957B	Diode	CR206,317,406	
IN4001	Diode	CR108-113,202,203, 311,312,402,403.	
RCR07	Resistor, Fixed Comp., 47 ohm 1/4w, 5%	R332	
RCR07	Resistor, Fixed Comp., 100 ohm 1/4w, 5%	R101,105,111,116, 121,224,227,230,361, 365,367,424,427,430.	
RCR07	Resistor Fixed Comp., 160 ohm 1/4w, 5%	R38	
RCR07	Resistor Fixed Comp., 180 ohm 1/4w, 5%	R201, 401	
RCR07	Resistor Fixed Comp., 220 ohm 1/4w, 5%	R1,7,9,13,16,18,20, 22.	
RCR07	Resistor Fixed Comp., 330 ohm 1/4w, 5%	R2,8,10,14,17,19,21, 23.	

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
RCR07	Resistor Fixed Comp., 470 ohm 1/4w, 5%	R26-32,37,44,52,55, 205,206,207,222,226, 320,326-331,359,405, 406,408,422,426.	
RCR07	Resistor Fixed Comp., 1K 1/4w, 5%	R3,4,5,6,11,12,15, 24,25,36,39,48,51, 53,54,57,61,109,209, 210,212,213,229,242, 335,366,409,410,412, 413,429,442.	
RCR07	Resistor Fixed Comp., 1.2K 1/4w, 5%	R301	
RCR07	Resistor Fixed Comp., 1.5K 1/4w, 5%	R108,235,237,435, 437.	
RCR07	Resistor Fixed Comp., 2.2K 1/4w, 5%	R102,106,215,415, 56.	
RCR07	Resistor Fixed Comp., 3K 1/4w, 5%	R239,360,439	
RCR07	Resistor Fixed Comp., 3.3K 1/4w, 5%	R110	
RCR07	Resistor Fixed Comp., 3.9K 1/4w, 5%	R203,403	
RCR07	Resistor Fixed Comp., 4.7K 1/4w, 5%	R50,103,107,246,350, 382.	
RCRC07	Resistor Fixed Comp., 5.1K 1/4w, 5%	R341	
RCR07	Resistor Fixed Comp., 5.6K 1/4w, 5%	R339	
RCR07	Resistor Fixed Comp., 6.2K 1/4w, 5%	R243,443	
RCR07	Resistor Fixed Comp., 7.5K 1/4w, 5%	R372,374	
RCR07	Resistor Fixed Comp., 10K 1/4w, 5%	R47,49,59,63,204, 216,218,220,221,310, 322- 35,334,336,337, 340,356,357,404,416, 418,420,421.	

ASSY NO. 31005200 - Continued CONTROL/SERVO ASSEMBLY

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
RCR07	Resistor Fixed Comp., 470 ohm 1/4w, 5%	R26-32,37,44,52,55, 205,206,207,222,226, 320,326-331,359,405, 406,408,422,426.	
RCR07	Resistor Fixed Comp., 1K 1/4w, 5%	R3,4,5,6,11,12,15, 24,25,36,39,48,51, 53,54,57,61,109,209, 210,212,213,229,242, 335,366,409,410,412, 413,429,442.	
RCR07	Resistor Fixed Comp., 1.2K 1/4w, 5%	R301	
RCR07	Resistor Fixed Comp., 1.5K 1/4w, 5%	R108,235,237,435, 437.	
RCR07	Resistor Fixed Comp., 2.2K 1/4w, 5%	R102,106,215,415, 56.	
RCR07	Resistor Fixed Comp., 3K 1/4w, 5%	R239,360,439	
RCR07	Resistor Fixed Comp., 3.3K 1/4w, 5%	R110	
RCR07	Resistor Fixed Comp., 3.9K 1/4w, 5%	R203,403	
RCR07	Resistor Fixed Comp., 4.7K 1/4w, 5%	R50,103,107,246, 382.	
RCR07	Resistor Fixed Comp., 5.1K 1/4w, 5%	R341	
RCR07	Resistor Fixed Comp., 5.6K 1/4w, 5%	R339	
RCR07	Resistor Fixed Comp., 6.2K 1/4w, 5%	R243,443	
RCR07	Resistor Fixed Comp., 7.5K 1/4w, 5%	R372,374	
RCR07	Resistor Fixed Comp., 10K 1/4w, 5%	R47,49,59,63,204, 216,218,220,221,310, 322- 35,334,336,337, 340,356,357,404,416, 418,420,421,350	

ASSY NO. 31005200 CONTROL/SERVO ASSEMBLY

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3105201-1	P/C Board, Control Servo		Cipher
3105204	Heatsink		Cipher
3105212-1	Mounting Bracket		Cipher
3105212-2	Mounting Bracket		Cipher
3105213	Strut		Cipher
3105013	Retainer, P/C Connector		Cipher
60802-2	Test Point (Rolled Pin)		Amp
1292P-1	Connector Plug (9 pin)	J2, 11, 13	Molex
1360P	Connector Plug (12 pin)	J3, 7	Molex
1375P	Connector Plug (15 pin)	J14	Molex
1396P	Connector Plug (3 pin)	J1,6,8,9,10,12	Molex
1653P-1	Connector Plug (15 pin)	J4, 5	
1376TL	Pins, Terminal, Male .093 dia.		Molex
IN827	Diode	CR301	
IN914	Diode	CR2-10, 100-102, 105-107, 201,204, 205,207-211,302-310, 313-316,401,404,405, 407,408,410,411.	
IN957B	Diode	CR206,317,406	
IN4001	Diode	CR108-113,202,203, 311,312,402,403.	
RCR07	Resistor, Fixed Comp., 47 ohm 1/4w, 5%	R332	
RCR07	Resistor, Fixed Comp., 100 ohm 1/4w, 5%	R101,105,111,116, 121,224,227,230,361, 365,367,424,427,430.	
RCR07	Resistor Fixed Comp., 160 ohm 1/4w, 5%	R38	
RCR07	Resistor Fixed Comp., 180 ohm 1/4w, 5%	R201, 401	
RCR07	Resistor Fixed Comp., 220 ohm 1/4w, 5%	R1,7,9,13,16,18,20, 22.	
RCR07	Resistor Fixed Comp., 330 ohm 1/4w, 5%	R2,8,10,14,17,19,21, 23.	

ASSY NO. 31005200 - Continued CONTROL/SERVO ASSEMBLY

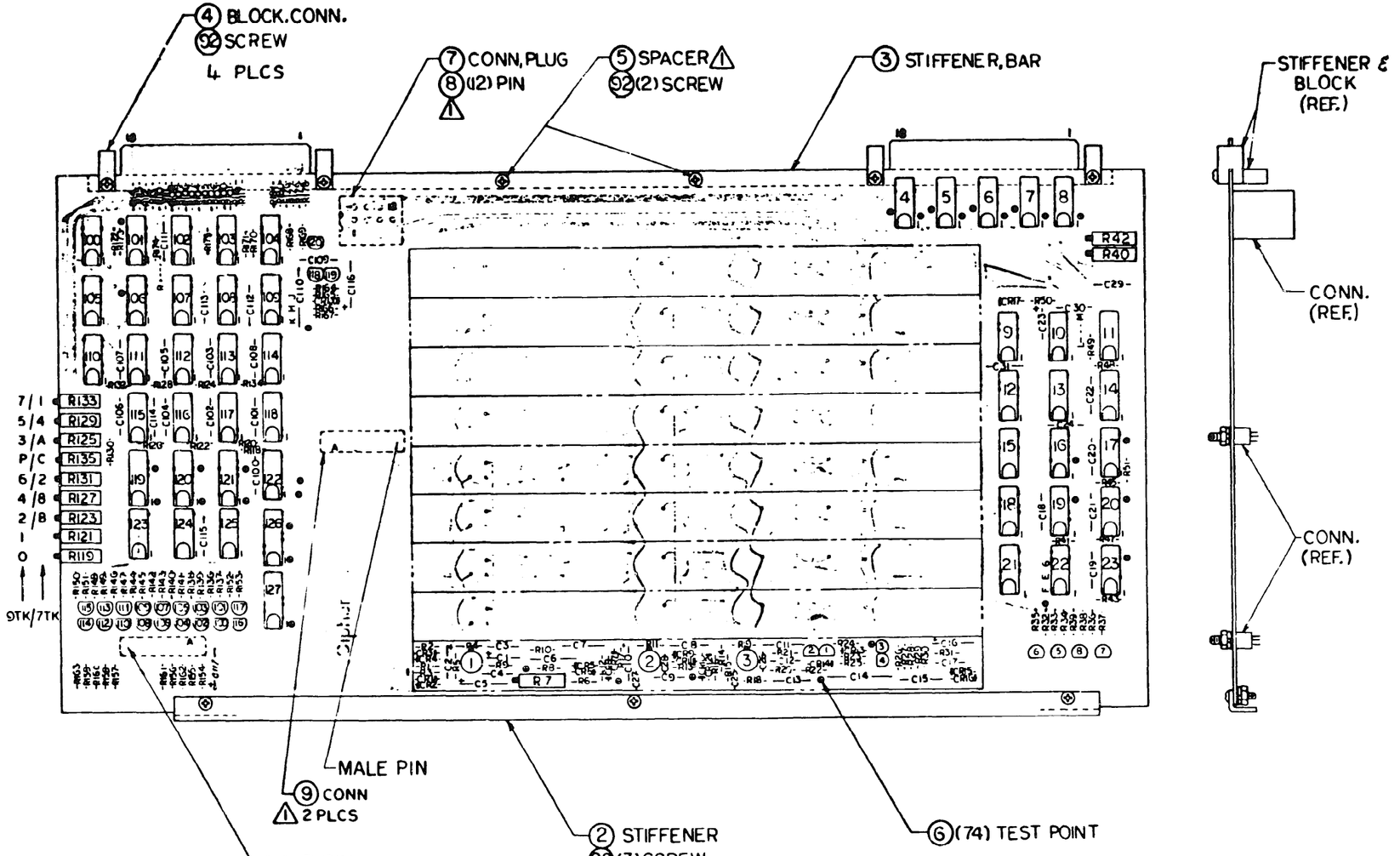
PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
C W 2 B	Resistor, W.W. 1 ohm, 3W	R112, 117,208,408	
C W 5	Resistor, W.W. .1 ohm, 6.5W	R225,231,236,425, 431,436.	
C W 5	Resistor, W.W. 1 ohm, 6.5W	R362, 368, 373	
ET34P501J	Potentiometer, 500 ohm	R114, 119, 124	Electrim
ET34P202J	Potentiometer, 2K	R60,64,202,306,312, 333,379,402.	Electrim
W M F 1 D 1	Capacitor, Mylar .001 mfd	C1,6,207,211,213,24, 306,308,407,411,413.	CDE
W M F 1 S 1	Capacitor, Mylar .01 mfd	C11-21,205,206,405, 406.	CDE
W M F 1 P 1	Capacitor, Mylar .1 mfd	C9,10,416,216.	CDE
S X 4 4 7	Capacitor, Polystyrene 47pf	C22,100,102,104 314, 318	Mallory
SX310	Capacitor, Polystyrene 100 pf	C2	Mallory
SX320	Capacitor, Polystyrene 200 pf	C3, 7, 23	Mallory
S X 2 5 0	Capacitor, Polystyrene 5000 pf	C212, 412	Mallory
6 2 5 B 1 A 2 2 J	Capacitor, Polycarbonate .0022 mfd, 50V 5%	C304	Electrocube
625BIA473J	Capacitor, Polycarbonate .047 mfd, 50V 5%	C307	Electrocube
625BIA124J	Capacitor, Polycarbonate .12 mfd, 50V 5%	C316	Electrocube
625BIA224J	Capacitor, Polycarbonate .22 mfd, 50V 5%	C317	Electrocube
625BIA474J	Capacitor, Polycarbonate .47 mfd, 50V 5%	C215,309,315,415	Electrocube
625BIA105J	Capacitor, Polycarbonate 1.0 mfd, 50V 5%	C208, 408	Electrocube
625BIA104J	Capacitor, Polycarbonate .1 mfd, 50V 5%	C8	Electrocube

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
625BIA683J	Capacitor, Polycarbonate .068 mfd, 50V 5%	C25	Electrocube
CS13BB476K	Capacitor, Tantalum 47 mfd, 6V	C4,105,203,204,313, 403,404.	
CS13BF475K	Capacitor, Tantalum 4.7 mfd, 35V	C101,103,201,202, 301,302,311,312,401, 402,5.	
CS13BG475K	Capacitor, Tantalum 4.7 mfd, 50V	C210,214,305,310, 410,414.	
2N3053	Transistor	Q15,101,201,204,315, 401,404.	
2N3054	Transistor	Q106, 109	
2N3055	Transistor	Q100, 103,111,314, 318.	
2N3702	Transistor	Q17,210,305-310	
2N3704	Transistor	Q1-11,13,14,16,209, 409.	
2N3771	Transistor	Q203,207,403,407	
2N4036	Transistor	Q102,104,107,108, 110,205,316,405.	
2N4303	Transistor	Q12,208,301-304,311, 312,315,408.	
2N5321	Transistor	Q206,317,406	
2N5323	Transistor	Q202,313,402	
SN5836N	Int. Cir. Hex Inverter	IC1,6,8,10,17,31,32, 33,43,47,304.	T.I. or Equiv.
SN15846N	Int. Cir. Quad. 2 input	IC5,9,11,19,20,24, 25,27,30,37,44,46, 302,303,48.	T.I. or Equiv.
SN15862N	Int. Cir. Triple 3 input	IC3,18,26,28,29,36, 45.	T.I. or Equiv.
SN15830N	Int. Cir. Dual 4 input	IC38	T.I. or Equiv.
DM994N	Int. Cir. Dual Buffer	IC12,14,16,22,23	Motorola
DM994N	Int. Cir. Dual Buffer	*IC2, 7	Motorola

*OPTIONAL: Do Not Load in Board

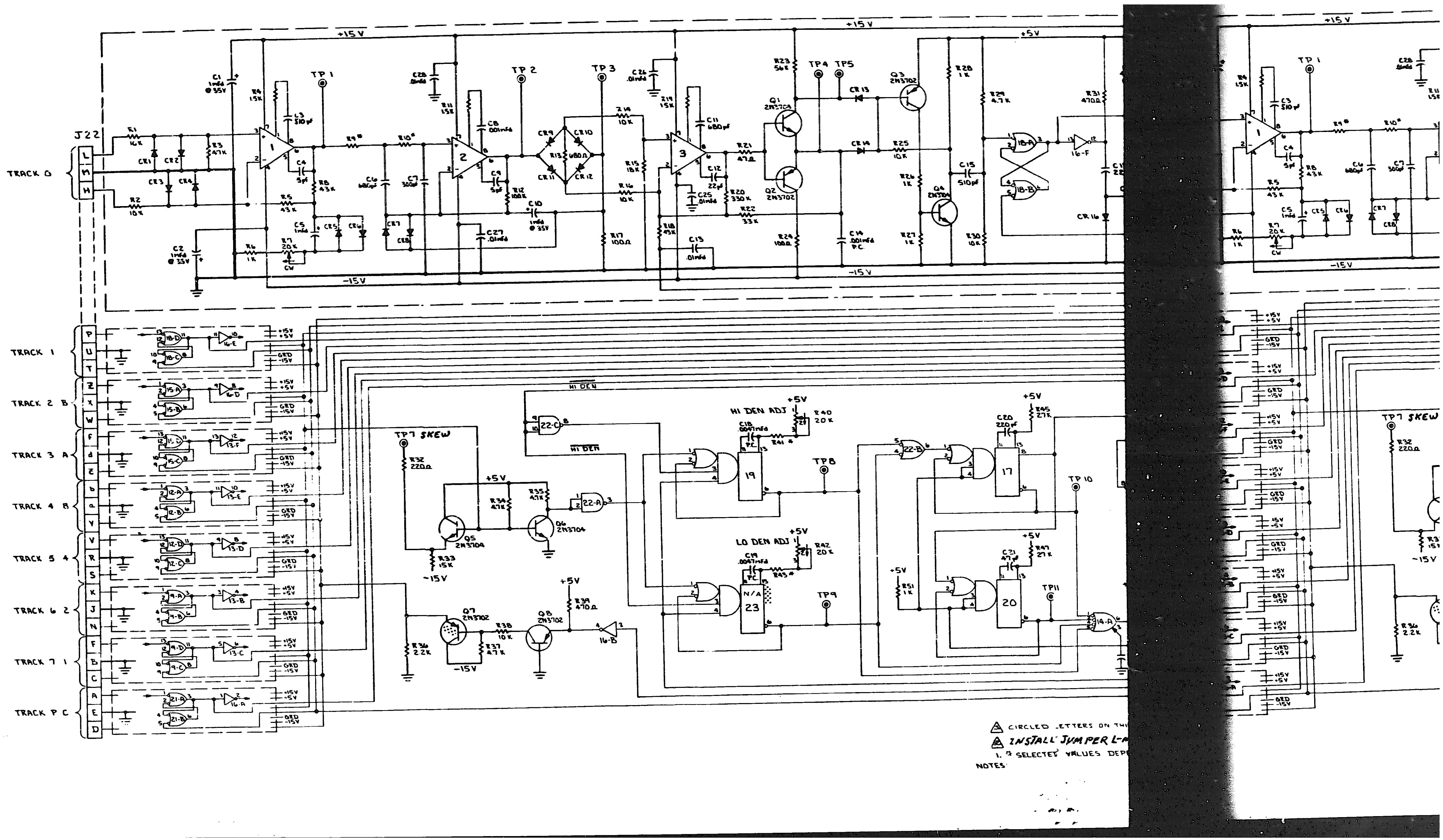
ASSY NO. 31005200 - Continued CONTROL/SERVO ASSEMBLY

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
DM8850	Int. Cir. Monostable	IC4,15,40,41,42	Motorola
SN7442N	Int. Cir. BCD to Decimal Converter	IC39	T.I. or Equiv.
SN7476	Int. Cir. Dual J-K Flip-Flop	IC13, 34,35	T.I. or Equiv.
N5558	Int. Cir. Dual OP-AMP	IC21,201,202,301, 305,306,307,401,402.	National
LM300	Int. Cir. Regulator	IC100,101,102	
R10-E1-W2-V185	Relay 2 P2T	K2	Potter - Bramfield
9XR10-4	Socket, Relay		Potter - Bramfield
R10-P49	Clip, Relay		Potter - Bramfield
4366-2	Insulator, Mylar-T066		Thermalox
4303-2	Insulator, Mylar-T03		Thermalox
43B51547F02	Bushing, nylon		
Type 120	Heatsink Compound		Wakefield or equiv.
7717-44	Transipad (TO .5)		R.V. Weatherford
TXBF0 320-25B	Heatsink, Top-Hat		IERC
IN1612	Diode	CR103, 104	
4-40 X 3/8	Screw, Pan Hd. Phil-Cad		
4-40 X 5/8	Screw, Pan Hd. Phil-Cad		
4-40 X 1/2	Screw, Pan Hd. Phil-Cad		
#4	Washers, Flat-Cad		
#4	Washers, Split, Lock-Cad		
#4	Nut, Radio-Cad		
6-32 X 5/8	Screw, Pan Hd. Phil		
#6	Nut, Radio-Cad		
#6	Washer, Flat, Cad		
#6	Washer, Split, Lock-Cad		
20GA	Wire, Solid Buss		
1/16 Dia.	Shrink Tubing		

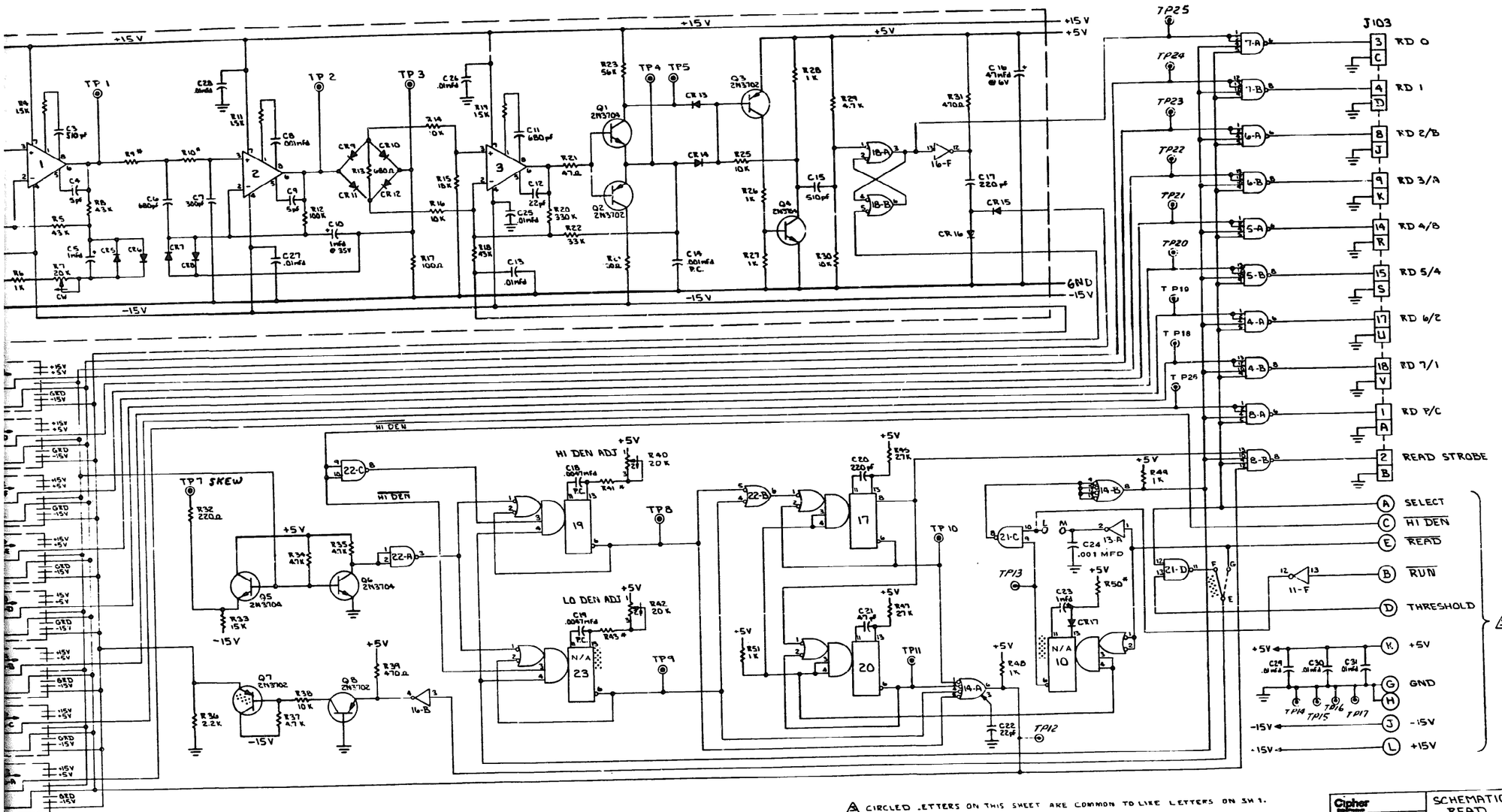


-1 BD

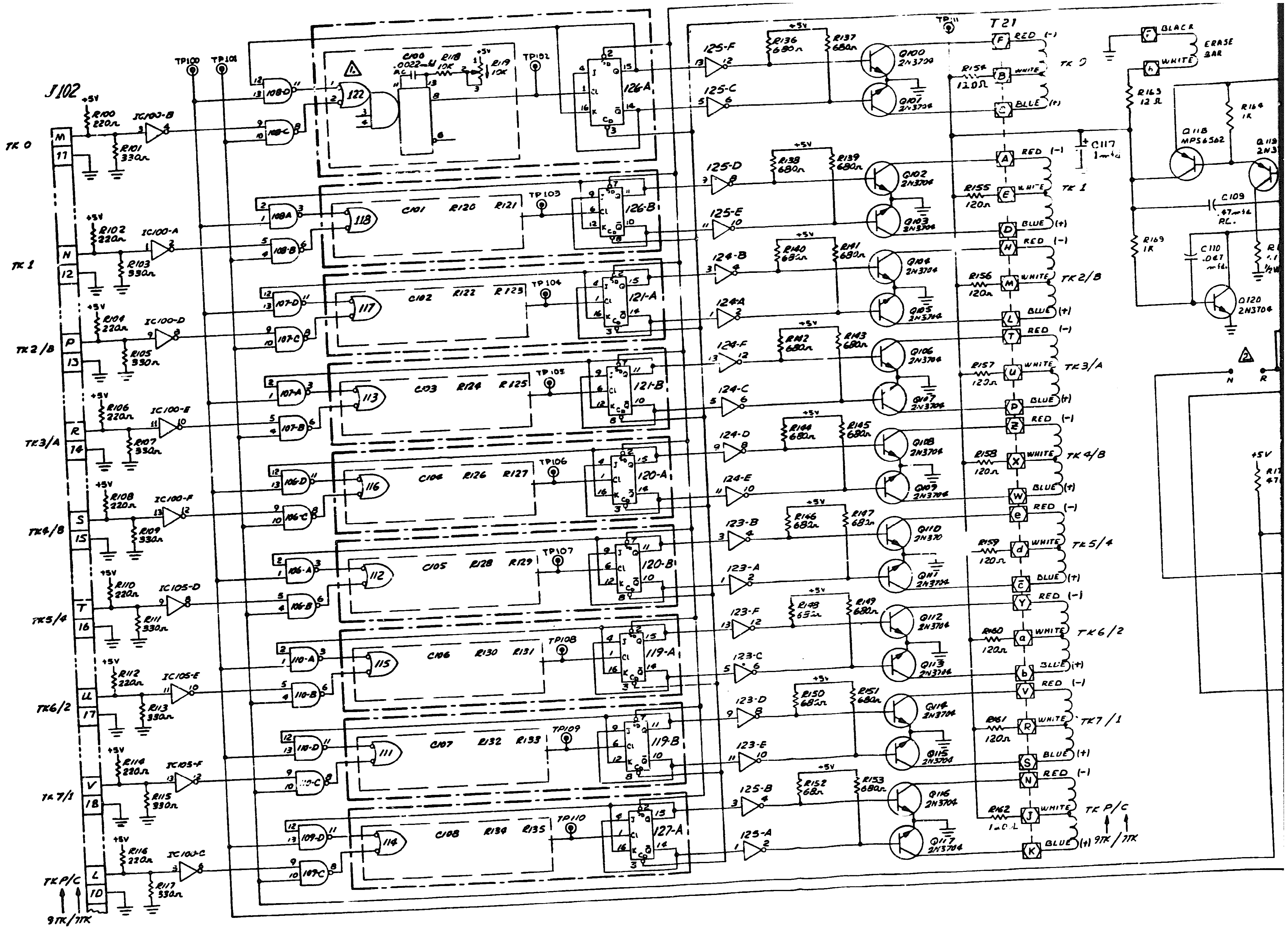
	Cipher		
		SCALE: FULL	DR'N BY: RAO
	TITLE ASSY- READ/WRITE		
	DATE 5/24/71	NO. 3105100	

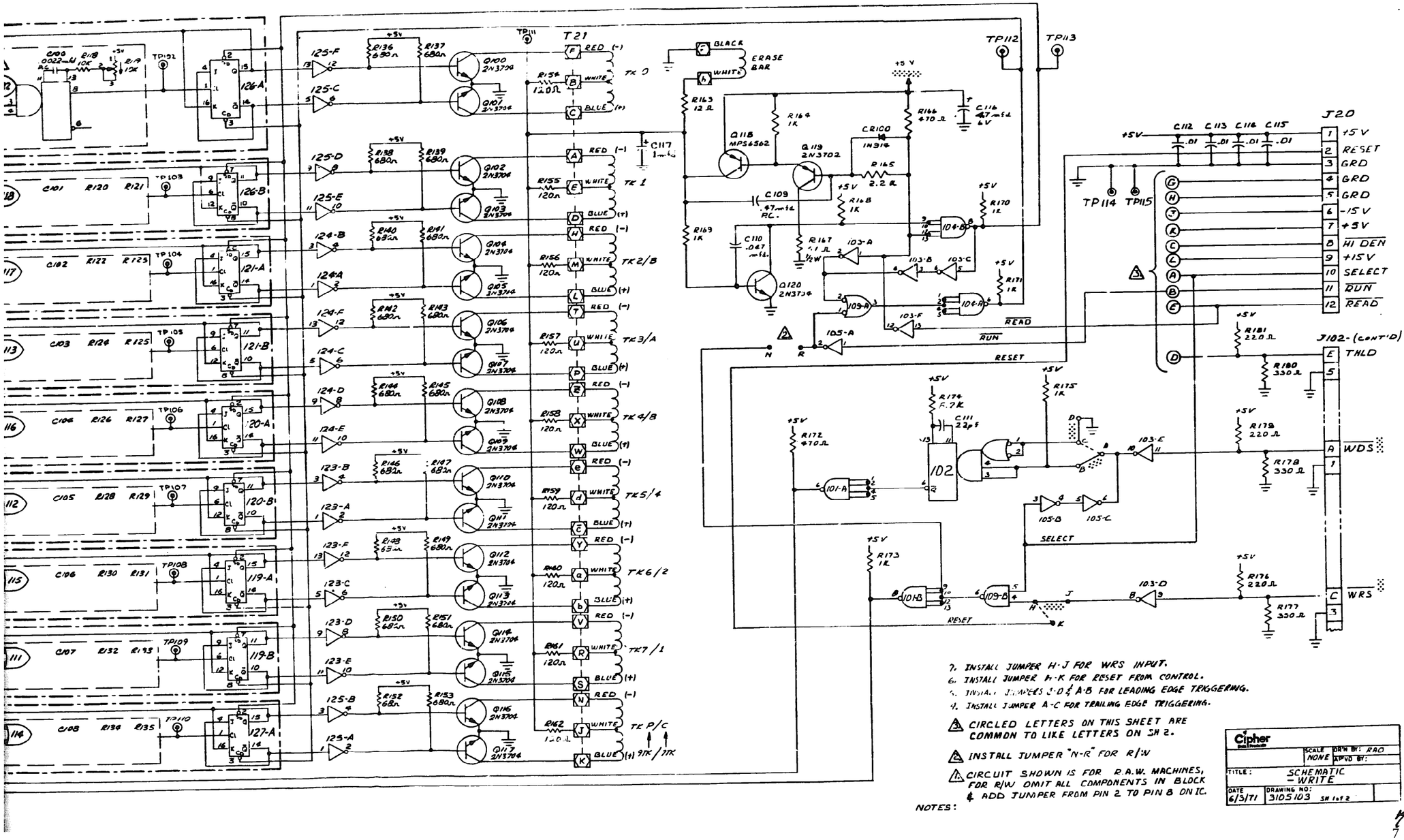


J22
TRACK O
TRACK 1
TRACK 2 B
TRACK 3 A
TRACK 4 8
TRACK 5 4
TRACK 6 2
TRACK 7 1
TRACK P C
+15V
-15V
+5V
TP 1
TP 2
TP 3
TP4
TP5
TP7 SKEW
TP8
TP9
TP 10
TP11
HI DEN
HI DEN ADJ
LO DEN ADJ
CIRCLED LETTERS ON TH
INSTALL JUMPER L-
1. * SELECTED VALUES DEP
NOTES:



Cipher	SCHEMATIC — READ
DWN KBO	3105103
CKD	SHT 2 OF 2
APPD	


J102
TK 0
TK 1
TK 2/B
TK3/A
TK4/8
TK5/4
TK6/2
TK7/1
TK P/C
9TK/7TK
TP100
TP101
TP102
TP103
TP104
TP105
TP106
TP107
TP108
TP109
TP110
T21
RED (-)
WHITE
BLUE (+)
BLACK
ERASE BAR
2N3704
MPS6562
C117
C109
C110
Q118
Q120
R163
R164
R169



NOTES:

7. INSTALL JUMPER H-J FOR WRS INPUT.
6. INSTALL JUMPER H-K FOR RESET FROM CONTROL.
5. INSTALL JUMPERS J-D & A-B FOR LEADING EDGE TRIGGERING.
4. INSTALL JUMPER A-C FOR TRAILING EDGE TRIGGERING.
3. CIRCLED LETTERS ON THIS SHEET ARE COMMON TO LIKE LETTERS ON SH 2.
2. INSTALL JUMPER "N-R" FOR R/W
1. CIRCUIT SHOWN IS FOR R.A.W. MACHINES, FOR R/W OMIT ALL COMPONENTS IN BLOCK & ADD JUMPER FROM PIN 2 TO PIN 8 ON IC.

Cipher	SCALE: NONE	DR'N BY: RAO
		APV'D BY:
TITLE: SCHEMATIC - WRITE		
DATE: 6/3/71	DRAWING NO: 3105103	SH 1 of 2

ASSEMBLY, READ AFTER WRITE

ASSY NO. 3105100-1, -2 **-1: 7 TRACK, -2: 9 TRACK**

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3105101	P/C Board, Read/Write		Cipher
310505	Stiffner Long		Cipher
3105104	Stiffner Bar		Cipher
3105013	Retainer, P/C Connector		Cipher
3105111	Spacer		Cipher
60802-2	Test Point .058 Dia.		Amp
1360P	Connector, Plug (12 pin)	J20	Molex
1376 TL	Pin Terminals, Male .093 Dia.		Molex
SRE-29-PD4J	Connector, Dip Solder Pins		Winchester
IN914	Diode	CR1-16,17,100	
RCR07	Resistor, Fix Comp., 12 ohm, 1/4w, 5%	R163	
RCR07	Resistor, Fix Comp., 47 ohm, 1/4w, 5%	R21	
RCR07	Resistor, Fix Comp., 100 ohm, 1/4w, 5%	R17, 24	
RCR07	Resistor, Fix Comp., 120 ohm, 1/4w, 5%	R156-162	
RCR07	Resistor, Fix Comp., 120 ohm, 1/4w, 5%	R154-162	
RCR07	Resistor, Fix Comp., 220 ohm, 1/4w, 5%	R32,100,102,104,106, 108,110,112,114,116, 176,179,181.	
RCR07	Resistor, Fix Comp., 330 ohm, 1/4w, 5%	R101,103,105,107, 109,111,113,115,117, 177,178,180.	
RCR07	Resistor, Fix Comp., 470 ohm, 1/4w, 5%	R31,39,166,172	
RCR07	Resistor, Fix Comp., 680 ohm, 1/4w, 5%	R13, 140-153	
RCR07	Resistor, Fix Comp., 680 ohm, 1/4w, 5%	R13, 136-153	
RCR07	Resistor, Fix Comp., 1K, 1/4w, 5%	R6,26,27,28,48,49, 51,164,168-171,173, 175.	

ASSY NO. 3105100-1, -2 - Continued

ASSEMBLY, READ AFTER WRITE
-1: 7 TRACK, -2: 9 TRACK

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
RCR07	Resistor, Fix Comp., 1.5K 1/4w, 5%	R4,11,19	
RCR07	Resistor, Fix Comp., 2.2K, 1/4w, 5%	R36, 165	
RCR07	Resistor, Fix Comp., 4.7K, 1/4w, 5%	R29,34,35,37	
RCR07	Resistor, Fix Comp., 8.2K. 1/4w, 5%	R174	
RCR07	Resistor, Fix Comp., 10K, 1/4w, 5%	R1,2,14,16,25,38,30, 122,124,126,128,130, 132,134.	
RCR07	Resistor, Fix Comp., 10K, 1/4w, 5%	R118, 120	
RCR07	Resistor, Fix Comp., 15K, 1/4w, 5%	R33	
RCR07	Resistor, Fix Comp., 18K, 1/4w, 5%	R15	
RCR07	Resistor, Fix Comp., 27K, 1/4w, 5%	R45, 47	
RCR07	Resistor, Fix Comp., 33K, 1/4w, 5%	R22	
RCR07	Resistor, Fix Comp., 43K, 1/4w, 5%	R5, 8, 18	
RCR07	Resistor, Fix Comp., 47K, 1/4w, 5%	R3	
RCR07	Resistor, Fix Comp., 56K, 1/4w, 5%	R23	
RCR07	Resistor, Fix Comp., 100K, 1/4w, 5%	R12	
RCR07	Resistor, Fix Comp., 330K, 1/4w, 5%	R20	
RCR07	Resistor, Fix Comp., 51 ohm, 1/2w, 5%	R167	
ET34P103J	Potentiometer, 10K, 5%	R123,125,127,129, 131,133,135.	E/M or Equiv.
ST34P103J	Potentiometer, 10K, 5%	R119, 121	E/M or Equiv.

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
ET34P203J	Potentiometer, 20K, 5%	R7, 40, 42	E/M or Equiv.
Z54	Capacitor, Ceramic Disc. .01 MFD	C25,26,27,28	
SX550	Capacitor, Polystyrene, 5PF	C4, 9	Mallory
SX422	Capacitor, Polystyrene, 22PF	C12, 22, 111	Mallory
SX447	Capacitor, Polystyrene, 47PF	C21	Mallory
SX322	Capacitor, Polystyrene, 220PF	C17, 20	Mallory
SX330	Capacitor, Polystyrene, 300PF	C7	Mallory
SX351	Capacitor, Polystyrene, 510PF	C15, 3	Mallory
SX368	Capacitor, Polystyrene, 680PF	C6, 11	Mallory
625BIA222J	Capacitor, Polycarbonate, .0022 mfd.	C102-108	Electrocube
625BIA222J	Capacitor, Polycarbonate, .0022 mfd.	C100, 101	Electrocube
625BIA102J	Capacitor, Polycarbonate, .001 mfd.	C14	Electrocube
625BIA474J	Capacitor, Polycarbonate, .47 mfd.	C109	
WMFIDI	Capacitor, Mylar, .001 mfd.	C8, 24	CDE
WMFISI	Capacitor, Mylar, .01 mfd.	C13,29,30,31,112, 113,114,115.	CDE
WMFIS47	Capacitor, Mylar, .047 mfd.	C110	
CS13BF105K	Capacitor, Tant, 1 mfd., 35V	C1,2,5,10,23,117	
CD13BB476K	Capacitor, Tant, 47 mfd., 6V	C16, 116	

ASSEMBLY, READ AFTER WRITE

ASSY NO. 3105100-1, -2 - Continued -1: 7 TRACK, -2. 9 TRACK

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
2N3702	Transistor	Q2,3,7,8,119	
2N3704	Transistor	Q1,4,5,6,104-117, 120	
2N3704	Transistor	Q100-104	
MPS6562	Transistor	Q118	Motorola
SN15836N	Hex Inverter	IC13,16,100,103,105, 123-125,11	T.I.
SN15846N	Quad - 2 Input	IC9,12,15,21,22,106-110.	T.I.
SN1584N	Quad - 2 Input	IC18	T.I.
SN7476N	Dual J-K Flip-Flop	IC119,120,121,127	T.I.
SN7476N	Dual J-K Flip-Flop	IC126	T.I.
DM944N	Dual Buffer	IC4-8,14,101,104	T.I.
DM8850	Monostable	IC10,17,19,20,23, 102,111-117.	
DM8850	Monostable	IC118, 122	
MA709	OP-AMP	IC1-3	
4-40-1/4	Screw, Pan Hd. Phil-Cad		
# 4	Nut, Radio-Cad		
# 4	Washer, Flat, Cad		
# 4	Washer, Split, Lock-Cad		
4-40 X 1/2	Screw, Pan Hd., Phil-Cad		

3105100-3, -4

ASSEMBLY, READ/WRITE
-3: 7 TRACK, -4: 9 TRACK

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
3105101	P/C Board - Read/Write		Cipher
1305105	Stiffner Long		Cipher
3105104	Stiffner Bar		Cipher
3105013	Retainer, P/C Connector		Cipher
3105111	Spacer		Cipher
60802-2	Test Point .058 Dia.		Amp
1360P	Connector, Plug (12 pin)	J20	Molex
1376TL	Pin Terminals, Male .093 Dia.		Molex
SRE-29-PD4J	Connector, Dip Solder Pins		Winchester
IN914	Diode	CR1-16,17,100	
RCR07	Resistor, Fix Comp., 12 ohm, 1/4w, 5%	R163	
RCR07	Resistor Fix Comp., 47 ohm, 1/4w, 5%	R21	
RCR07	Resistor, Fix Comp., 100 ohm, 1/4w, 5%	R17, 24	
RCR07	Resistor, Fix Comp., 120 ohm, 1/4w, 5%	R156-162	
RCR07	Resistor, Fix Comp., 300 ohm, 1/4w, 5%	R154-162	
RCR07	Resistor, Fix Comp., 220 ohm, 1/4w, 5%	R32,100,102,104,106, 108,110,112,114,116, 176,179,181.	
RCR07	Resistor, Fix Comp., 330 ohm, 1/4w, 5%	R101,103,105,107, 109,111,113,115,117, 177,178,180.	
RCR07	Resistor, Fix Comp., 470 ohm, 1/4w, 5%	R31,39,166,172	
RCR07	Resistor, Fix Comp., 680 ohm, 1/4w, 5%	R13, 140-153	
RCR07	Resistor, Fix Comp., 680 ohm, 1/4w, 5%	R13, 136-153	
RCR07	Resistor, Fix Comp., 1K, 1/4w, 5%	R6,26,27,28,48,49, 51,164,168-171,173, 175.	

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
RCR07	Resistor, Fix Comp., .5K, 1/4w, 5%	R4, 11, 19	
RCR07	Resistor, Fix Comp., 2.2K, 1/4w, 5%	R36, 165	
RCR07	Resistor, Fix Comp., 4.7K, 1/4w, 5%	R29,34,35,37	
RCR07	Resistor, Fix Comp., 3.2K, 1/4w, 5%	R174	
RCR07	Resistor, Fix Comp., 10K, 1/4w, 5%	R1,2,14,16,25,38,30.	
RCR07	Resistor, Fix Comp., 15K, 1/4w, 5%	R33	
RCR07	Resistor, Fix Comp., 18K, 1/4w, 5%	R15	
RCR07	Resistor, Fix Comp., 27K, 1/4w, 5%	R45, 47	
RCR07	Resistor, Fix Comp., 33K, 1/4w, 5%	R22	
RCR07	Resistor, Fix Comp., 43K, 1/4w, 5%	R5, 8, 18	
RCR07	Resistor, Fix Comp., 47K, 1/4w, 5%	R3	
RCR07	Resistor, Fix Comp., 56K, 1/4w, 5%	R23	
RCR07	Resistor, Fix Comp., 100K, 1/4w, 5%	R12	
RCR07	Resistor, Fix Comp., 330K, 1/4w, 5%	R20	
RCR20	Resistor, Fix Comp., 51 ohm, 1/2w, 5%	R167	
ET34P203J	Potentiometer, 20K, 5%	R7, 40, 42	E/M or Equiv.
Z54	Capacitor, Ceramic, Disc., .01 MFD	C25,26,27,28	
SX550	Capacitor, Polystyrene, 5PF	C4, 9	Mallory
SX422	Capacitor, Polystyrene, 22PF	C12,22,111	Mallory

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
SX447	Capacitor, Polystyrene 47PF	C21	Mallory
SX322	Capacitor, Polystyrene, 220PF	C17, 20	Mallory
SX330	Capacitor, Polystyrene, 300PF	C7	Mallory
SX351	Capacitor, Polystyrene, 510PF	C15, 3	Mallory
SX368	Capacitor, Polystyrene, 680PF	C6, 11	Mallory
625BIA472J	Capacitor, Polycarbonate, .0047 mfd.	C18, 19	Electrocube
625BIA102J	Capacitor, Polycarbonate, .001 mfd.	C14	Electrocube
625BIA474J	Capacitor, Polycarbonate, .47 mfd.	C109	Electrocube
WMFIDI	Capacitor, Mylar, .001 mfd.	C8, 24	CDE
WMFISI	Capacitor, Mylar, .01 mfd.	C13,29,30,31,112, 113,114,115.	CDE
WMFIS47	Capacitor, Mylar, .047 mfd.	C110	CDE
CS13BF105K	Capacitor, Tant, 1 mfd., 35V	C1,2,5,10,23,117	
CS13BB476K	Capacitor, Tant, 47 mfd., 6V	C16, 116	
2N3702	Transistor	Q2,3,7,8,119,	
2N3704	Transistor	Q1,4,5,6,104-117, 120	
2N3704	Transistor	Q100-104	
MPS6562	Transistor	Q118	Motorola
SN15836N	Hex Inverter	IC13,16,100,103,105, 123-125,11.	T.I.
SN15846N	Quad - 2 Input	IC9,12,15,21,22,106-110.	T.I.

ASSY NO. 3105100-3, -4 - Continued

PART NO.	DESCRIPTION	REFERENCE DESIGNATOR	VENDOR
SN15846N	Quad - 2 Input	IC18	T.I.
SN7476N	Dual J-K Flip-Flop	IC119,120,121,127	T.I.
SN7476N	Dual J-K Flip-Flop	IC126	
DM944N	Dual Buffer	IC4-8,14,101,104	T.I.
DM8850	Monostable	IC10,17,19,20,23,102	
MA709	OP-AMP	IC1-3	
4-40-1/4	Screw, Pan Hd. Phil-Cad		
# 4	Nut, Radio-Cad		
# 4	Washer, Flat, Cad		
# 4	Washer, Split, Lock, Cad		
4-40 X 1/2	Screw, Pan Hd., Phil-Cad		

NOTE: Install jumper from pin 2 to pin 8 on IC 111-118, 122. The IC is omitted.

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END

11-10-82

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MICROFORM
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