

MODEL NO. _____

SERIAL NO. _____

MODEL 6X40
SYNCHRONOUS READ
AFTER WRITE
TAPE TRANSPORT

PERTEC
PERIPHERAL EQUIPMENT

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OPERATING AND SERVICE MANUAL NO. 100884

FOREWORD

This manual provides operating and service instructions for the Synchronous Write/Synchronous Read Tape Transport, Model 6X40, manufactured by PERTEC Peripheral Equipment, Chatsworth, California.

The content includes a detailed description, specifications, installation instructions, and checkout of the transport. Also included is the theory of operation and preventive maintenance instructions. Section VII contains the schematics and parts lists.

All graphic symbols used in logic diagrams conform to the requirements of MIL-STD-806 and all symbols used in schematic diagrams are as specified in MIL-STD-15.

The tape transport models covered by this manual are listed below.

Model No.	Bit Packing Density (cpi)	Character Rate at 45 ips (KHz)	Number of Channels
6840-9	800	36	9
6840-75	800/556	36/25	7
6840-72	800/200	36/9	7
6540-72	556/200	25/9	7

SERVICE AND WARRANTY

This PERTEC product has been rigorously checked out by capable quality control personnel. The design has been engineered with a precise simplicity which should assure a new level of reliability. Ease of maintenance has been taken into consideration during the design phase with the result that all components (other than mechanical components) have been selected wherever possible from manufacturer's "off the shelf" stock. Should a component fail, it may be readily replaced from PERTEC or your local supplier. The unit has been designed for "plug-in" replacement of circuit boards or major components which will ensure a minimum of equipment down time.

PERTEC warrants products of its manufacture to be free from defects in design, workmanship, and material under normal and proper use and service for a period of twelve (12) months after the date of shipment. PERTEC agrees to repair or replace at the place of manufacture, without charge, all parts of said products which are returned, for inspection, to its factory within the applicable warranty period, provided such inspection discloses that the defects are as above specified and provided also that the equipment has not been altered or repaired other than with authorization from PERTEC and by its approved procedures, subjected to misuse, improper maintenance, negligence, or accident, damaged by excessive current or otherwise, or had its serial number or any part thereof altered, defaced or removed. This warranty is in lieu of all other warranties, expressed or implied, including those of merchantability or fitness for purpose.

Please read the instruction manual thoroughly as to operation, maintenance, and component reference list. Should you require additional assistance in servicing this equipment, please contact the following regional service centers. A trained service representative will be pleased to assist you.

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SECTION I GENERAL DESCRIPTION AND SPECIFICATIONS

1.1 INTRODUCTION

This section provides a physical description, functional description, and specifications for the Synchronous Write/Synchronous Read Tape Transport, Model 6X40, manufactured by PERTEC Peripheral Equipment, Chatsworth, California.

1.2 PURPOSE OF EQUIPMENT

The tape transport has the capability of recording digital data on either 7- or 9-track magnetic tape at tape speeds of up to 45 ips in an ANSI and NRZI IBM-compatible format. The data can be completely recovered when the tape is played back on an IBM digital tape transport or its equivalent.

The transport can also synchronously read either 7- or 9-track magnetic tape at a speed up to 45 ips, which has been recorded in an NRZI IBM-compatible format.

The transport is equipped with a dual-gap head which has the read and write heads separated by 0.15 inch. The dual gap head enables simultaneous read and write operations to be performed so data just recorded by the write head can be read by the read head after the tape has moved on approximately 0.15 inch. This technique allows writing and checking of data in a single pass.

The transport operates directly from 115v ac or 230v ac, single-phase, 48 to 400 Hz power.

1.3 PHYSICAL DESCRIPTION OF EQUIPMENT

The Model 6X40 transport is shown in Figure 1-1; it can accommodate tape reels up to 10-1/2 inches in diameter. All electrical and mechanical components necessary to operate the transport are mounted on the deck which is designed to be hinge mounted in a standard 19-inch EIA rack.

In addition to the dual gap head, the transport is equipped with an erase head which is automatically activated when writing.

Access to the printed circuit boards is from the rear. The dust cover, which is hinged, protects the magnetic tape, magnetic head, capstan, and other tape path components from dust and other contaminants.

The operational controls, which light when the relevant function is being performed, are mounted on a control panel on the front trim and are accessible when the dust cover door is closed. Power is supplied through a strain-relieved cord having a standard 3-pin plug. Interface signals are routed through three printed circuit connectors that plug directly into the printed circuit boards.

In certain transports, a fourth printed circuit board is used. This is the EOT/BOT Amplifier which is mounted on the Write Lockout assembly bracket at the rear of the tape deck.

1.4 FUNCTIONAL DESCRIPTION

Figure 1-2 shows a block diagram of the system. The transport uses a single capstan drive for controlling tape motion during the Synchronous Write, Synchronous Read, and Rewind modes. The tape is under a constant tension of 8 ounces, thus eliminating the possibility of tape "cinch" when the tape reel is placed on a computer transport.

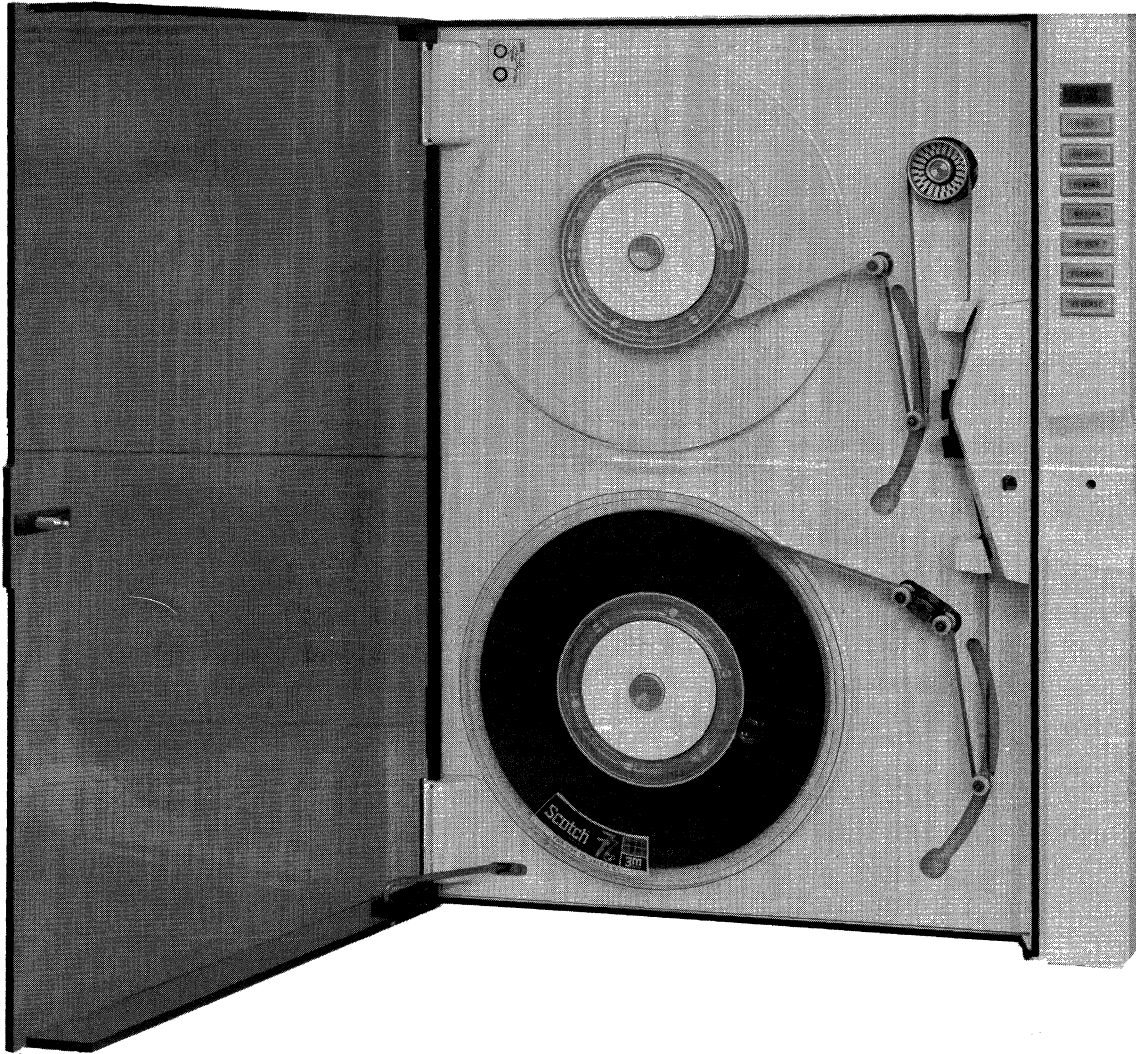


Figure 1-1. Model 6X40 Tape Transport

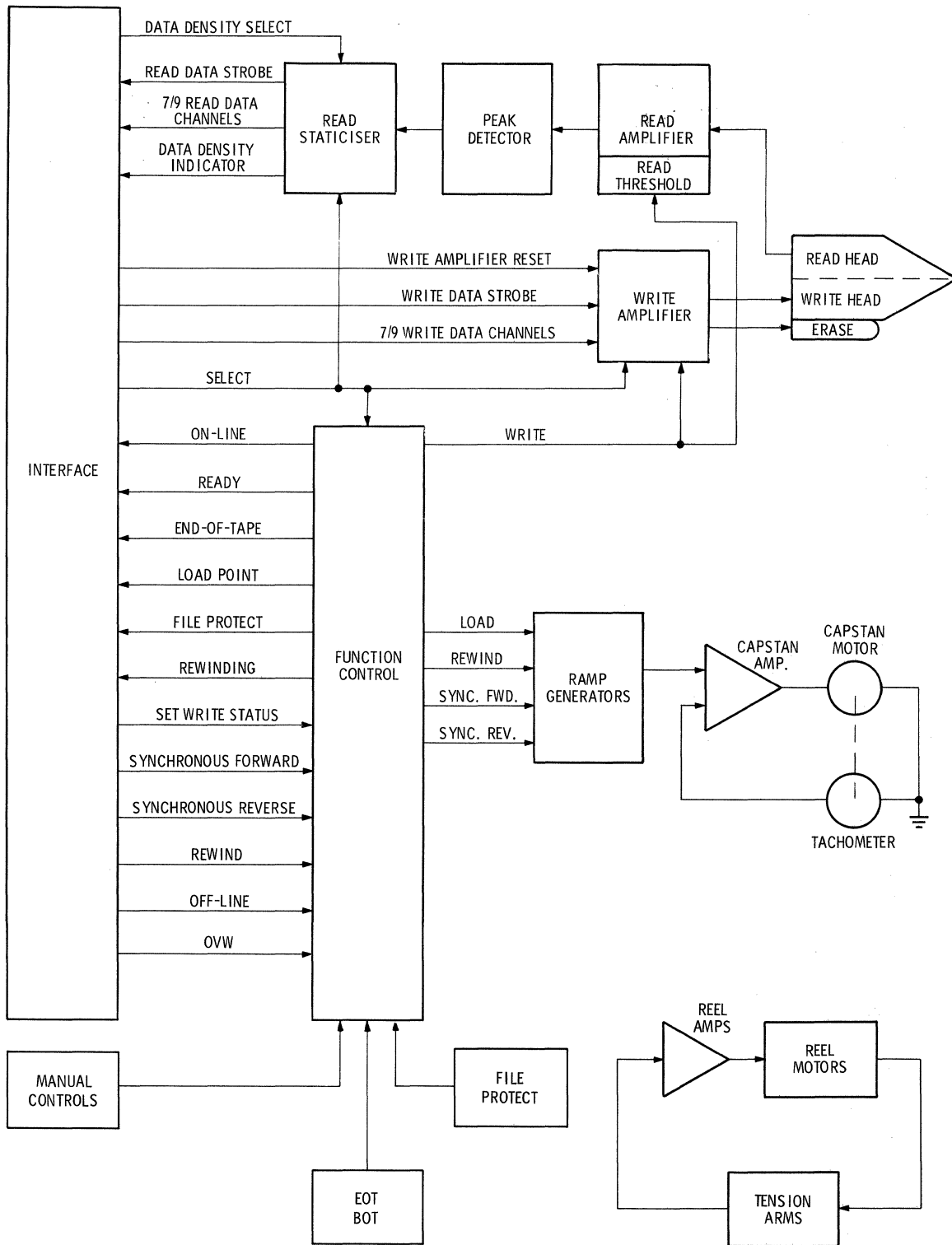


Figure 1-2. Block Diagram of Model 6X40 Tape Transport

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. The servo voltage is proportional to the angular velocity of the capstan. This voltage is compared to the reference voltage from the ramp generators by applying 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.

During a writing operation, 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, tape is decelerated to zero velocity in a controlled manner.

Since the writing operation relies on a constant tape velocity, Inter-Record Gaps (IRGs) (containing no data) must be provided to allow for 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 within the transport.

During a reading operation, tape is accelerated to the required velocity. The acceleration time is such that the tape velocity becomes constant before data signals are received.

Seven or nine data channels are presented to the interface. They are accompanied by a READ DATA STROBE (RDS) pulse derived by conventional ORed clock techniques.

The end of a record is detected in the customer controller using "Missing Pulse Detector" circuits and the tape is 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.

In addition to the capstan control system, the transport consists of a mechanical tape storage system, supply and take-up reel servo systems, magnetic head and its associated electronics, and the control logic.

The mechanical storage system buffers the relatively fast starts and stops of the capstan from the high inertia of the supply and take-up reels. As tape is taken from or supplied to the storage system, a photoelectric sensor measures the displacement of the storage arm and feeds an error signal to the reel motor amplifier. 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 storage arm in its nominal operating position. The storage arm system is designed to give a constant tape tension as long as the arm is within its operating region. This tape path design minimizes tape wear because there is only relative motion on the tape oxide at the magnetic head.

The magnetic head writes and reads the flux transitions on the tape under control of the data electronics. Switching from the read-after-write to the read-only mode is accomplished by remote command.

The control logic operates on manual commands to enable the loaded tape to be brought to the Load Point. At this stage, remote commands control tape motion, writing, and reading. The logic also provides re-wind and unload functions in conjunction with the manual REWIND control.

The transport is also equipped with a photoelectric sensor to detect the Beginning of Tape (BOT) tab and End of Tape (EOT) tab. The EOT signal is sent as a level to the customer while the BOT signal is also used internally in the transport for control purposes.

The transport is designed with an interlock to protect the tape from damage due to component or power failure, or incorrect tape threading. A tape cleaner is provided to minimize tape contamination.

1.5 MECHANICAL AND ELECTRICAL SPECIFICATIONS

The mechanical and electrical specifications for the tape transport are shown in Table 1-1.

1.5.1 INTERFACE SPECIFICATIONS

Levels: True = Low = 0 to +0.4v (approximately)
False = High = +3v (approximately)

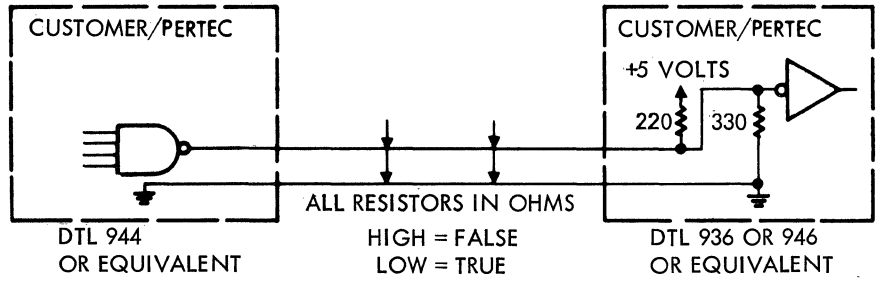
Pulses: Levels as above. Edge transmission delay over 20 feet of cable is not greater than 200 nsec.

The interface circuits are designed so any disconnected wire results in a false signal.

Figure 1-3 shows the configuration for which the transmitters and receivers have been designed.

Table 1-1
Mechanical and Electrical Specifications

Tape (computer grade)		
Width (inches)	0.5	
Thickness (mil)	1.5	
Tape Tension (ounces)	8.0	
Reel Diameter (inches)	10.5 maximum	
Recording Mode (IBM compatible)	NRZI	
Magnetic Head	Dual Gap (with erase head)	
Tape Speed (ips) Standard	45, 37.5, 25, 18.75, 12.5	45 => 36.00 KHz
Instantaneous Speed Variation (%)	±1	37.5 => 30.00 KHz
Long-Term Speed Variation (%)	±1	25 => 20.00 KHz
Rewind Speed (ips)	150 nominal	18.75 => 15.00 KHz
Interchannel Displacement Error		
Read	150 maximum*	
Write	150 maximum**	
Stop/Start Time (milliseconds) at 45 ips (inversely proportional to tape speed)	8.33 ±0.55	
Stop/Start Displacement (inch)	0.19 ±0.02	
Beginning of Tape (BOT) and End of Tape (EOT) Detectors	Photoelectric*** IBM compatible	
Weight (pounds)	85	
Dimensions		
Height (inches)	24.5****	
Width (inches)	19.0	
Depth (inches) (from mounting surface)	12.5	
Depth (inches) (total)	15.0	
Operating Temperature (°C)	2 to 50	
Altitude (feet)	0 to 20,000	
Power		
(volts ac)	117 or 230	
(watts) maximum on high line	300 to 400	
(Hz)	48 to 400	
Mounting — Standard 19-inch EIA rack	—	
Electronics	All silicon	
<p>* The maximum displacement between any two bits of a character when reading an IBM master tape using the Read section of the Read After Write head is 150 μinches.</p> <p>** The maximum displacement between any two bits of a character on a tape written with all ones using the Write section of the Read After Write head is 150 μinches.</p> <p>*** Approximate distance from detection area to head gap = 1.2 in.</p> <p>**** Includes one-half-inch spacer furnished with unit.</p>		



27.8 μ s
 33.3 μ s
 50 μ s
 66 μ s

Figure 1-3. Interface Configuration

SECTION II INSTALLATION AND INITIAL CHECKOUT

2.1 INTRODUCTION

This section contains a summary of interface lines, information for uncrating the transport, and the procedure for electrically connecting and initially checking out the transport.

2.2 UNCRATING THE TRANSPORT

The transport is shipped in a protective container to minimize the possibility of damage during shipping.

To uncrate the transport place the shipping container in the position indicated by the arrows on the container.

Open the shipping container and remove the packing material so the transport and its shipping frame can be lifted from the container.

Lift the transport out of the container using the shipping frame and set it down so there is access to both the front and rear of the deck.

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

Check the printed circuit boards and all connectors for correct installation. Check the plug-in relay on the printed circuit board associated with the heatsink to ensure that it is fully seated and good contact is established.

Check the identification label on the back of the tape deck for 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 as shown in Figure 4-3. The power switch indicator wire should not be moved.

2.3 POWER CONNECTIONS

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

2.4 INITIAL CHECKOUT PROCEDURE

Section III contains a detailed description of all of the controls. To check the proper operation of the transport before placing it in the system, follow the specified procedure.

- (1) Connect the power cord (replace power plug and change power transformer wiring if necessary).
- (2) Load tape on the transport as described in Paragraph 3.3.
- (3) Turn the transport power on by depressing the POWER control.
- (4) Depress the LOAD control momentarily to apply capstan-motor and reel-motor power.
- (5) Depress the LOAD control momentarily a second time to initiate the Load sequence. The tape will move forward until it reaches the BOT tab, at which point it stops. The LOAD indicator should light when the BOT 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.

- (6) Check On-line by depressing the control repeatedly and observe that the ON LINE indicator is alternately lit and extinguished.
- (7) With the transport 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.

Check that, if the transport is on-line, the action of the FORWARD control is inhibited although the indicator light will still show the status of the control.
- (8) Press the alternate action REVERSE switch. Tape will move backward until the BOT tab reaches the photosensor, when it will stop. Check that the action of the REVERSE control is inhibited when the transport is on-line.
- (9) Using the FORWARD control, run several feet of tape onto the take-up reel. Depress the REWIND control momentarily to initiate the Rewind mode and light the REWIND indicator. 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 tape will rewind until tape tension is lost. This action is used to unload tape. The reel can be removed as outlined in Paragraph 3.3.2.
- (10) Visually check the components of the tape path for correct tape tracking (tape rides smoothly in the head guides, etc.).

2.5 INTERFACE CONNECTIONS

It is assumed that interconnection of PERTEC and Customer equipment uses a harness of individual twisted pairs, each with the following characteristics.

- (1) Maximum length of 20 feet.
- (2) Not less than one twist per inch.
- (3) 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 board to which it is connected.

Three printed circuit edge connectors are supplied with each transport. These must be wired by the customer and strain relieved as shown in Figure 2-1. Interface signals are thus routed directly to and from the printed circuit boards. Table 2-1 shows the Input/Output lines required. Details relating to the interface are contained in Section III.

2.6 RACK MOUNTING THE TRANSPORT

The physical dimensions of the transport are such that it may be mounted in a standard 19-inch EIA rack; 24.5 inches of panel space is required. It requires a depth behind the mounting surface of at least 13 inches.

Figures 2-2 and 2-3 illustrate the procedure for mounting the transport as follows.

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

- (2) Set the shipping frame down with the front door of the transport facing up (i. e. , lying in a horizontal position). Remove the screws securing the Z-shaped shipping blocks to the frame.

CAUTION

SECURE THE EIA RACK SO THAT IT WILL NOT TIP OR MOVE WHEN THE TRANSPORT IS POSITIONED UPON THE HINGE PIN BLOCKS. TWO PERSONS SHOULD HANDLE THE TRANSPORT WHEN MOUNTING TO PREVENT DAMAGE TO THE DATA BOARDS OR OTHER ACCESSORY PARTS.

- (3) Lift the transport out of the shipping frame and hang the transport on the hinge pin blocks (see Figure 2-3). Hang the transport by placing it up to the hinge pin blocks on an angle of 60 degrees to its closed position.
- (4) Remove the Z-shaped shipping blocks from the tape deck.
- (5) Adjust the hinge pin blocks on the EIA rack so that the transport hangs symmetrically in the rack. Tighten the screws.
- (6) Open the tape deck to 90 degrees and install the safety blocks using 4-40 screws (see Figure 2-3).
- (7) Check that the fastener engages behind the EIA rack.
- (8) Clean the tape deck as described in the maintenance procedure.

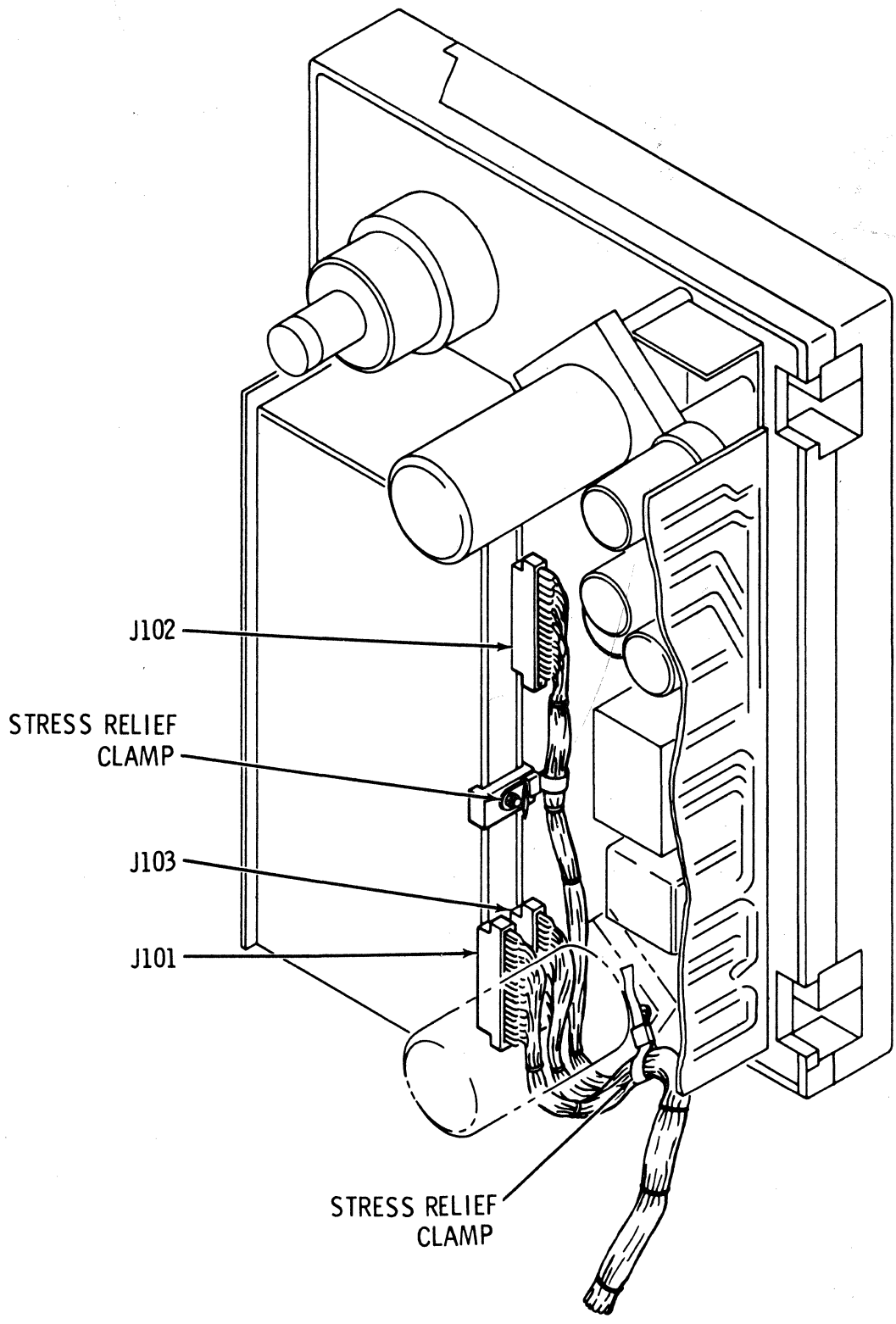


Figure 2-1. Interface Cable Installation

Table 2-1
Interface Connections

Transport Connector Mating Connector		36 Pin Etched PC Edge Connector 36 Pin ELCO 00-6007-036-980-002	
Connector (Reference Figure 2-1)	Live Pin	Ground Pin	Signal*
J101 <i>INPUT TO DECK</i> <i>OUTPUT FROM DECK</i>	B	2	→ OVERWRITE (OVW)
	J	8	* → SELECT (SLT)
	C	3	* → SYNCHRONOUS FORWARD Command (SFC)
	E	5	* → SYNCHRONOUS REVERSE Command (SRC)
	H	7	* → REWIND Command (RWC)
	L	10	* → OFF-LINE Command (OFFC)
	K	9	* → SET WRITE STATUS (SWS)
	D	4	→ DATA DENSITY SELECT (DDS) (Optional)
	T	16	* ← READY (RDY)
	M	11	* ← ON-LINE Command
	N	12	* ← REWINDING (RWD)
	U	17	* ← END OF TAPE (EOT)
	R	14	* ← LOAD POINT (LDP) <i>BOT</i>
	P	13	* ← FILE PROTECT (FPT)
F	6	* ← DATA DENSITY INDICATOR (DDI)	
J102 <i>DATA</i>	A	1	→ WRITE DATA STROBE (WDS)
	C	3	→ WRITE AMPLIFIER RESET (WARS)
	L	10	→ WRITE DATA PARITY (WDP)
	M	11	→ WRITE DATA 0 (WD0) } Omit for
	N	12	→ WRITE DATA 1 (WD1) } 7-Channel Head
	P	13	→ WRITE DATA 2 (WD2)
	R	14	→ WRITE DATA 3 (WD3)
	S	15	→ WRITE DATA 4 (WD4)
	T	16	→ WRITE DATA 5 (WD5)
	U	17	→ WRITE DATA 6 (WD6)
V	18	→ WRITE DATA 7 (WD7)	
J103	2	B	← READ DATA STROBE (RDS)
	1	A	← READ DATA PARITY (RDP)
	3	C	← READ DATA 0 (RD0) } Omit for
	4	D	← READ DATA 1 (RD1) } 7-Channel Head
	8	J	← READ DATA 2 (RD2)
	9	K	← READ DATA 3 (RD3)
	14	R	← READ DATA 4 (RD4)
	15	S	← READ DATA 5 (RD5)
	17	U	← READ DATA 6 (RD6)
	18	V	← READ DATA 7 (RD7)

*See Section III for definitions of interface functions.

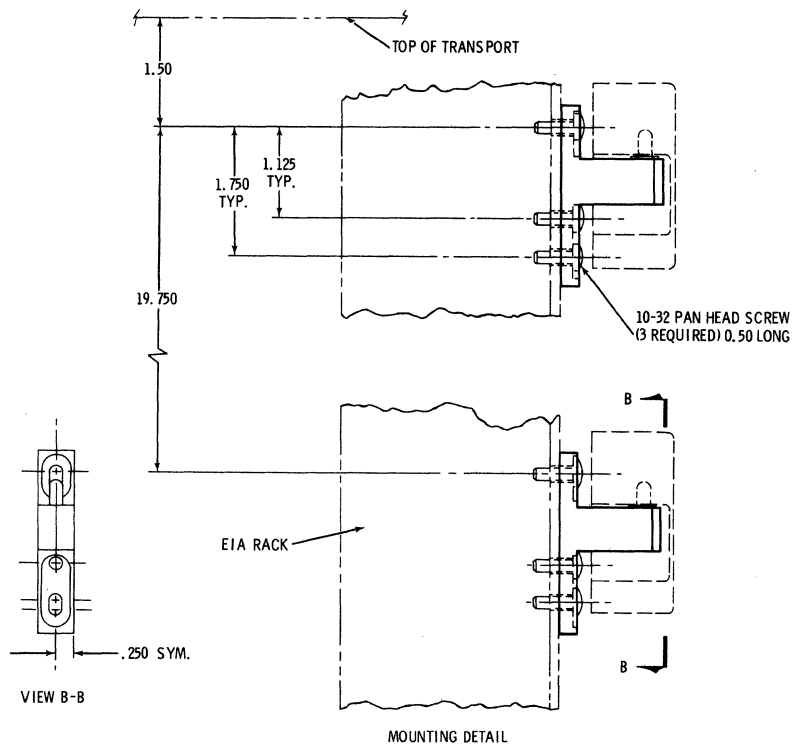
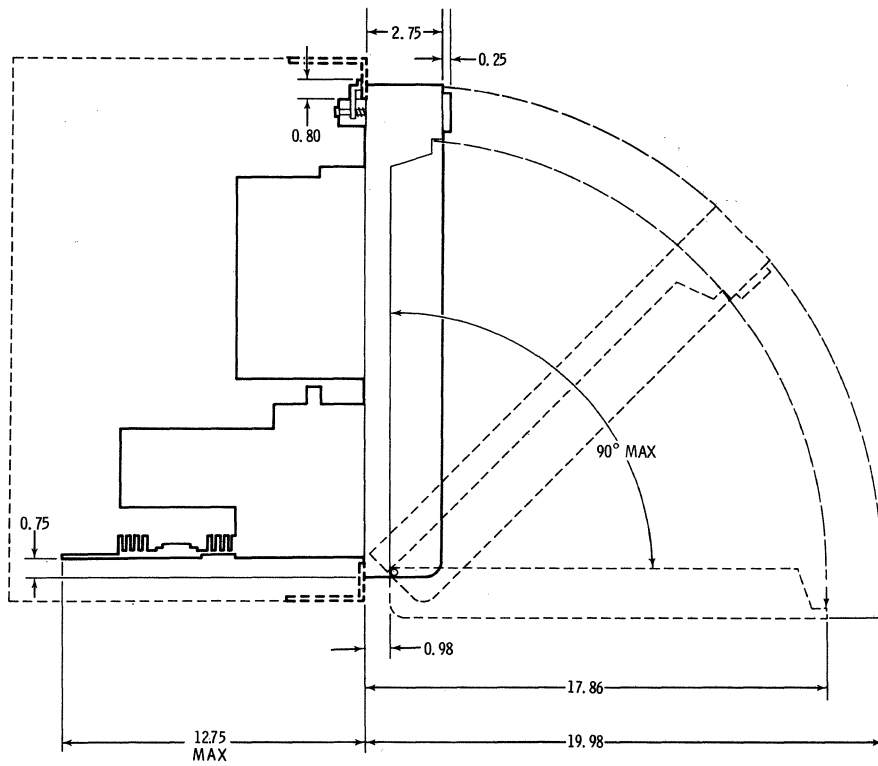


Figure 2-2. Rack Mounting the Transport

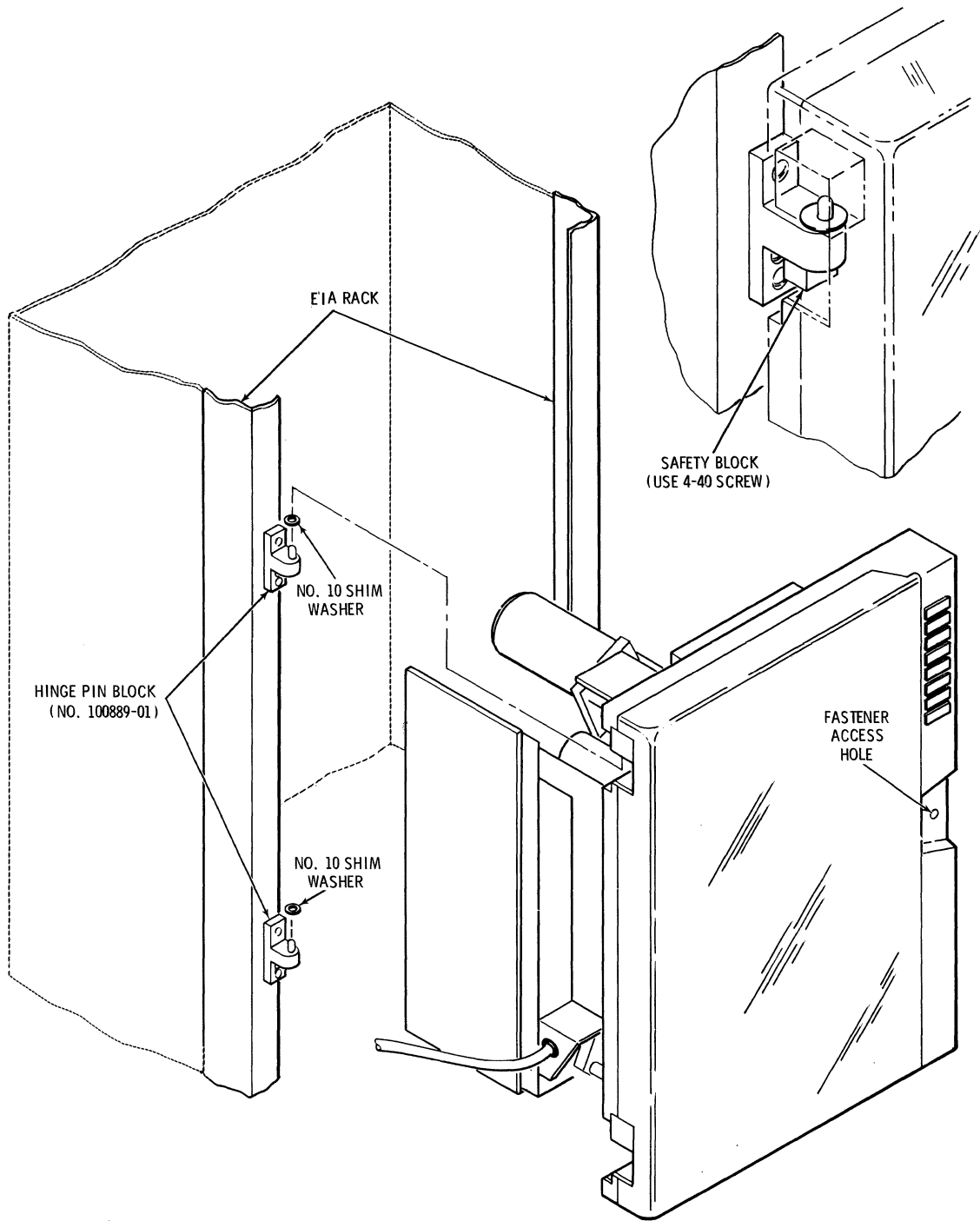


Figure 2-3. Installation Diagram

SECTION III OPERATION

3.1 INTRODUCTION

This section explains the manual operation of the transport and defines the interface functions with regard to timing, levels, and interrelationships.

3.2 CLEANING THE HEAD AND GUIDES

The brief operation described in Paragraph 6.4 should be performed daily to realize the data reliability capabilities of the transport.

3.3 LOADING TAPE ON TRANSPORT

The Model 6X40 transport, in the position shown in Figure 3-1, has the supply reel (reel to be recorded or reproduced) at the bottom. The tape must unwind from the supply reel when the reel is turned in a clockwise direction. Note that the presence of a Write Enable ring on the reel is required to close the interlocks which allow writing.

To load a tape reel (maximum reel size is 10-1/2 inches in diameter with 2400 feet of tape), position the reel over the quick-release hub and depress the center plunger. This allows the reel to slip over the rubber ring on the hub. Press the reel evenly and firmly against the back flange of the hub with the center plunger depressed. Release the center plunger. The reel is now properly aligned in the tape path and ready for tape threading.

Thread the tape along the path shown in Figure 3-1. It will be necessary to open and hold the Flux Gate unit away from the head during tape threading. Wrap the tape leader onto the take-up reel so that the tape will be wound onto the reel when it is rotated clockwise. Wind several turns onto the take-up reel, then turn the supply reel counterclockwise until slack tape has been taken up.

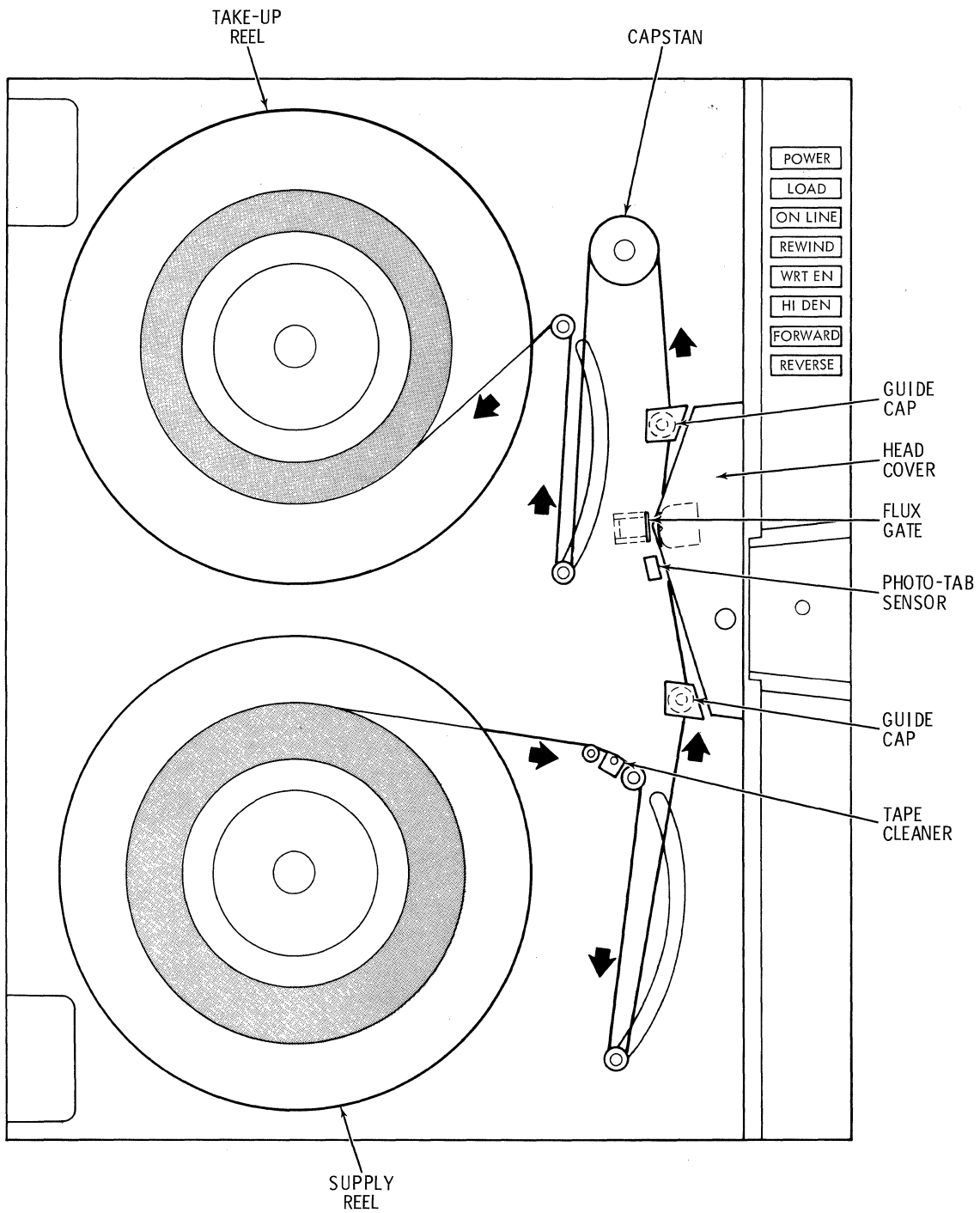


Figure 3-1. Tape Path and Controls

3.3.1 BRINGING TAPE TO LOAD POINT (BOT)

After tape has been manually tensioned and checked for correct seating in the guides, then, to bring tape to Load Point:

- (1) Turn power on by depressing the POWER control.
- (2) Depress the LOAD control and release it. This applies power to the capstan and reel motors and brings tape to the correct operating tension. The tape storage arms are now in the operating position.

CAUTION

CHECK THAT THE TAPE IS POSITIONED CORRECTLY ON ALL GUIDES OR TAPE DAMAGE MAY RESULT.

- (3) Depress the LOAD control a second time and release it. This causes tape to move forward at the prescribed operating velocity. Check tape tracking in the guides again and close the dust cover.

CAUTION

THE DUST COVER SHOULD 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.

When the reflective BOT tab reaches the Load Point, tape stops with the front edge of the tab approximately 1 inch from the magnetic head gap. The transport is now ready to receive external commands.

3.3.2 UNLOADING THE TAPE

To unload a recorded tape, complete the following procedure if power has been switched off; if power is on, start at Step (3).

- (1) Turn power on by depressing the POWER control.
- (2) Depress the LOAD control and release it; this applies tape tension.
- (3) Depress the REWIND control and release it. When tape has rewound to the BOT tab it comes to a controlled stop. The tape overshoots and the transport enters the Load sequence to bring tape to rest at the BOT.
- (4) Depress the REWIND control a second time and release it; this initiates a further rewind action which continues until tension is lost.
- (5) Open the dust cover and wind the end of the tape onto the supply reel. Depress the hub center plunger and remove the reel. Close the dust cover.

3.4 MANUAL CONTROLS

Eight operational controls with indicators are located on the control panel on the front of the transport (see Figure 3-1). The following paragraphs describe the functions of these controls.

3.4.1 POWER

The POWER control is an alternate action switch/indicator which connects line voltage to the power transformer. When power is turned on: all power supplies are established; all of the motors are open-circuited (low value resistors are connected across the reel motors); and, a reset signal is applied to key control flip-flops.

3.4.2 LOAD

The LOAD control is a momentary switch/indicator. Depressing and releasing the control for the first time after power is switched on energizes the servo system by applying ground returns to all motors and removes the reset signal. Tape will now be tensioned.

Depressing and releasing the LOAD control for the second time causes tape to move to and stop at the Load Point. The transport is now ready to receive external commands. While the BOT tab is located over the photo-tab sensor (see Figure 3-1), the LOAD indicator is lit. The LOAD control is disabled after the first LOAD or manual REWIND command has been given and can only be re-enabled by loss of tape tension or restoration of power after power has been off.

3.4.3 REWIND

The REWIND control is a momentary switch/indicator which is enabled only in the Off-line mode. Depressing and releasing the control causes tape to rewind at approximately 150 ips. On reaching the BOT tab, the rewind drive ceases and the Load sequence automatically entered. The BOT tab will overshoot the photo-tab sensor, move forward, and stop at the Load Point.

If the REWIND control is depressed and released when the tape is at Load Point (LOAD indicator lit), the tape rewinds off the take-up reel and tension is lost.

The REWIND indicator is lit throughout any rewind operation including the subsequent Load sequence where relevant.

A manual REWIND command will override the Load sequence.

3.4.4 ON LINE

The ON LINE control is a momentary switch/indicator which is enabled after an initial Load or Rewind sequence has been initiated.

Depressing and releasing the switch after an initial Load or Rewind sequence is initiated switches the transport to an On-line mode and lights the indicator.

In this condition the transport can accept external commands provided it is also Ready and Selected.

The transport will revert to the Off-line mode if the following occur.

- (1) ON LINE is depressed a second time.
- (2) An external OFF-LINE command (OFFC) is received.
- (3) Tape tension is lost.

3.4.5 WRT EN (WRITE ENABLE)

This is an indicator which is lit whenever power is on and a reel of tape with a Write Enable ring installed is mounted on the transport.

3.4.6 HI DEN (HIGH DENSITY)

The HI DEN control is an alternate action switch/indicator. It is provided in all models of the transport, but is only relevant to 7-track operation where it determines the character packing density at which the Read electronics operates.

When the indicator is lit, the Read electronics is conditioned to operate in the High Density mode. If the indicator is not lit, the transport will be in the Low Density mode.

The following possible combinations are available.

<u>Model</u>	<u>Density Combination</u>
6840-75	800/556
6840-72	800/200
6540-72	556/200

For 9-track transports, only 800-cpi operation is allowed; thus, the switch is disabled and the indicator is permanently lit. When the external Data Density Select (DDS) option is used, the switch is also disabled and the indicator reflects the state of the DDS command.

3.4.7 FORWARD

The FORWARD control is an alternate action switch/indicator which is enabled only in the Off-line mode and when the transport is Ready.

When the switch is depressed, the indicator lights and tape will move forward at the prescribed speed. When the switch is depressed again, tape stops and the indicator is extinguished.

If the EOT tab is encountered while moving forward, tape stops but the indicator will remain lit.

3.4.8 REVERSE

The REVERSE control is an alternate action switch/indicator which is enabled only in the Off-line mode and when the transport is Ready.

When the switch is depressed, the indicator lights and the tape will move backward at the prescribed speed. When the switch is depressed again, tape stops and the indicator is extinguished.

If the BOT tab is encountered while moving backward, tape stops but the indicator will remain lit.

3.5 INTERFACE INPUTS (CONTROLLER TO TRANSPORT)

All waveform names are chosen to correspond to the logical true condition. Drivers and receivers belong to the DTL 830 series where the True level is 0v and the False level is between +3v and +5v. Figure 1-3 is a schematic of the interface circuit.

3.5.1 SELECT (SLT)

This is a level which, when true, enables all the interface drivers and receivers in the transport, thus connecting the transport to the controller.

It is assumed that all of the Interface inputs discussed in the following paragraphs are gated with SELECT.

3.5.2 SYNCHRONOUS FORWARD COMMAND (SFC)

This is a level which, when true and the transport is Ready (see Paragraph 3.6.1), causes tape to move forward at the specified velocity. When the level goes false, tape motion ceases. The velocity profile is trapezoidal with nominally equal rise and fall times.

3.5.3 SYNCHRONOUS REVERSE COMMAND (SRC)

This is a level which, when true and the transport is Ready (see Paragraph 3.6.1), causes tape to move in the reverse direction at the specified velocity. When the level goes false, tape motion ceases. The velocity profile is trapezoidal with nominally equal rise and fall times. An SRC will be terminated upon encountering the BOT tab, or ignored if given when the tape is at Load Point.

3.5.4 REWIND COMMAND (RWC)

This is a pulse (minimum width of 2 μ sec) which, if the transport is Ready, causes tape to move in the reverse direction at approximately 150 ips. Upon reaching BOT, the rewind ceases and the Load sequence is automatically initiated. Tape now moves forward and comes to rest at BOT.

The REWIND indicator is lit for the duration of the Rewind and the following Load sequence.

An RWC is ignored if tape is already at BOT.

The velocity profile is trapezoidal with nominally equal rise and fall times of approximately 0.5 second.

3.5.5 SET WRITE STATUS (SWS)

This is a level which must be true for a minimum period of 20 μ sec after the front edge of an SFC (or SRC) when the Write mode of operation is required. The front edge of the delayed SFC (or SRC) is used to sample the SWS signal and sets the Write/Read flip-flop in the transport to the Write state.

If the Read mode of operation is required, the SWS signal must be false for a minimum period of 20 μ sec after the front edge of a SFC (or SRC), in which case the Write/Read flip-flop will be set to the Read state.

3.5.6 WRITE DATA LINES (WDP, WD0 - WD7, 9-Channel; WDP, WD2 - WD7, 7-Channel)

These are levels which, when true, at WRITE DATA STROBE (WDS) time (when the transport is in the Write status) result in a flux reversal being recorded on the corresponding tape track. These lines must be held steady during the WDS, and for 0.5 μ sec before and after the WDS pulse.

3.5.7 WRITE DATA STROBE (WDS)

This is a pulse (2 μ sec minimum) for each character to be recorded. It samples each of the WRITE DATA lines and toggles the appropriate flip-flops in the write register when a "1" is written. The WDP, WD0 - WD7 levels must be steady during and for 0.5 μ sec before and after the WDS. Toggling of the write register is initiated by the trailing edge of WDS.

The recording density is determined by tape speed and the frequency of the WDS pulses. Frequency stability should normally be better than 0.25 percent.

An additional WDS pulse, accompanied by the appropriate levels on WDP, WD0 - WD7 is required to write the Cyclic Redundancy Check Character (CRCC) in 9-channel systems, four character spaces after the last data character. The Longitudinal Redundancy Check Character (LRCC) is written by a pulse on control line WARS, eight character spaces after the last data character (four character spaces for 7-channel).

3.5.8 WRITE AMPLIFIER RESET (WARS)

This is a pulse (2 μ sec minimum) which causes the LRCC to be written onto tape eight character spaces (four character spaces for 7-channel) after the last data character has been written. The pulse resets the write register causing all channels to be erased in a uniform direction in the Inter-Record Gap (IRG). The LRCC is written coincident with the leading edge of this pulse.

3.5.9 OFF-LINE (OFFC)

This is a level or pulse of a minimum width of 2 μ sec which resets the On-line flip-flop to the false state, placing the transport under manual control.

It is gated in the transport by SELECT only, allowing an OFF-LINE command to be given while a rewind is in progress.

OFF-LINE must be separated by at least 2 μ sec from a REWIND command.

3.5.10 OVERWRITE (OVW)

This is a level which, when true, conditions appropriate circuitry in the transport to allow updating (rewriting) of a selected record. The transport must be in the Write mode of operation to utilize the OVW feature.

3.5.11 DATA DENSITY SELECT (DDS) (OPTIONAL)

This is a level which, when true, conditions the Read electronics to operate in the High Density mode and causes the HI DEN indicator to be lit.

When this option is selected, the manual HI DEN switch is disabled.

3.6 INTERFACE OUTPUTS (TRANSPORT TO CONTROLLER)

It is assumed that all the Interface outputs discussed in the following paragraphs are gated with SELECT.

3.6.1 READY (RDY)

This is a level which is true when the transport is ready to accept any external command; i. e., when

- (1) Tape tension is established.
- (2) The initial LOAD or REWIND command has been completed.
- (3) There is no subsequent REWIND command in progress.
- (4) The transport is On-line.

3.6.2 READ DATA (RDP, RD0 - RD7, 9-Channel; RDP, RD2 - RD7, 7-Channel)

The individual bits of each character are assembled into parallel form in a one-stage deskewing register. The register outputs drive the Read Data interface lines.

The complete character is obtained by sampling the interface lines simultaneously with the trailing edge of the Read Data Strobe (RDS).

3.6.3 READ DATA STROBE (RDS)

This is a pulse with a minimum width of 1 μ sec for each data character read from tape. The trailing edge of this pulse should be used to sample the Read Data lines.

Although the average time between adjacent RDS pulses is $\frac{1}{BV}$, where B is the bit density and V is the tape velocity, this may vary considerably because of skew and bit crowding effects.

3.6.4 ON-LINE

This is a level which is true when the On-line flip-flop is set. When true, the transport is under remote control; when false, the transport is under local control.

3.6.5 LOAD POINT (LDP)

This is a level which is true when the transport is Ready and tape is at rest with the BOT tab under the photo-tab sensor. The signal goes false after the tab leaves the photosensor area.

3.6.6 END OF TAPE (EOT)

This is a level which, when true, indicates that the EOT reflective tab is positioned under the photo-tab sensor.

3.6.7 REWINDING (RWD)

This is a level which is true when the transport is engaged in any Rewind operation or the Load sequence following a Rewind operation.

3.6.8 FILE PROTECT (FPT)

This is a level which is true when power is on and a reel of tape, without a Write Enable ring installed, is mounted on the transport.

3.6.9 DATA DENSITY INDICATOR (DDI)

This is a level which is true whenever the Read electronics are conditioned to operate in the High Density mode. This condition can be created either by the external DDS signal or the local HI DEN switch, depending on the option selected (see Paragraphs 3.4.6 and 3.5.11).

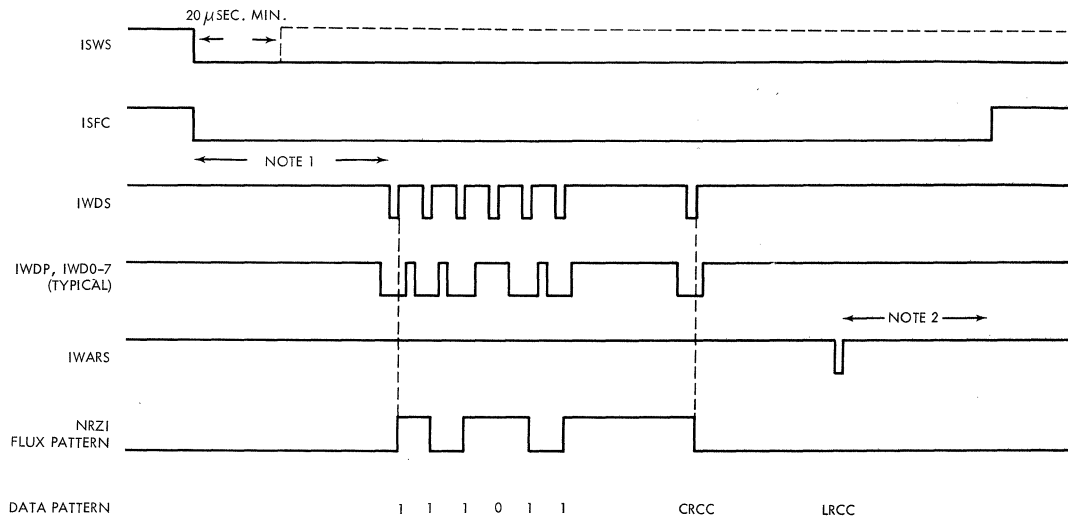
3.7 INTERFACE TIMING

3.7.1 WRITE WAVEFORMS

Figure 3-2 shows the write waveforms. The controller generates all command waveforms.

3.7.2 READ WAVEFORMS

Figure 3-3 shows the read waveforms.



NOTES:

1. PRE-RECORD DELAY SHOULD BE CALCULATED TO PRODUCE 3.5 INCHES OF TRAVEL WHEN STARTING FROM BOT; OTHERWISE 0.4 INCH IN A 9-CHANNEL TRANSPORT AND 0.51 INCH IN A 7-CHANNEL TRANSPORT.
2. THE POST-RECORD DELAY SHOULD BE CALCULATED TO PRODUCE 0.075 INCH OF TRAVEL AFTER THE LRCC HAS BEEN DETECTED BY THE READ ELECTRONICS, BEFORE REMOVING THE SFC.

Figure 3-2. Write Waveforms

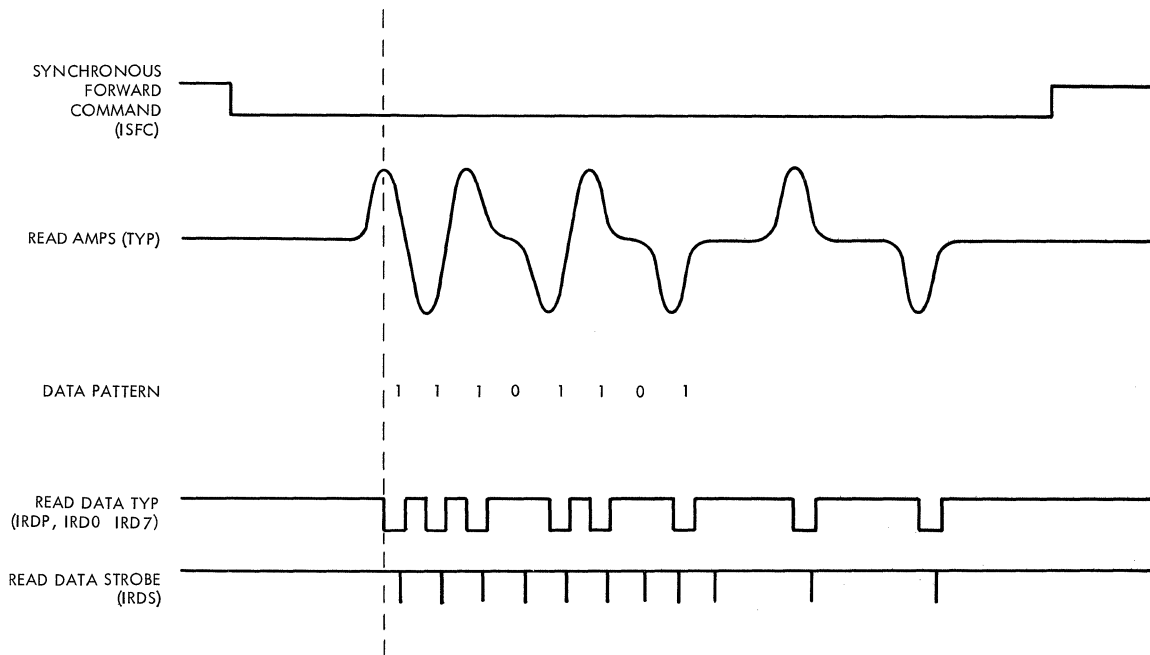


Figure 3-3. Read Waveforms

SECTION IV THEORY OF OPERATION

4.1 INTRODUCTION

This section provides a description of the operation of the tape transport.

The transport consists of the mechanical and electronic components necessary to handle magnetic tape in such a manner that data can be reproduced from a tape recorded on an IBM digital tape transport or its equivalent, and a tape can be generated from which data can be completely recovered when played back on an IBM transport or its equivalent.

The transport consists of the following components.

- (1) Power supply
- (2) Capstan drive system
- (3) Tape storage and reel servo systems
- (4) Magnetic head and associated tape guides and cleaner
- (5) Data electronics
- (6) Control logic and interlock system

4.2 ORGANIZATION OF THE TRANSPORT

A highly modular construction has been adopted with all of the major components and subassemblies interconnected by means of connectors rather than the more conventional wiring techniques. See Figure 4-1.

Three (or four) printed circuit boards are employed. The first, the Servo and Power Supply board, is mounted to a common heatsink extrusion which is secured to the power supply module. It contains the

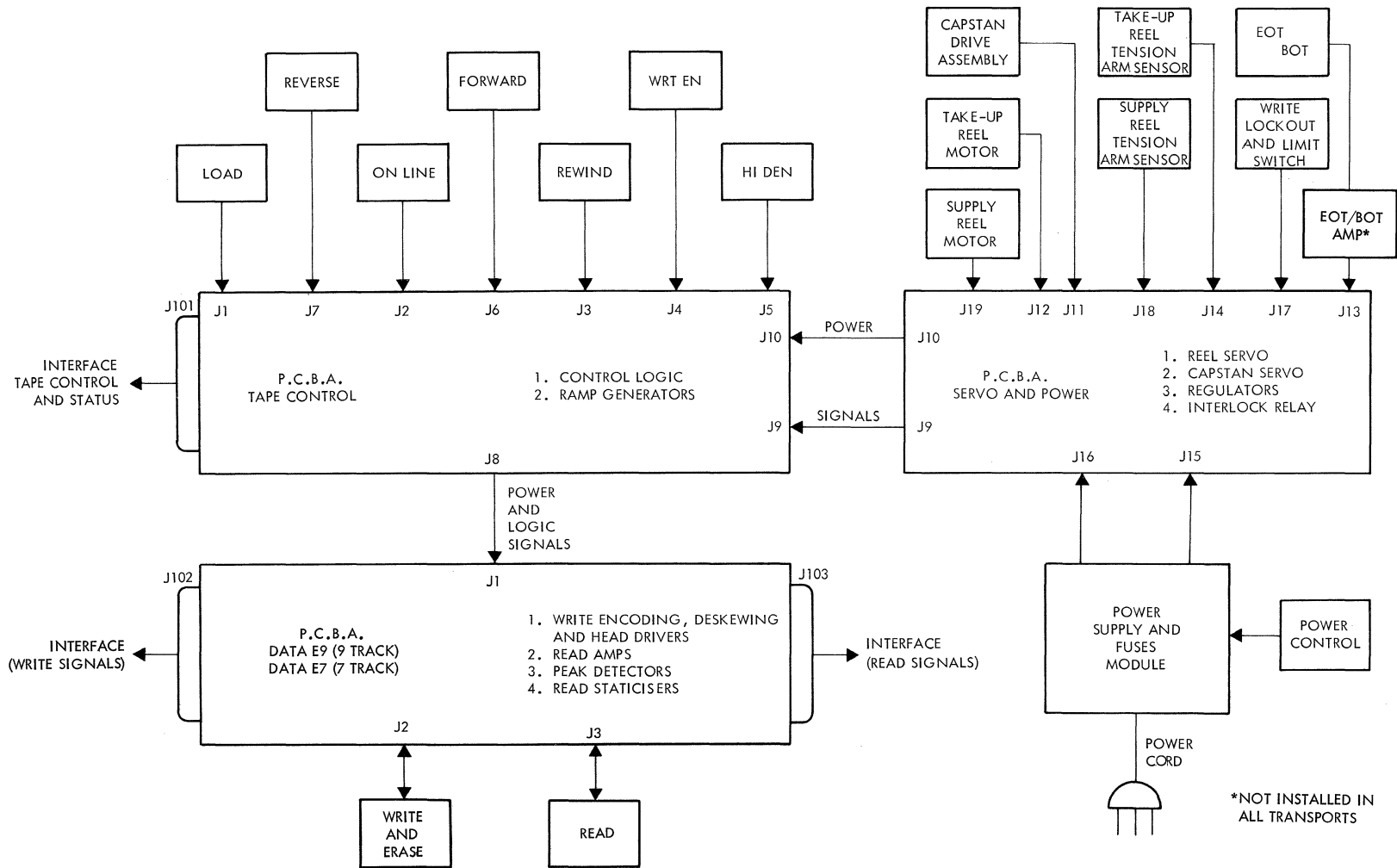


Figure 4-1. Organization of the Model 6X40 Tape Transport

reel servo amplifiers, capstan servo amplifier, voltage regulators, photo-tab sensor amplifiers, and interlock relay. With the exception of the magnetic head and the manual control switches, all of the deck-mounted components (power supply, motors, tension arm position sensors, photo-tab sensors, etc.) plug directly into locations on the board.

Two other boards are mounted in slides parallel to the rear of the deck plate. They are the Data circuit board, closest to the deck plate, and the Tape Control circuit board.

The Data board is concerned with the writing and reading of data. Write data enters by means of a printed-circuit edge connector on one end of the board; it is encoded, deskewed, and the results transferred to the write head through the appropriate connector (one of two) in the middle of the board. Signals from the read head enter the circuit board via the second of the two connectors and are fed to the amplifiers, peak detectors, read staticisers, and transmitters. Digital read signals, together with a READ DATA STROBE are transmitted by means of a second interface edge connector.

DC power and three control levels are obtained from the Tape Control board via a single harness.

The Tape Control board contains the ramp command generators for the capstan servo, together with the control logic. All of the manual controls, except POWER, plug directly into this board. The printed-circuit edge connector carries interface signals to and from the board.

DC power and control signals are passed between this board and the Servo and Power Supply board via a twin harness.

The harnesses from the three interface connectors are merged, strain relieved, and leave the transport.

The fourth board is the EOT/BOT Amplifier which is present only on certain transports since early versions did not incorporate the EOT/BOT feature.

4.3 FUNCTIONAL SUBSYSTEMS DESCRIPTIONS

4.3.1 POWER SUPPLY

Figure 4-2 is a block diagram of the power supply which is in two parts. The first part, the power supply module, is fastened to the deck plate and contains the power transformer, rectifier, capacitors, fuses, and a number of power resistors and diodes. Four unregulated supplies are generated at nominal voltages of $\pm 45\text{v}$ and $\pm 18\text{v}$.

The second part consists of the $\pm 10\text{v}$ and $\pm 5\text{v}$ voltage regulators which are located on the Servo and Power Supply board. Interconnection between the two parts is provided by a harness from the power supply module which plugs into the Servo and Power Supply board via two 9-pin connectors.

The transformer primary connections are shown in Figure 4-3 for several line voltages. Line voltage is connected to the transformer via the POWER control. The POWER control neon indicator is always connected across terminals 1 and 3, i. e., 115v ac, independent of selected line voltage. Unregulated dc (at a nominal $\pm 18\text{v}$ under load) is used to power the motors and voltage regulators. Four unregulated supplies are generated. The $\pm 10\text{v}$ supplies can supply up to 1.0 amp. The $\pm 5\text{v}$ supplies are adjusted, regulated, and can supply 3.0 amps and 1.0 amp, respectively.

Since Diode Transistor Logic (DTL) integrated circuits are widely used, it is necessary to use an SCR for "crowbar" protection against over-voltage on the +5v line. The circuits can withstand up to 12v for 1 second. When the +5v line rises to +8v, the SCR connected between +18v and 0v fires. This holds the voltage on the ICs down until the fuse blows a few milliseconds later.

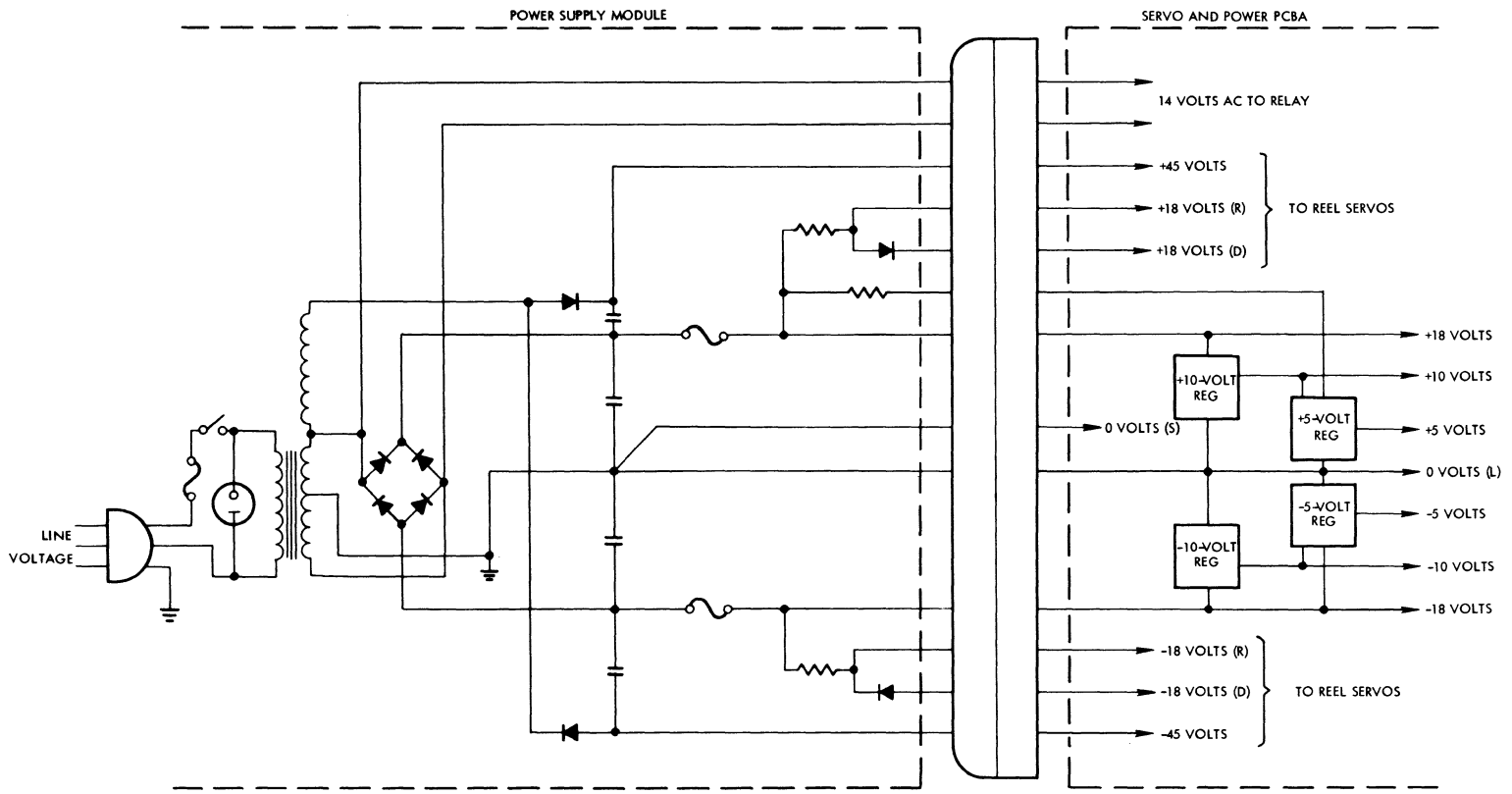
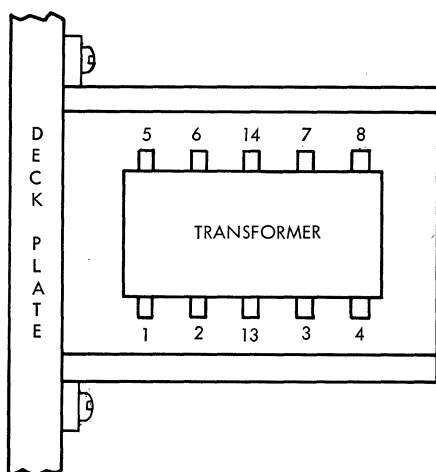


Figure 4-2. Block Diagram of Power Supplies



LINE VOLTAGE	LINE BETWEEN	LAMP	CONNECT
95	14 AND 3	1	3 TO 7 AND 13 TO 14
105	7 AND 2	4	2 TO 6 AND 3 TO 7
115	7 AND 1	3	1 TO 5 AND 3 TO 7
125	8 AND 1	3	1 TO 5 AND 4 TO 8
190	7 AND 13	4	3 TO 14
210	7 AND 2	4	3 TO 6
220	7 AND 1	3	3 TO 6
230	7 AND 1	3	3 TO 5
240	8 AND 1	3	3 TO 5
250	8 AND 1	3	4 TO 5

NOTE: THIS TABLE APPLIES TO POWER SUPPLY ASSEMBLY NO. 100990-01, REV. L AND SUBSEQUENT

Figure 4-3. Transformer Primary Connections

The $\pm 45v$ supplies are utilized by the reel servos during high-speed re-wind operation so that the final amplifiers can supply the necessary drive voltage to the reel motors. The power diodes form part of the switch circuit that supplies the $\pm 45v$ during rewind. The power resistors are used to reduce dissipation in the heatsink from the reel amplifier and the $+5v$ regulator.

4.3.2 CAPSTAN SERVO

Figure 4-4 is a block diagram of the capstan servo. It consists of three parts: the deck-mounted capstan drive assembly, consisting of the motor-tachometer combination and the capstan; the ramp generators on the Tape Control board; and, the capstan drive amplifier on the Servo and Power Supply board. A relay contact disconnects the motor when tape tension is lost.

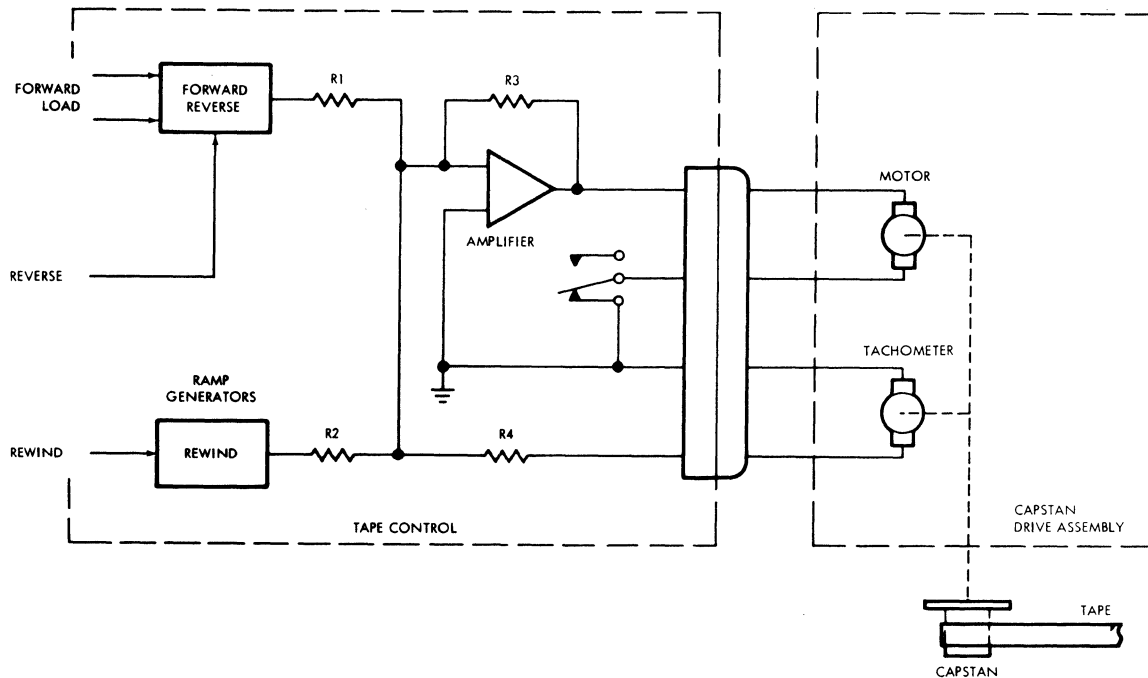


Figure 4-4. Capstan Servo Block Diagram

The tape is moved by the capstan at a velocity determined by the velocity servo and the output of one of the two ramp generators. If the Forward ramp generator is selected by the logic, the voltage at resistor R1 rises at a rate corresponding to the required start time of the tape. The amplifier then accelerates the motor and the tape; the feedback voltage from the tachometer produces current in resistor R4, which tends to reduce the amplifier input current produced by the selected ramp generator. The voltage at resistor R1 stops rising after the required start time and the velocity builds up to the point where the currents in resistors R4 and R1 are approximately equal and opposite.

The Forward ramp generator is activated by the SYNCHRONOUS FORWARD command (SFC) or a Load sequence. The Reverse ramp generator is activated by a SYNCHRONOUS REVERSE command (SRC) and the Rewind ramp generator by a REWIND command (RWC), either

remote or manual. When the transport is in the standby condition, neither ramp generator is activated. In this case, the capstan position is maintained by motor friction.

Both Forward and Reverse ramps rise and fall in a time calculated to produce start-stop distances of 0.19 ± 0.02 inch, e.g., 8.33 milliseconds for a 45 ips transport. Typical waveforms are shown in Figure 4-5.

The Rewind ramp rise and fall times are not critical; they are approximately 0.5 second and are chosen so as to allow the reel servos to keep up with the rise and fall in tape speed.

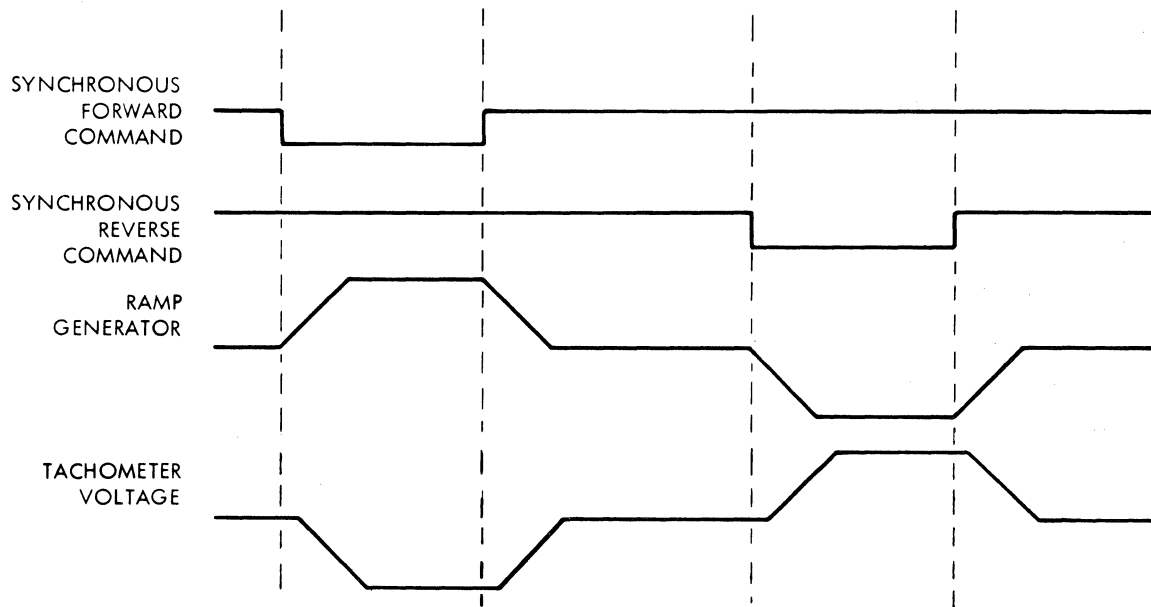


Figure 4-5. Typical Capstan Servo Waveforms

4.3.3 REEL SERVO SYSTEM

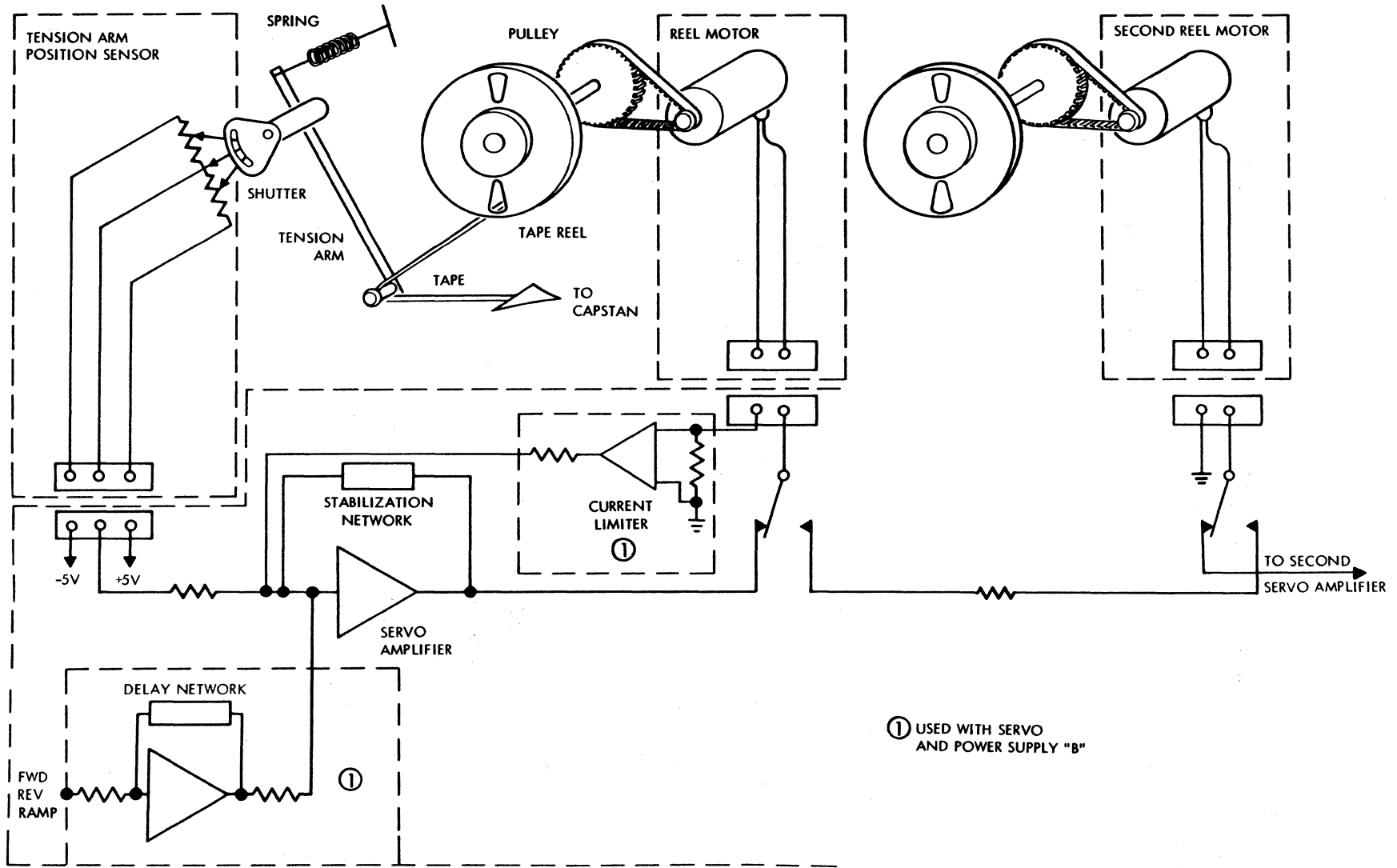
Identical position servos control the supply and take-up of tape by the reels. Figure 4-6 is a diagram of one complete reel servo together with part of a second and the relevant interconnections.

The components of the servo are: (1) tension arm position sensor, (2) pulleys, belt, tension arm, and tape reel, (3) reel motor, and (4) servo amplifiers on the Servo and Power Supply circuit board.

The tension arms establish tape tension and isolate the inertia of the reels from the capstan. Low-friction ball bearing guides are used to minimize tape tension variations. The angular position of the tension arm is sensed by a photosensitive potentiometer which produces a voltage output proportional to the arm position. This output is amplified and drives the reel motor in the direction to center the tension arm. The geometry of the tension arm and spring ensures that only negligible tape tension changes occur as the storage arm moves through a 60-degree arc.

There are two basic versions of the Servo and Power Supply PCBA.

- (1) Servo and Power Supply "A" utilizes a low gain linear amplifier; this provides a critically damped linear servo system which can be used at tape speeds up to 37.5 ips.
- (2) Servo and Power Supply "B" utilizes a high gain amplifier in conjunction with current limiting to provide a non-linear servo system. The Servo and Power Supply "B" enables operation to be extended to a tape speed of 45 ips without changing the mechanical and electro-mechanical components of the transport.



① USED WITH SERVO AND POWER SUPPLY "B"

Figure 4-6. Reel Servo Diagram

4.3.3.1 Operation with Servo and Power Supply "A"

With tape stationary, the storage arms take a position such that the amplified tension arm sensor output, when applied to the reel motor, provides sufficient torque to balance the pull of the tension arm spring.

Initially, the sensor is set by rotating the shutter on the tension arm shaft so that the tension arms operate in the center of their range. The position of the tension arm changes for different steady-state tape velocities. This occurs because the amplifier output varies with the motor back-emf requiring corresponding changes in voltages from the sensor.

When the capstan injects a tape velocity transient in either direction, the arm moves and the sensor output changes, driving the reel motor in the direction to recenter the arm.

Each reel motor is driven by a linear amplifier with lead-lag servo stabilization. The zero of the stabilization network is at 2.7 Hz and the pole is at 12.8 Hz. The low-frequency gain of the amplifier is approximately 3.6 volts per volt. With 10v across the arm sensor, the sensor gain is 4.2 volts per radian and the motor gain is 10 radians per second per volt. The motor velocity is stepped down by a pulley ratio of 4 to 1, so that the open loop gain (reel velocity divided by arm displacement) is 37.5 radians per second per radian. Thus, the arm displacement for a change in tape velocity from 37.5 ips forward to 37.5 ips reverse (an empty reel: ± 14.6 radians per second) is approximately 0.8 radian at 46 degrees.

Without tape, the arm rests against the stops and the tension arm limit switch opens, de-energizing the interlock relay. When the relay is de-energized, the two reel motors are disconnected from their respective amplifiers and connected together through a low resistor (see Figure 4-6), thus providing a dynamic braking effect. The characteristics of the

system ensure that when power is lost in the Rewind mode, the two reels come to rest in such a manner that tape tension is never exceeded and significant tape spillage never occurs. The dynamic braking feature is also useful when tape tension is lost in the tape unload operation.

In the Rewind mode, the characteristics of the reel servos are altered by electronic switching as follows.

- (1) The relevant parts of the two reel servo amplifiers are connected to +36v and -36v instead of +18v and -18v. This allows the amplifiers to supply sufficient output voltage to enable the reel servos to follow tape speeds of 150 ips.
- (2) The low frequency gain of the servos is increased by a factor of approximately 2; in addition, a voltage from the Rewind ramp generator is added to the feedback from the tension arm sensor. Therefore, the displacement of the tension arm required to generate the necessary amplifier output at 150 ips is reduced, minimizing the tension arm stroke requirements.

4.3.3.2 Operation with Servo and Power Supply "B"

With tape stationary, the storage arms take a position such that the amplified tension arm sensor output, when applied to the reel motor, provides sufficient torque to balance the pull of the tension arm spring.

Initially, the sensor is set by rotating the shutter on the tension arm shaft so that the tension arms operate in the center of their range.

When the capstan injects a tape velocity transient in either direction the arm moves and the high gain amplifier, together with the current limiter, cause a predetermined current to flow in the reel motor in such

a direction to recenter the arm. In addition, however, a voltage from the Forward/Reverse capstan ramp generator, suitably delayed, is subtracted from the arm sensor input. This causes the steady state displacement of the arm to be large in spite of the high amplifier gain so that storage associated with the complete arm movement is available when the capstan velocity reverses. The high amplifier gain ensures little variation in arm displacement as the reel velocity varies due to changes in effective reel diameter from an empty to full reel.

The amplifier gain is 33 volts per volt, the motor gain is 10 radians per second per volt, and the motor velocity is stepped down by 4 to 1. If the arm is displaced 0.4 radian (one-half of the total possible displacement) the output from the arm sensor gain (4.2 volts per radian) is $0.4 \times 4.2 = 1.68\text{v}$. The magnitude of the voltage from the Forward/Reverse ramp generator is 4.8v and the gain of the delay network is 0.305 volts per volt. Thus, the output of the delay network is $0.305 \times 4.8 = 1.46\text{v}$. The angular velocity of the reel is therefore

$$(1.68 - 1.46) \times 33 \times 10 \div 4 = 18 \text{ radians per second}$$

This corresponds to a linear tape speed of 45 ips for an empty reel (5-inch diameter). Thus, the arm displacement from 45 ips forward to 45 ips reverse is 0.8 radian. When the reel is full (10-inch diameter) the required velocity is only 9 radians per second. This requires an arm sensor input of 1.57v instead of 1.68v which corresponds to a change of arm displacement of 0.03 radian, or less than 10 percent.

The zeros of the stabilization network are at 1.45 Hz and 1.75 Hz and two poles at 0.3 Hz and 150 Hz.

Without tape, the arms rest against the stops and the tension arm limit switch opens, de-energizing the interlock relay. When the relay is de-energized, the two reel motors are disconnected from their respective

amplifiers and connected together through a low resistor (see Figure 4-6), thus providing a dynamic braking effect. The characteristics of the system ensure that when power is lost in the Rewind mode, the two reels come to rest in such a manner that tape tension is never exceeded and significant tape spillage never occurs. The dynamic braking feature is also useful when tape tension is lost in the tape unload operation.

In the Rewind mode the relevant parts of the two reel servos are connected to +36v and -36v instead of +18v and -18v. This allows the amplifiers to supply sufficient output voltage to enable the reel servos to follow tape speeds of 150 ips.

4.3.4 DATA ELECTRONICS

Information is recorded in the NRZI mode, i.e., a "1" on the information line causes a change of direction of magnetization between positive and negative saturation levels. Two tape formats are in general use. They are the IBM 727/729 7-track format which can operate at 200, 556, and 800 cpi, and the IBM 2400 9-track format which operates at 800 cpi.

Figures 4-7 and 4-8 illustrate the relevant 9- and 7-track allocations and spacing. In the 9-track system, consecutive data channels are not allocated to consecutive tracks. This organization increases tape system reliability because the most used data channels are located near the center of the tape. Consequently, they are least subject to errors caused by contamination of the tape.

Illustrated in Figure 4-9 are waveforms that occur on a channel during a write and read-back operation. Magnetization transitions recorded on the tape are not perfectly sharp because of the limited resolution of the magnetic recording process.

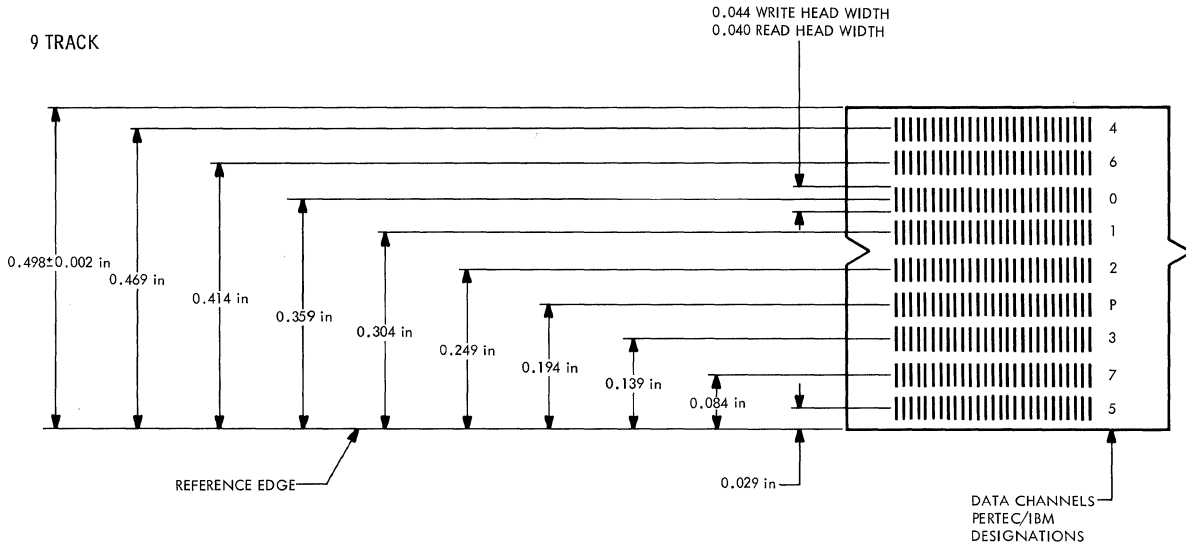


Figure 4-7. 9-Track Allocation and Spacing

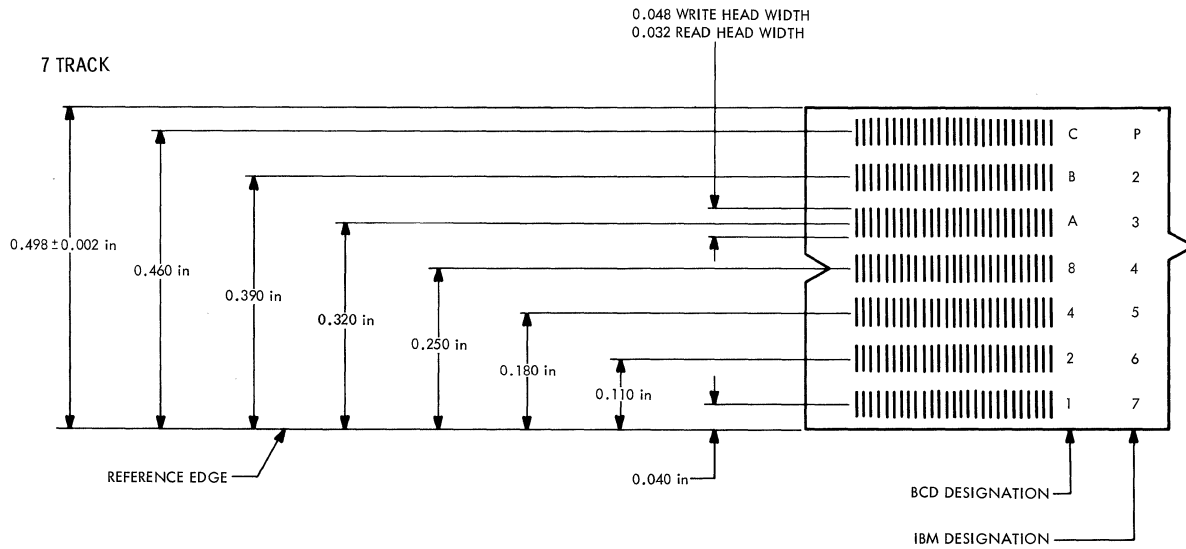


Figure 4-8. 7-Track Allocation and Spacing

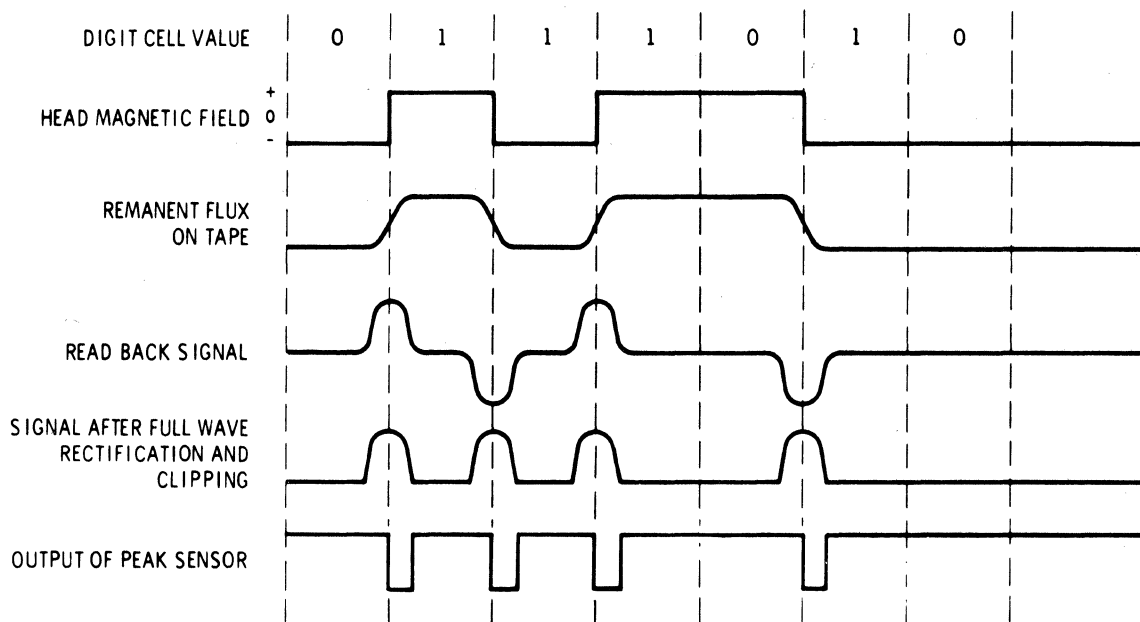


Figure 4-9. Write and Read Waveforms

During reading, the amplified read-back voltage is full-wave rectified (because no significance is attributable to the sign of the read-back voltage) and clipped to remove baseline noise. This is necessary because there is no read signal output for a recorded '0'. The output of the rectifier is peak detected and a pulse generated for each '1' recorded. These pulses are fed to a set of read staticisers and then to the interface.

Figure 4-10* is a functional logic diagram of one channel of data electronics and the relevant common control logic. This diagram is to be used only for purposes of describing system operation.

4.3.4.1 Operation with a Dual-Gap Head

The 6X40 transport utilizes a dual-gap head which enables simultaneous read and write operations to take place, thus allowing writing and checking of data in a single pass.

* Foldout drawing, see end of this section.

Gap scatter in both the write and read heads is held within tight limits so that correction is not necessary. Conversely, the azimuth angle of both heads is not held within such tight limits and correction is therefore necessary.

The read head azimuth adjustment is provided by shimming the fixed head guides adjacent to the head so that the tape tracks at 90 degrees to the read head azimuth. Since the write and read heads are constructed in the same block, an independent method of azimuth adjustment is required for the write head. This is achieved electronically by triggering the write waveform generators for different channels sequentially and at such times that the azimuth error in the write head is nullified.

4.3.4.2 Data Recording

Figure 4-11* shows a timing diagram for data recording. Assume that the transport is Selected, Ready, On-line, and has a Write Enable ring installed. The WRT PWR control line will therefore be at +5v, providing power for the head driver circuits.

When a SYNCHRONOUS FORWARD command is received, the MOTION signal generated on the Tape Control board goes high, removing one input of OR gate U8. See Figure 4-10*.

In operation, the front edge of the SYNCHRONOUS FORWARD command is delayed and differentiated and the resulting pulse is used to sample the condition of the SET WRITE STATUS line. If this is true, the following action takes place.

- (1) The Write/Read mode flip-flop U20 (see Paragraph 4.3.5.6) is set.
- (2) The NWRT waveform becomes low.
- (3) Erase driver Q3 is energized.

* Foldout drawing, see end of this section.

- (4) Both the S_D and C_D inputs of flip-flop U4 go high. The action of the "stretcher" circuit is to delay the rise of the C_D input relative to the S_D input ensuring that the flip-flop is in the reset state before a recording starts. The polarity of the field from the erase and write heads under these conditions is such that tape will be erased in an IBM-compatible direction.
- (5) The C_D input of control flip-flop U9 goes high, unclamping the flip-flop.

The SFC command (Plot 1 on Figure 4-11) also enables the ramp generator, which causes tape to accelerate to the prescribed velocity (Plot 2). After a time (T1) determined by the required inter-record gap (IRG) displacement, the WRITE DATA inputs together with the WDS are supplied to the interface connector.

The WRITE DATA (IWD^{*}) input is received by interface receiver U1 and, when true, enables one input of AND gate U2. The IWDS pulse is received by interface receiver U5 and fed to AND gate U2. The output of gate U2 is thus a positive-going pulse at WDS time. The leading edge of the positive-going pulse from U2 enables the J input of the J-K write waveform generator flip-flop U4 directly, and also the K input of the flip-flop via OR gate U3. Since the clock input of U4 is high at this time, the master section of U4 is toggled whenever the IWD signal is true.

Each WDS (Plot 3) is also fed to flip-flop U9 which is set on the trailing edge (Plot 4). This unclamps the oscillator, which then generates a series of pulses at a high frequency (Plot 5). The pulses are fed to the shift register, which produces 10 negative-going outputs consecutively on 10 wires.

* Interface lines connecting transport to controller are prefixed by "I".

The 9 outputs (T1 through T9) are used to toggle the output (slave) sections of the write waveform generator flip-flops (U4 typically) in the appropriate time order so as to achieve azimuth deskewing of the recording system. Plots 6 and 7 show the write current in the WD5 and WD2 channels for a 9-track system. The tenth output (T10) resets flip-flop U9, terminating the sequence of events. In practice, the oscillator frequency is adjusted to compensate for the azimuth error in the particular head being used.

Both outputs of flip-flop U4 are fed to head driver transistors Q1 and Q2 which cause current to flow in one half or the other of the center-tap head winding. Consequently, magnetization on the tape is maintained in the appropriate direction between changeovers and changes direction for each "1" bit to be recorded (as required by the IBM NRZI format).

At the end of each record, check characters have to be recorded and an IRG inserted. Figures 4-12 and 4-13 show the IBM IRG format for 9- and 7-track systems.

In a 9-track system, both a CRCC and LRCC are written. The CRC character is supplied by the customer to the interface, together with a single WDS signal whose trailing edge is separated by four character times from the trailing edge of the last WDS. The LRC character is written by resetting all the write waveform generator flip-flops using the WRITE AMPLIFIER RESET signal (IWARS) received by interface receiver U6. The timing of this reset operation is controlled by the leading edge of the WARS signal, which should be separated by eight character times from the trailing edge of the last WDS (Plot 8).

The output of U6 is fed to OR gate U3 and the positive-going output is fed to the K input of the write waveform generator flip-flops (typically U4) and resets the master sections of these flip-flops. In addition, the leading edge of the WARS signal is differentiated and sets flip-flop U9.

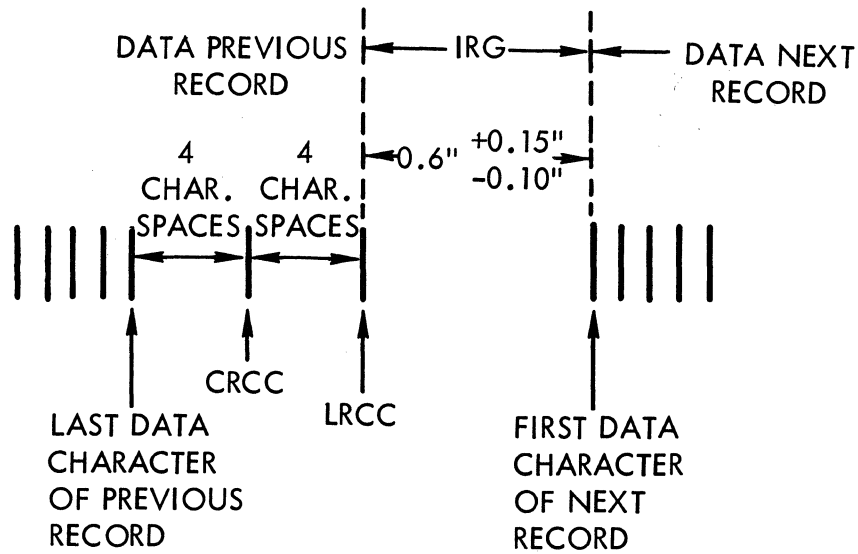


Figure 4-12. 9-Track IRG Format

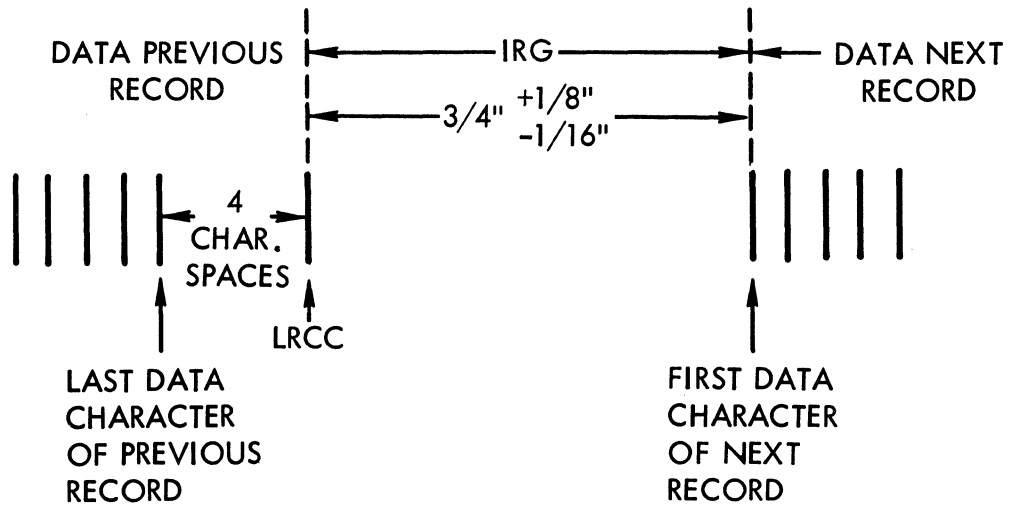


Figure 4-13. 7-Track IRG Format

A sequence of pulses is produced as described, which toggles the write waveform generator flip-flops to the reset state in the appropriate order. The LRCC is written such that the total number of magnetization transitions in any track is even.

In a 7-track system, only the LRCC is written; this is achieved again by the WARS signal. Consequently, the leading edge must be separated four character times from the trailing edge of the last WDS.

When the LRCC has been recorded, the SFC command goes false after the post-record delay time (T2), the ramp generator is disabled and the tape decelerates to zero velocity.

The IRG displacement consists of the following.

- (1) The stop distance: the distance traveled during the tape deceleration period to zero velocity.
- (2) The start distance: the distance traveled while the tape is accelerating to the prescribed velocity.
- (3) An additional distance determined by the pre-record time (T1), from the SFC command going true to the time of the first WDS and the post-record time (T2) from the LRCC to the SFC going false. (Time delays T1 and T2 are provided by the customer's controller.)

To separate files of information on tape, a file gap is used. This is identified by a special character on the tape followed by its LRC character. Figures 4-14 and 4-15 describe the IBM file gap formats for 9- and 7-track systems.

A file gap is inserted under external control by the customer controller. An SFC is given, followed at the appropriate time by the File Mark

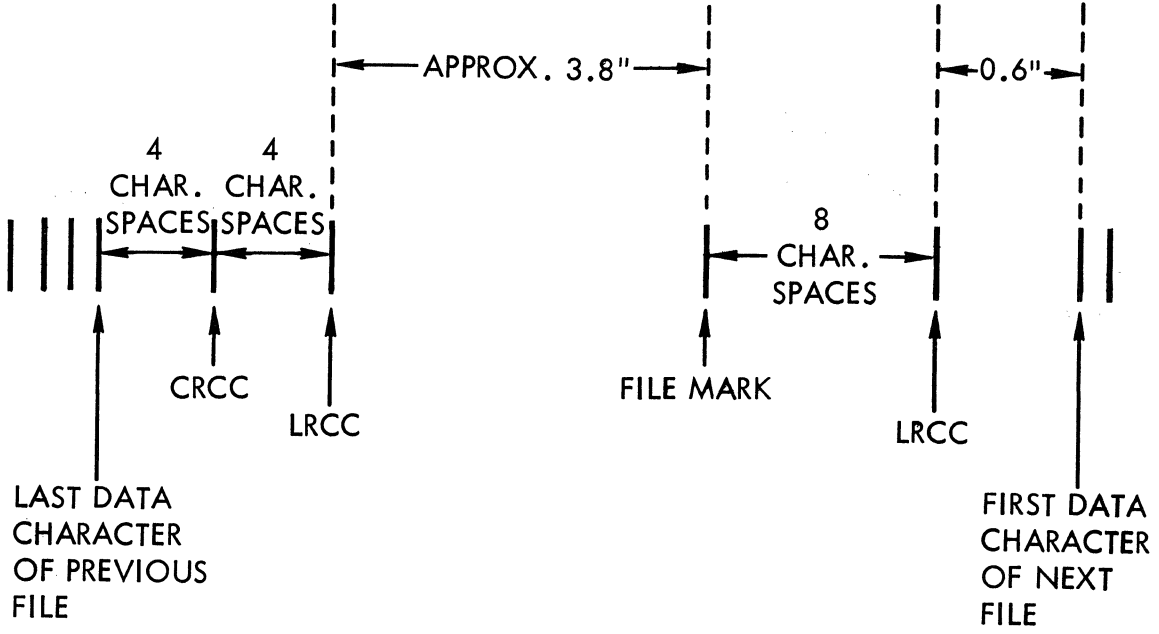


Figure 4-14. 9-Track File Gap Format

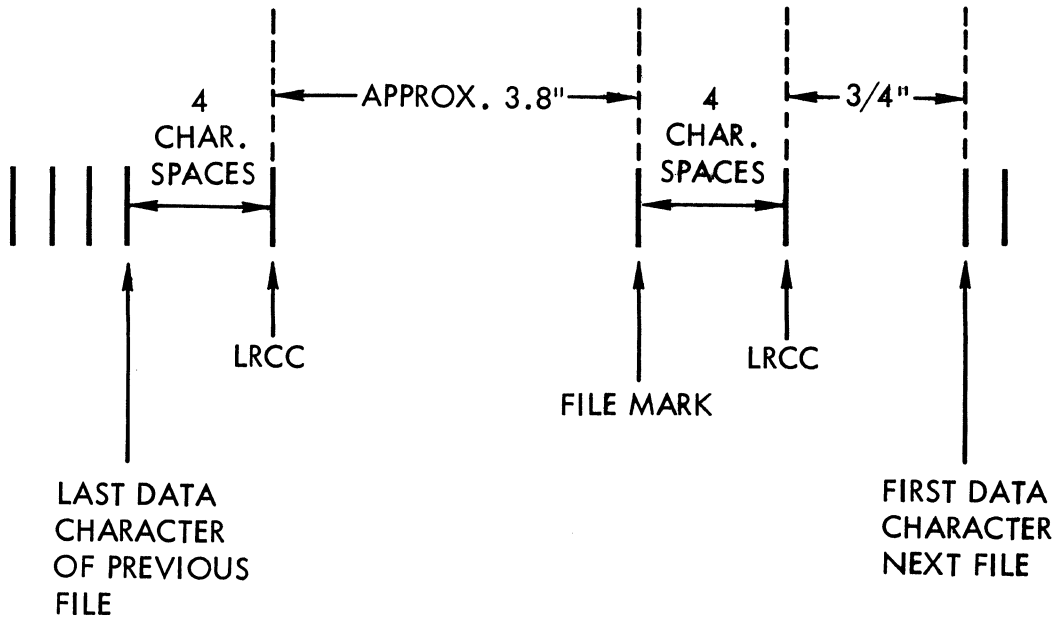


Figure 4-15. 7-Track File Gap Format

character (a "1" in data bit positions WD4, 5, 6, and 7 for 7-track systems, and a "1" in data bit positions WD3, 6, and 7 for 9-track systems), together with its WDS, followed by the LRC character (written using the WARS signal) after four character times in a 7-track system, and after eight character times in a 9-track system.

4.3.4.3 Overwrite (OVW)

The Overwrite function provided in the transport allows updating (re-writing) of a selected record. The new data block to be inserted must be exactly the same length as the data block being replaced. This restriction is necessary since replacing a block of data with a block longer than the original could result in an IRG distance which is less than the minimum allowed or in writing over the next record. If the new data block is shorter than the existing block, errors could result since some unerased portion of the old data would remain.

Additionally, when write and erase currents are switched off abruptly there is a small area of tape which is influenced by the collapsing magnetic fields of the heads. This constitutes flux transients on the tape which appear as spurious signals when read back. The Overwrite feature has effectively eliminated this problem by turning the write current off slowly while tape is still in motion.

NOTE

Refer to PERTEC Application Note "Editing Pre-Recorded Tapes, 6000/7000 Series Tape Transports" (Document No. 50259) for control and timing restrictions associated with Overwrite.

To update a previously recorded record, the transport must be Selected, Ready, On-line, and a Write Enable ring installed on the supply reel.

Additionally, the Overwrite (OVW) signal from the controller must be true and coincident with SWS and SFC.

Overwrite operation is terminated by the IWARS signal disabling the write power circuitry. This action causes the write current to ramp down to zero as the tape decelerates to rest. The transient pulse, generated when the write current is switched off, is spread over a longer distance on the tape and produces a negligible signal on replay.

4.3.4.4 Data Reproduction

When an SFC is received, the following occurs.

- (1) The MOTION signal generated on the Tape Control PCBA goes true so that the output of OR gate U14 correspondingly will go high, thus removing the reset signal from the read staticiser flip-flops (typically U14).
- (2) The Forward ramp generator is enabled and the tape accelerates to the prescribed velocity.

Data signals from the magnetic head at a level of approximately 10 to 20mv peak-to-peak are fed by a shielded cable to the read amplifier. The amplifier output at a level of approximately 10.5v peak-to-peak is full-wave rectified and baseline clipped. The clip level is variable and is under the control of the NWRT waveform.

In a dual-gap transport, the read system always operates whether the transport is in the Write or Read mode. However, in the Write mode where the reading facility is used to check the data that have been recorded, the NWRT waveform is low and a high clip level of 50 percent is generated. This ensures that data are written with enough margin to ensure data recovery when tape is read on another transport.

If the transport is in the Read mode, the NWRT waveform is high and a clip level of approximately 20 percent is generated, which is only sufficient to reject system noise. After clipping, the signal is fed to a feedback differentiator which generates an edge bearing a fixed time relationship (ideally zero delay) to the peak of the input signal. This edge is differentiated by differentiator 2 to form a pulse for each "1" bit detected. Plots 1 and 2 (see Figure 4-16*) show outputs from the read amplifier for two different channels. In general, skew will exist between the signals as shown. Plots 3 and 4 are the pulse outputs from the peak detector differentiator for the two channels.

The output pulse from differentiator $\delta 2$ is fed to the clock input of the read staticiser flip-flop U14. This flip-flop is set on the negative-going edge of the pulse (Plots 5 and 6).

The Q output from U14 is fed to interface driver U16 while the \bar{Q} output is fed to OR gate U11, where it is ORed with the corresponding outputs of the other channels so that the first data "1" of a character causes the output of U11 to go high (Plot 7), enabling the run-down circuit. The circuit is set for half-a-character period and at the end of this time the output goes low. This edge is differentiated by differentiator $\delta 3$ and generates a nominal 2 δ sec RDS (Plot 8), which is fed to interface driver U17.

The output of the rundown circuit is also delayed and resets the read staticiser flip-flops (typically U14) via OR gate U15. This causes the \bar{Q} outputs of all the read staticiser flip-flops to go high and the rundown circuit is therefore clamped back to its quiescent level. The delay in the loop prevents the READ DATA interface lines from resetting before the trailing edge of RDS.

After the last character of a record has been read (the LRC character), the SFC goes false, the Forward ramp generator is disabled, and tape

* Foldout drawing, see end of this section.

decelerates to rest. In addition, the MOTION signal goes false, applying a reset signal to flip-flop U14 via OR gate U15. (Reproduction in reverse is identical.)

By varying the timing of the rundown circuit, the read staticiser may be used at different packing densities as required for 7-track operation. Control of this timing is provided by the HI DEN manual control on the transport via OR gate U13. Alternatively, the DDS interface line can be used to provide the same function.

4.3.5 TAPE CONTROL SYSTEM

The second major electronic subsystem consists of the circuits necessary to control tape motion. This includes manual controls, interlocks, and logic. Operation can best be described by detailing the Bring-to-Load-Point sequence, subsequent tape motion commands, Rewind sequence, and subsequent unloading of tape. Figure 4-17* is a logic diagram for the Tape Control system.

4.3.5.1 Bring-to-Load-Point System

The system will be described by considering the sequence required to bring a tape to the BOT (or Load Point). Figure 4-18* shows the waveforms during the operation.

Associated with each of the manual control switches is a "switch clean-up" flip-flop (U1, U2, U25) which eliminates the problems of switch contact bounce. Relay K1 has four changeover contacts, three of which (K1A, K1B, and K1C) are used to disconnect the reel and capstan servo motors, and the fourth (K1D) is used in conjunction with the tension arm limit switch as a system interlock. The tension arm limit switch is operated by a cam on the supply reel tension arm and is closed when the cam is in its normal operating position. The tension arm limit switch opens at both extremes of the arm travel so that protection against over-tension as well as under-tension conditions is provided.

* Foldout drawing, see end of this section.

The Write Lockout (WLO) switch is located on the File Protect assembly located behind the supply reel. The switch is closed when a Write Enable ring is mounted on the supply reel. The probe, which detects the Write Enable ring, is retracted when power is switched on and K1D is closed. A solenoid whose transistor driver is supplied with base currents through the WLO switch and K1D retracts the probe. Write current is also supplied on demand through K1D and the WLO switch.

4.3.5.2 Actuate POWER Control

When power is turned on initially (Plot 1), the relay contacts on the tension arm limit switch are open. The INTLK signal is low and is connected either directly or through OR gate U30 to the reset inputs of the five control flip-flops RW1, RW2, RW3, Load, and FLR (U15, U16, U17, U18, and U31).

4.3.5.3 Depress LOAD Control (First Time)

When the LOAD control is depressed for the first time (Plot 3), the relay driver for K1 is turned on, the four contacts close, activating the reel servos which tension the tape, thus closing the tension arm limit switch. The tension arm limit switch supplies an alternate source of base current for the delay driver, thus latching the relay (which remains activated after the LOAD control is released). When K1D closes, a high level appears at the INTLK output (Plot 2), removing the reset signal from the control flip-flops. Load flip-flop U18 is not set by the first operation of the LOAD control because, at the time the C input of U18 goes low (which normally sets the flip-flop), the INTLK signal is still holding the reset input low (closure of the relay contacts is delayed from the appearance of the command level by several milliseconds while the relay contacts close).

If, at any time, the tension arm moves outside its operating region, the interlock relay de-energizes, power is disconnected from the motors, and the INTLK signal returns to the low state, resetting the five control flip-flops.

4.3.5.4 Depress LOAD Control (Second Time)

When the LOAD control is depressed momentarily a second time (Plot 3), the following sequence occurs.

- (1) Since the INTLK signal is high, the Load flip-flop U18 and the FLR flip-flop U31 set (Plots 4 and 5). The Q output of U18 is fed to one input of OR gate U21. The output of OR gate U21 goes low, enabling the Forward ramp generator that drives the capstan servo (not shown). The tape accelerates to the specified speed (Plot 9) and continues to move until the BOT tab reaches the BOT sensor, at which time the BOT signal goes high, enabling one input of AND gate U29. In addition, the single-shot is triggered, generating an 0.5-second negative-going waveform (NBOTD) (Plot 7).
- (2) Since the LOAD waveform and the output of gate U28 are high at this time, AND gate U29 is enabled (Plot 10) and the Load flip-flop is reset. This causes tape to decelerate to rest with the phototab under the phototab sensor. At this time, all three inputs to AND gate U41 are high so that the NLDP waveform is low (Plot 11), indicating that the transport is at Load Point and enabling the Load lamp driver.
- (3) At the end of the 0.5-second delay, the NBOTD waveform (Plot 7) goes high and, since the other two inputs to AND gate U38 are both high at this time, the NREADY waveform at the output of gate U38 goes low (Plot 8), enabling one input of AND gate U39.
- (4) The setting of the FLR flip-flop causes the NFLR waveform to go low, disabling AND gate U10 and thus inhibiting the possibility of further manual LOAD commands.

4.3.5.5 Depress ON LINE Control

If the ON LINE control is momentarily depressed, On-line flip-flop U26 is set (if it is depressed a second time, U26 is reset), enabling the second input of AND gate U39. The Q output of the flip-flop U26 enables the On-line lamp driver. The output of gate U39 goes high, indicating that the transport is Ready and On-line (RO). If the transport is also selected, the output of AND gate U40, the Selected, Ready, On-line (SRO) waveform goes high.

When the transport is On-line, the output of the manual REWIND control flip-flop is disabled by NONLINE at gate U12.

If the transport is Selected, the ISLT waveform is low. The following options are available.

- (1) If W4 is not present, then the SLT waveform goes high-true when the transport is Selected.
- (2) If W4 is present, SLT only goes true if the transport is Selected and On-line.
- (3) If W3 is not present, the SLTA waveform is permanently high and the status lines are enabled. This option is used when interrogation of transport status lines is required, whether the transport is Selected or not.
- (4) If W3 is present, the status lines are gated with the SLT waveform.

When the FLR or INTLK waveforms are low, the On-line flip-flop is held reset by OR gates U23 and U24, ensuring that the On-line flip-flop cannot be set until the interlock has been made and the First Load Rewind sequence has been entered. The On-line flip-flop can also be reset from the interface by the OFF-LINE command (OFFC) via interface receiver U22 and OR gate U24.

The transport is now ready to receive external commands.

4.3.5.6 Operation From External Commands

Assuming the transport is Selected, Ready, and On-line (SRO is high), receipt of an SFC will cause the output of interface receiver U4 to go high and the output of AND gate U6 to go low. The MOTION signal will go high and the Forward ramp generator will be enabled via OR gate U21.

The MOTION signal is delayed approximately 10 μ sec, differentiated, and a positive-going "GO" pulse generated at the output of differentiator δ 1. This pulse samples the status of the SET WRITE STATUS (SWS) line. If SWS is true, indicating that the Write mode is required, then Write/Read flip-flop U20 is set and the NWRT waveform goes low. If SWS is false, U20 is reset and the NWRT waveform goes high. For a SYNCHRONOUS REVERSE command, a similar sequence of events occurs.

If the BOT tab is encountered during the execution of an SRC, the BOT signal goes high, the NBOT signal goes low, and the single-shot is triggered. As a result, AND gate U7 is disabled, inhibiting the action of SRC and the NBOTD waveform goes low for 0.5 second so that the transport becomes Not Ready for this period of time.

4.3.5.7 Operation From Control Panel — Forward

Forward tape motion in response to a remote input command was described in Paragraph 4.3.5.6. When the transport is in the Off-line mode (NONLINE is true) and the FORWARD control is depressed, tape will advance at the specified speed until the FORWARD control is again depressed (or until the transport is placed in the On-line mode).

NOTE

The FORWARD control should be de-activated prior to placing the transport in the On-line mode. Failure to de-activate the FORWARD control will cause tape to advance the next time the transport is placed in the Off-line mode.

The transport cannot write information on tape when motion is caused by the FORWARD command since the Write/Read flip-flop is held reset.

4.3.5.8 Operation From Control Panel — Reverse

Reverse operation is identical to Forward operation described in Paragraph 4.3.5.7 except for direction of tape motion.

4.3.5.9 Rewind Sequence, Case 1 — Tape Not at Load Point

This is the normal Rewind to Load Point sequence that results from either a remote or manual command. Figure 4-19* shows the waveforms that occur during the operation.

In response to either a remote or manual command, the RW1 flip-flop is set (Plot 3). The Q output of the flip-flop enables the Rewind ramp generator via AND gate U28 (since the \overline{Q} output of the RW3 flip-flop is high at this time) and the tape accelerates to a reverse velocity of 150 ips in approximately 0.5 second (Plot 13). In addition, when flip-flop RW1 is set, the output of gate U33 goes low, disabling AND gate U38 and causing the SRO waveform to go false (Plot 12).

When the BOT tab is detected, flip-flop RW2 is set on the leading edge of the BOT waveform (Plot 6), flip-flop RW3 is set on the trailing edge (Plot 7) and the 0.5-second single-shot is triggered (Plot 8). The \overline{Q} output of flip-flop RW3 goes low, disabling AND gate U28. The output of gate U28 goes high, disabling the Rewind ramp generator so that the tape decelerates to rest.

At the end of the 0.5-second delay, the trailing edge of the NBOTD waveform is differentiated by differentiator $\delta 2$ generating a positive-going BOTDP pulse (Plot 9). Since the Q output of flip-flop RW3 is high at this time, Load flip-flop U18 is set via gates U9 and U11. This enables the Forward ramp generator.

*Foldout drawing, see end of this section.

The characteristics of the ramp generators are such that the BOT tab overshoots the photosensor and then returns. When the BOT tab is detected for the second time, the 0.5-second single-shot is triggered (Plot 8), AND gate U29 is enabled and its output goes low, resetting the RW1, RW2, RW3, and Load flip-flops (Plots 3, 6, 7, and 10). The Forward ramp generator is thus disabled and the tape decelerates to rest. The delay between the LOAD waveform and AND gate U29 ensures that the reset waveform is the appropriate length. At the end of the 0.5-second period, the NBOTD waveform goes high and, since the other two inputs are high at this time, gate U38 is enabled and the SRO waveform goes true.

The RW1 waveform (Plot 3) is true throughout the Rewind sequence and is used to generate the REWINDING (IRWD) interface waveform.

4.3.5.10 Rewind Sequence, Case 2 — Tape at Load Point

A manual REWIND command initiates the Rewind sequence as previously described. However, in this case the tape unwinds from the take-up reel and tape tension is lost. Remote REWIND commands are inhibited by the NBOT waveform on AND gate U13, i. e., it is impossible to unload tape remotely — operator intervention is required.

4.3.5.11 Ready Mode From Tape Not at Load Point

An option is available which allows the transport to be placed in the Ready mode after a Power-off, Power-on sequence even though tape has previously been brought beyond the Load Point, e. g., in the middle of a reel.

When this option is present (by deleting jumper W4), depress the LOAD control once to establish tape tension, then depress the ON LINE control. The Ready line will go true and the transport can accept remote commands.

4.3.5.12 Data Density Select

This remote input command is applicable only to 7-track systems. A negative-true level at the DATA DENSITY SELECT (IDDS) input will disable the Hi Density lamp driver, indicating the lower density condition.

The NHID signal is routed to the Data PCBA to enable the appropriate density conditioning for the system.

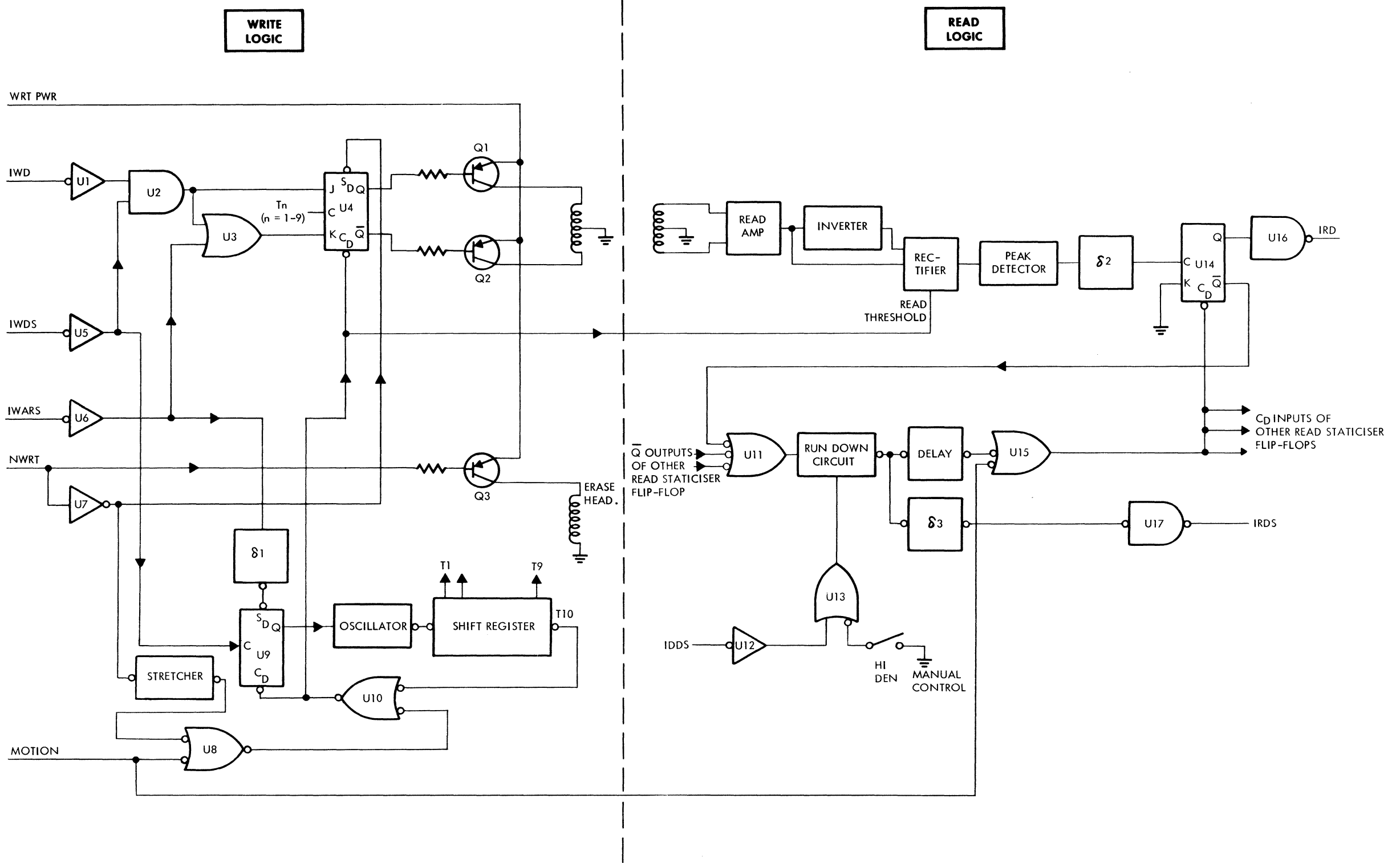
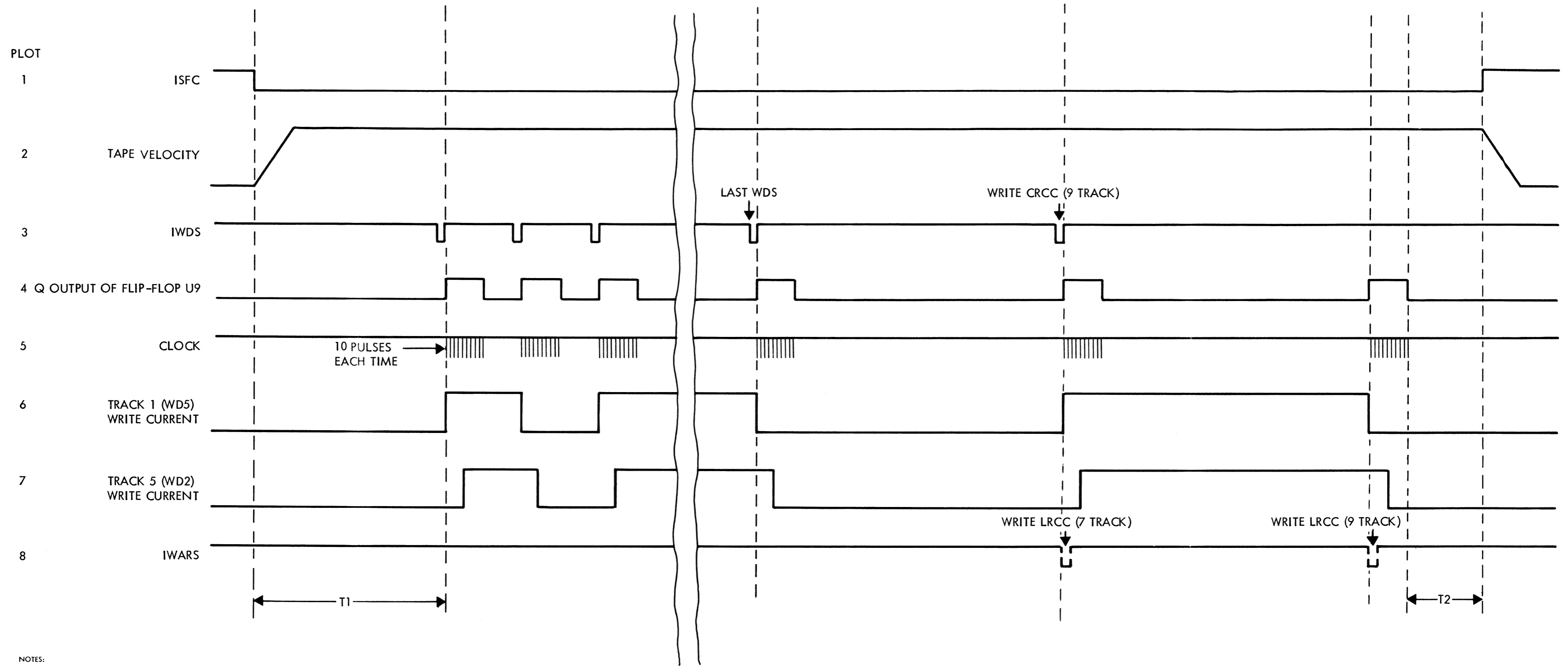
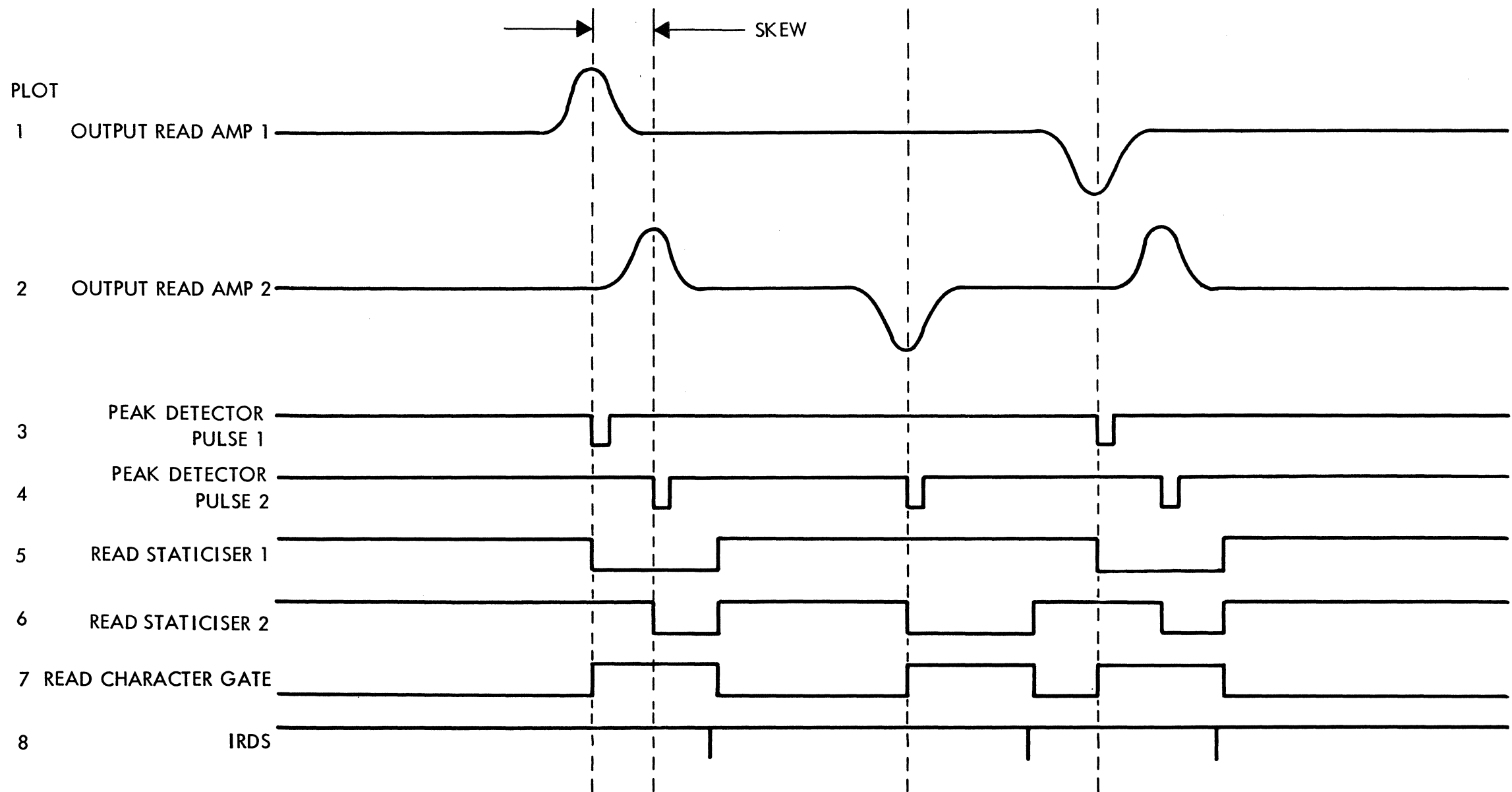


Figure 4-10. Block Diagram, One Channel of Data Electronics



NOTES:
 1. DIAGRAM IS FOR 9-TRACK OPERATION. FOR 7-TRACK OPERATION, THE WDS PULSE (LABELLED WRITE CRCC) AND THE WARS PULSE (LABELLED WRITE LRCC (9-TRACK)) ARE OMITTED AND THE DOTTED WARS PULSE (LABELLED WRITE LRCC (7-TRACK)) IS USED.

Figure 4-11. Timing Diagram, Data Recording



NOTES:

1. SKEW AS SHOWN IS THE TIME DISPLACEMENT BETWEEN THE READ SIGNALS FROM THE TWO TRACKS.

2. THE TOTAL TIME DISPLACEMENT WHILE READING IS THE SUM OF THE SKEW COMPONENT WHICH WAS PRODUCED WHEN THE TAPE WAS WRITTEN (ON THIS OR ANY OTHER TRANSPORT) AND THE SKEW COMPONENT PRODUCED DURING THIS READING PROCESS.

Figure 4-16. Timing Diagram, Data Reproduction

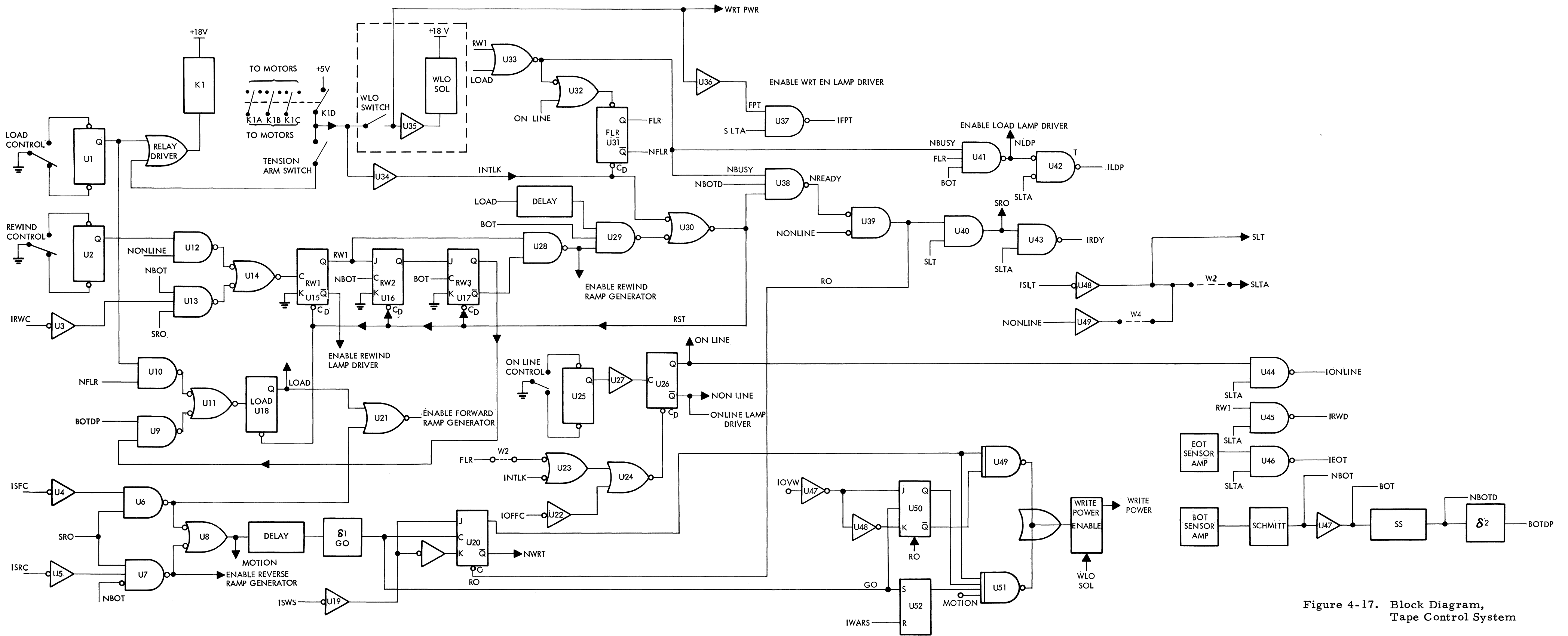


Figure 4-17. Block Diagram, Tape Control System

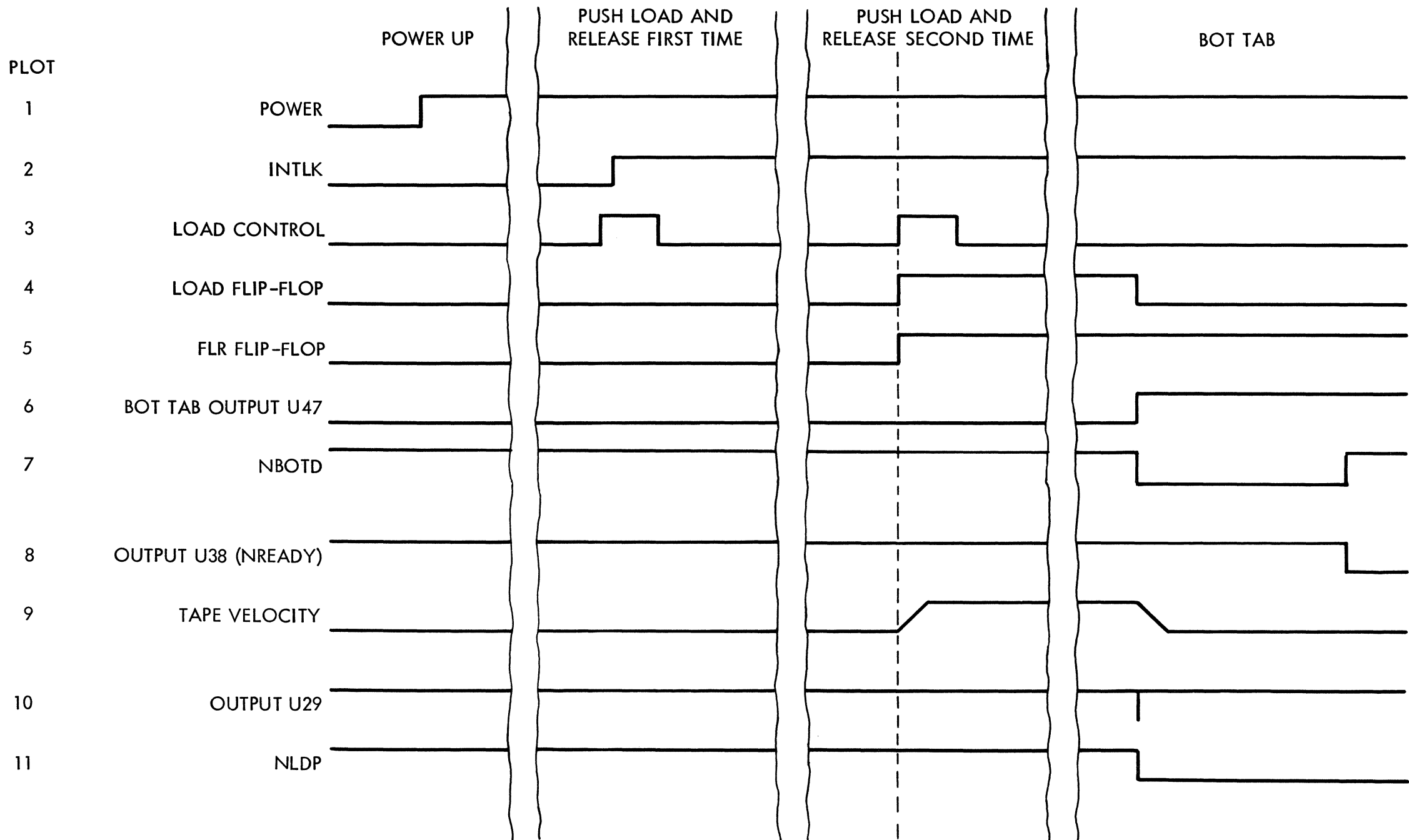


Figure 4-18. Timing Diagram, Bring to Load Point Sequence

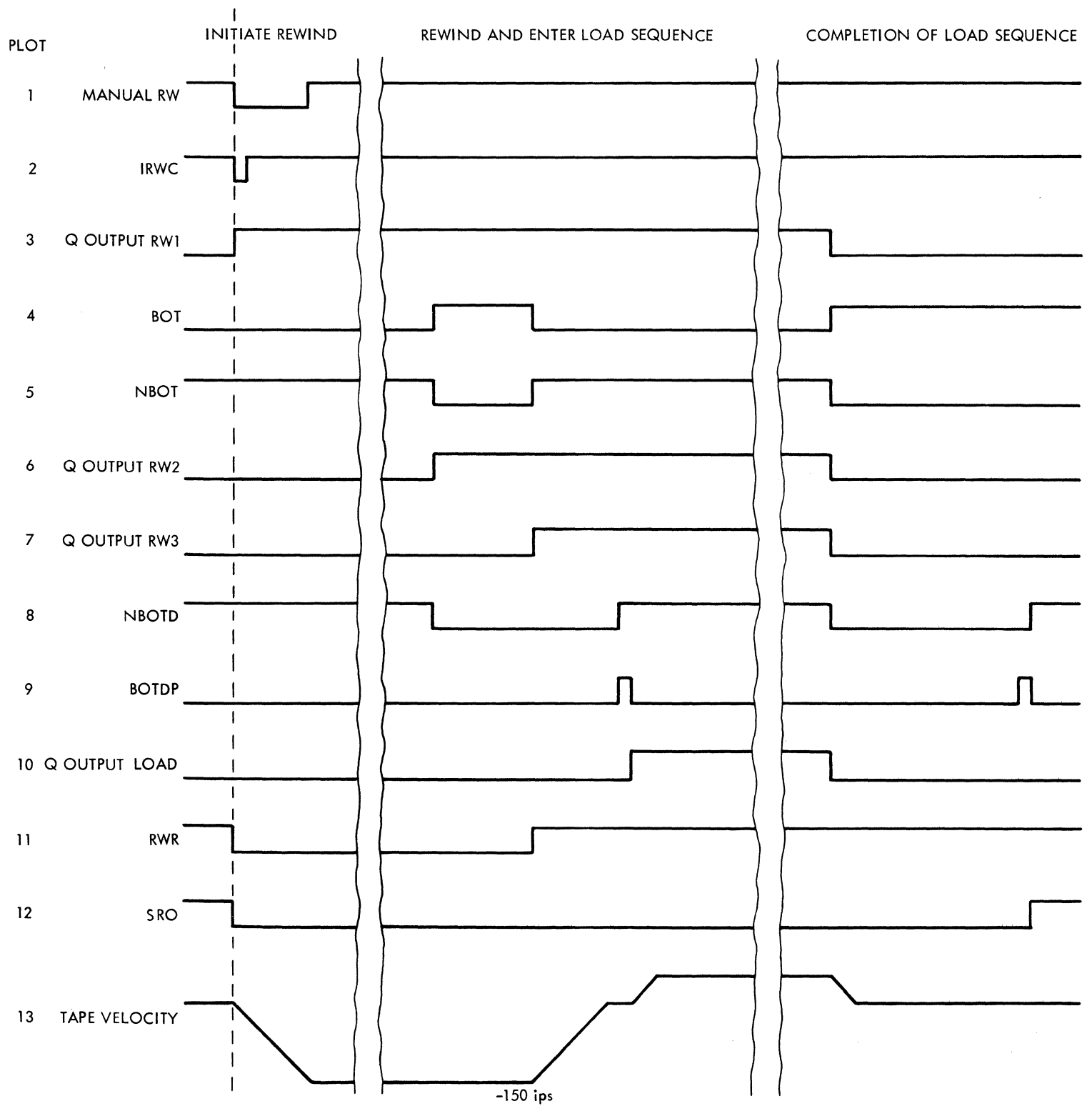


Figure 4-19. Timing Diagram, Rewind to Load Point Sequence

SECTION V
PRINTED CIRCUIT BOARDS THEORY OF OPERATION

5.1 INTRODUCTION

This section contains the theory of operation of the four printed circuit boards used in the Model 6660 Tape Transport. The schematic and assembly drawings for each board are contained at the end of Section VII.

A better understanding of the logic utilized in the tape transport can be gained when the operation of the J-K flip-flop is fully understood. The following paragraphs provide a brief summary of the operation of the 852 J-K flip-flop, which is the type most commonly used in the system.

This flip-flop operates on a "Master-Slave" principle. A logic diagram of the flip-flop is shown in Figure 5-1. The flip-flop is designed so that the threshold voltage of AND gates 101 and 102 is higher than that of AND gates 103 and 104. Since operation depends exclusively on voltage levels, any waveform of the proper voltage levels can trigger the J-K flip-flop.

Assume that the trigger voltage is initially low. As the trigger voltage goes high, AND gates 103 and 104 are disabled. Subsequently, AND gates 101 and 102 are enabled by the trigger pulse, the J and K inputs, and the information previously stored at the output of the "slave" unit.

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 101 and 102 are disabled. AND gates 103 and 104 are then enabled and the information stored in the "master" unit is transferred to the output of the "slave" unit.

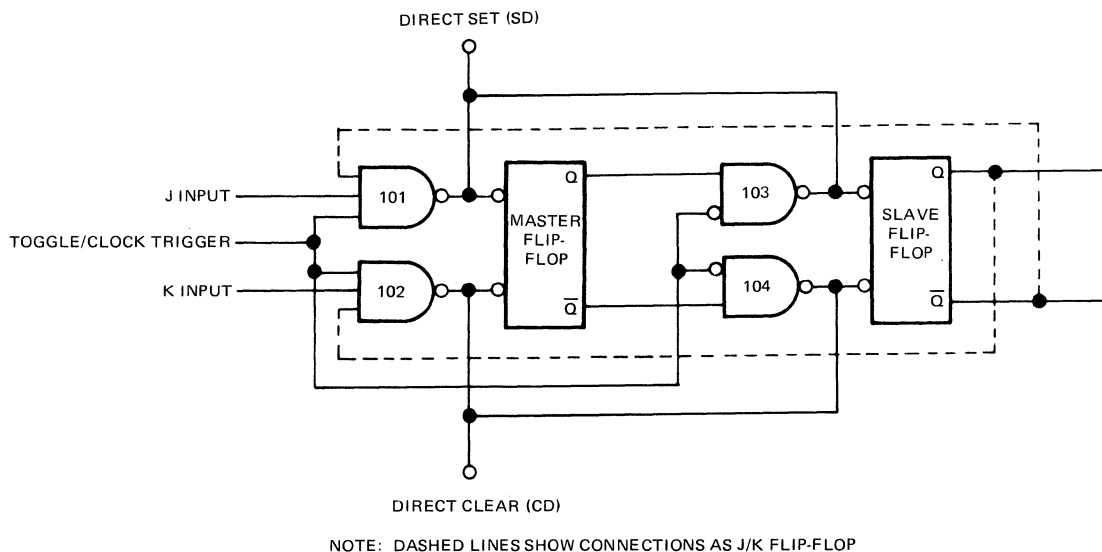


Figure 5-1. Simplified Logic Diagram, "Master-Slave" Flip-Flop

5.2 THEORY OF OPERATION

Table 5-1 lists all interconnects between the various PCBAs installed in the 6X40 transport.

5.2.1 DATA E

The following is a description of the Data E9 PCBA (refer to Schematic No. 101010 and Assembly No. 101011).

The Data E9 is approximately 16.5 inches long with edge connectors (J102 and J103) at each end along one edge. These are the interface connectors and are slotted to mate with keys in the mating plugs. There are three additional connectors on the Data E9. J1 is used to connect power and control signals from the Tape Control PCBA. J2 and J3 are the connectors into which the write and read head cables plug.

Table 5-1
PCBA Interconnections

Tape Control PCBA	
J1	LOAD Control
J2	ON LINE Control
J3	REWIND Control
J4	WRT EN Indicator
J5	HI DEN Control
J6	FORWARD Control
J7	REVERSE Control
J8	Data PCBA, J1
J9	Servo and Power Supply PCBA, J9
J10	Servo and Power Supply PCBA, J10
Servo and Power Supply PCBA	
J11	Capstan Drive Assembly
J12	Take-up Reel Motor
J13	EOT/BOT Amplifier
J14	Take-up Reel Tension Arm Sensor
J15	Power Supply
J16	Power Supply
J17	WLO and Limit Switch
J18	Supply Reel Tension Arm Sensor
J19	Supply Reel Motor
Data PCBA	
J2	Write and Erase Head
J3	Read Head
EOT/BOT Amplifier PCBA	
J1	Photo-tab Sensor

5.2.1.1 Circuit Description

The board operation is described with reference to circuit 100, which is identical to circuits 200 through 900. All interface signals relevant to writing data (seven or nine WRITE DATA signals (IWD0, etc.), WRITE DATA STROBE (IWDS), and WRITE AMPLIFIER RESET (IWARS)) enter via J102 and are terminated by a resistor combination and an IC inverter.

Referring to circuit 100, the Write Data Parity (IWDP) data line is terminated by resistors R101, R102, and inverter U5-A. Inverters U5-A and U5-B perform a low-true AND function between IWDP and the WDS pulse received by U5-D, boosted by power gate U6-A, and bussed to all channels. Thus, a true signal on the IWDP line at WDS time results in a positive-going pulse being fed directly to the J input of the write waveform generator flip-flop U13-A and via inverter U5-C and OR gate U14-A to the K input of U13-A. Since the clock input level is high at this time, the "master" section of U13-A is toggled.

The WDS pulse also toggles clock control flip-flop U13-B which initiates the write deskewing operation. The Q output goes high, switching off clamp transistor Q2 for the clock oscillator Q3, Q4. This is an emitter-coupled multivibrator which generates 100-nsec negative pulses at the base of Q4 of a width determined by resistor R19 and capacitor C6; the frequency is determined by resistors R17 and R18 and capacitor C6.

The pulses are fed to two 5-bit shift registers (U17 and U16), which generate 10 negative-going edges which occur sequentially on 10 output pins. Outputs T1 through T9 are fed to the relevant write waveform generator flip-flops and cause the "slave" section of the flip-flop to toggle on the negative-going edge.

The tenth output "C" resets the control flip-flop U13-B via U14-B and U14-C. The \bar{Q} output of U13-B goes high, clamping the shift register; also, the Q output goes low, clamping the oscillator.

The outputs of the write waveform generator flip-flops drive write amplifier transistors Q101 and Q102, whose emitters are taken to +5v when the WRT POWER line (J1-4) is high. The transistor connected to the low (approximately 0v) output of the flip-flop will conduct and a current will flow in the associated half of the head winding. When the WRT POWER line is low (approximately 0v), writing is inhibited because the write amplifier transistors cannot be turned on. Similarly, the erase current supplied by transistor Q1 is inhibited when the WRT POWER line is low. In operation, the write current is defined by resistors R105 and R106, while R107 is the associated damping resistor.

The write waveform generator flip-flops are primed for writing by the NWRT line (J1-9). This signal is inverted by power gate U15-B and bussed to the S_D inputs of the write waveform generator flip-flops. The signal is also connected via an R-C delay to OR gate U14-D and power gate U15-A. The output of U15-A is bussed to the C_D inputs of all the write waveform generator flip-flops. Thus, when the NWRT line is high, the ability to write is removed because both the Q and \bar{Q} outputs of the write waveform generator flip-flops are at +5v. When the NWRT level is lowered to allow writing, the R-C network delays the removal of the C_D input with respect to the S_D input, leaving the flip-flops in the reset state.

The head windings are so phased that the reset flip-flops cause current to flow in the standard "erase" direction. Lowering of the NWRT level also turns on the erase current driver (Q1). The MOTION level received at J1-6 prevents write current from flowing unless tape is in motion.

The IWARS pulse received by inverter U5-E is used to reset all the write waveform generator flip-flops as required to write LRCC at the end of the record. The pulse is fed to the K inputs of all write waveform generator flip-flops via inverter OR gates U14-A, U11-D, etc., resetting the "master" section of all flip-flops.

The leading edge of the IWARS pulse is differentiated by capacitor C4 and resistors R12 and R13 and sets clock control flip-flop U13-B. This initiates a Write Deskewing sequence resulting in toggling of the write waveform generator flip-flops and the writing of the LRC character in a de-skewed manner.

During reading, signals from the read head at a level of 10 to 20 mv are fed via connector J3 to the read amplifier which is one-half of a dual operational amplifier IC (U22-B for 9-track, and U19-B for 7-track). The amplifier output is maintained close to 0v in the absence of an input signal by the feedback path of resistors R110 and R113, which determine a fairly low dc gain. The low frequency cutoff is determined by capacitors C101 and C102. The operating gain of the amplifier is defined by resistor network R111, R114, and R112. R112 is a variable resistor used in the initial setup to set the output peak-to-peak amplitude.

The read amplifier output is fed to a unity gain inverting amplifier, using transistors Q103, Q104, and Q105. The positive-going halves of the two phases of the read signal are added by means of diodes CR101, CR102, and transistors Q106 and Q107. The exact voltage at which CR101 and CR102 conduct is controlled by the level at TP13, to which R120 is connected. This level is controlled by the NWRT line. When NWRT is low, indicating a write operation, a voltage close to +2v is obtained at TP13 which results in a clip level of close to 50 percent of the read amplitude.

When NWRT is high, indicating a read operation, a voltage close to 0v is obtained at TP13, which results in a clip level of close to 20 percent of the read amplitude.

The double emitter-follower stage Q106, Q107 is used to drive the input of the peak detector.

The peak detector is essentially a feedback differentiator circuit which uses one-half of a dual operational amplifier (U27-B for 9-track, U23-B for 7-track). The amplifier is prevented from saturating by feedback diodes CR103, CR104, CR105, and CR106. The amplifier is biased to a negative output in the absence of an input signal by resistor R123. At this point, a positive-going transition from -1v to +1v corresponds to a peak of the read waveform. The output of the peak detector operational amplifier is passed to Q108, which converts the signal to standard logic levels. At this point, a negative-going edge corresponds to the peak of the read waveform. Resistor R128 and the corresponding resistors of the other 8 circuits are connected to TP15. Examination of the output at TP15 with an oscilloscope while reading an "all ones" tape allows a good estimate to be made of the condition of the tape path. Skew is indicated by a progression of steps on the negative-going edge and the magnitude of skew by the ratio of fall time to the character time (see Paragraph 6.7.5).

The output of Q108 is differentiated by capacitor C110 and resistor R129 and fed to the clock input of Read Staticiser flip-flop U37-A, setting it.

The \bar{Q} output of U37-A, together with those of the other eight Read Staticiser flip-flops are ORed by gate U40-B. The first flip-flop to be set causes a positive-going transition at TP11, which switches off clamp transistor Q8. This initiates rundown circuit Q7, Q8, Q9, and Q10. The voltage at the cathode of CR2 decays toward -5v from +4.5v with a time constant $(R31 + R32) C10$.

At approximately 0v, Q9 starts to cut off. This action is regenerative due to the positive feedback via capacitor C11 and resistors R36, resulting in a negative-going transition at the collector of Q10 (TP9). This transition is differentiated, and subsequently shaped in single-shot U39, U40, and associated components, to form a 2- μ sec READ DATA STROBE (RDS) pulse which is fed to the interface via power gate U38-B.

In addition, the negative transition is delayed via U39-F, resistor R41, capacitor C14, and inverter U39-A, and fed via OR gate U38-A and power gate U36-B to the reset inputs of the Read Staticiser flip-flops. This causes the output of U40-B to go negative, turning on Q8, therefore reapplying the clamp to the rundown circuit.

The delay is such that the data lines reset a minimum of 0.5 μ sec after the trailing edge of the RDS.

The Read Staticisers are reset whenever the MOTION signal (J1-6) is false, i. e., tape is not in motion.

The 7-channel version of the Data PCBA (Data E7) has a different configuration. Circuits 200 and 300 are omitted from both the write and read sections of the board and the deskewing connections from the shift register to the write waveform generator flip-flops are different to accommodate the different track layout format (see Figures 4-7 and 4-8).

5.2.2 SERVO AND POWER SUPPLY TYPES

The following are descriptions of the different Servo and Power Supply PCBAs, only one of which is applicable to a particular tape transport. Refer to the schematic/assembly documents at the end of this manual, or to the part number marked on the Servo and Power Supply PCBA to determine which assembly is installed.

<u>Nomenclature</u>	<u>Schematic</u>	<u>Assembly</u>
Servo and Power Supply - A	101020	101021
Servo and Power Supply - B	101261	101262

Servo and Power Supply - A (101021) is used for tape speeds up to and including 37.5 ips; Servo and Power Supply - B (101262) can be used at any tape speed up to and including 45 ips.

A small (approximately 2 by 4 inches) EOT/BOT pre-amplifier circuit board (Assembly 101949) is utilized. This board is mounted on the Write Lockout bracket at the rear of the tape deck. It is required in addition to the basic EOT/BOT circuitry already on the Servo and Power Supply PCBAs to ensure correct operation due to the wide tolerance limits on the phototransistors used in the EOT/BOT sensor.

5.2.3 SERVO AND POWER SUPPLY - A (Schematic 101020, Assembly 101021)

The Servo and Power Supply - A PCBA (101021) is approximately 18 inches long and contains the reel servo amplifiers, capstan servo amplifiers, regulators, write enable and interlock circuitry, and the basic EOT/BOT sensor amplifier. The power transistors associated with the circuits are mounted on a heatsink.

The circuit board is secured to the heatsink by using screws that also serve as connections between the transistor cases and the printed circuitry.

Connections are made to the board via connectors which are strategically located with respect to their associated circuitry. These connectors are used to:

- (1) Connect all deck-mounted assemblies to the board, e. g. , power supply, motors, tension arm sensors, photo-tab sensors, Write Lockout assembly, and the tension arm limit switch.
- (2) Feed power and signal levels to the Tape Control circuit board.

5.2.3.1 Circuit Description (Schematic 101020, Assembly 101021)

The description of the circuit board consists of a discussion of the circuits associated with each of the connectors.

J17 is used to connect the tension arm interlock switch, the write lock-out switch, and write lockout solenoid to the associated circuitry.

When the LOAD switch is depressed, the junction of resistors R120 and R121 is no longer grounded and base current is supplied to relay driver transistors Q56, turning it on. Relay K1 energizes, closing contacts 9 and 10, thus establishing an alternate source of base current for transistor Q56 via the interlock switch. When the LOAD control is released, the relay remains energized, completing the circuits for the capstan and reel servo motors and supplying write power from the +5v line to the write circuits via relay contacts 9 and 10.

For the capstan motor, the relay contact is placed on the ground return from the motor. For the reel motors, one side of each motor is grounded and the other connected to the appropriate amplifier output via the relay contact. When the relay is de-energized, the contacts connect the two reel motors together through a resistor (R41). This provides optimum regenerative braking conditions.

Diodes CR2, CR3, CR14, CR15, CR4, and CR5 prevent arcing of the relay contacts when they are open.

Write lockout solenoid driver transistor Q57 is turned on by the appearance of the WRT POWER level and causes the write lockout solenoid to retract the write enable ring probe.

The relay voltage is derived from an auxiliary supply that decays rapidly upon loss of line voltage. This ensures that the relay drops out, removing motor power (and write current) before the main power supplies have had time to decay to the point where inadvertent motor motion (or writing) could occur.

J13 connects the photo-tab sensors mounted on the head plate to the Servo and Power Supply - A PCBA, via the EOT/BOT amplifier PCBA which is mounted on the Write Lockout bracket at the rear of the tape

deck. Note that with the inclusion of this EOT/BOT amplifier PCBA, potentiometers R2 and R10 on the Servo and Power Supply - A PCBA are no longer used for adjustments and should always be set fully clockwise. Refer to Paragraph 5.2.7.1 for a description of the EOT/BOT amplifier.

The EOT sensor output drives emitter-follower transistor Q2 via an RC network (R128, C32) which filters any spurious signals. The output of the emitter-follower is fed to the interface transmitter on the Tape Control PCBA and is not used elsewhere.

The BOT signal is fed via an RC network (R127, C30) to a Schmitt trigger circuit to remove the possibility of multiple pulses at the leading and trailing edges of the BOT tab. The Schmitt trigger uses one-half of a dual operational amplifier IC (U1-A) connected in a positive feedback mode and set to switch at approximately 2.3v. The output of the EOT phototransistor, and subsequently the output of the BOT amplifier system, drops upon detection of the photo-tab. The output of the Schmitt trigger is inverted by transistor Q1 and connected to the Tape Control PCBA by J9.

J15 and J16 connect unregulated +18v and -18v, +45v and -45v, and the auxiliary 14v ac for the relay, to the Servo and Power Supply PCBA. The +18v and -18v supplies are also fed via power diodes and power resistors in the power supply module (see Figure 4-2) to form the lines labeled +18v (D), -18v (D), +18v (R), and -18v (R), which are used in the reel servos and are connected to the Servo and Power Supply - A PCBA via J15 and J18.

Two pins are allocated to the high current lines to reduce the current density in the pins.

Two regulators supply +5v and -5v to the digital ICs, photo-tab sensors, tension arm sensor lamps, indicator lamps, etc., and consist of two identical circuits whose outputs are set up by potentiometers R102 and R103. The +5v and -5v references are zener diodes CR16 and CR20. Diodes CR17 and CR19 improve the temperature stability of the supplies.

The zener diode references are also used by the +10v and -10v regulators. The majority of the current for the zener diodes is supplied from the +10v and -10v regulators via resistor R116 and diode CR18 for the +5v reference, and by resistor R99 and diode CR23 for the -5v reference. Resistors R97 and R98 provide the currents to prime the regulators. This system results in improved ripple characteristics for the regulator supplies.

A "crowbar" over-voltage protection circuit is provided and uses zener diode CR24 to detect an increase in the +5v level to +8v, in which case the SCR (CR25) is fired, which blows the +18v fuse on the power supply module and removes the +18v supply.

J11 connects the capstan motor assembly to the associated servo amplifier and relay contact. When the relay is energized, the ground return path of the motor is completed to 0v (S). The capstan servo amplifier uses one-half of a dual operational amplifier as an input stage and discrete transistors Q3, Q4, Q5, Q6, Q7, and Q8 to drive the high currents in the motor. Output transistors Q6 and Q8 are mounted on the heatsink.

In operation, defined currents are fed to the virtual ground input of the IC amplifier (pin 9 of U1-B) from either the Forward/Reverse ramp generator or the Rewind ramp generator (depending on the operation mode of the transport). These currents are amplified and cause the capstan motor-tachometer to rotate. The output voltage from the tachometer is fed back to the virtual ground input of the IC in such phase as to produce negative feedback. This system is a velocity servo in which

the motor rotates at a speed such that the current from the tachometer is equal and opposite to that from the ramp generator.

The system is designed so that motor-tachometers from two different manufacturers (Electrocraft Corp. and Printed Motors, Inc.) can be used interchangeably. The tachometer voltage constants are different in the two cases, therefore two different tachometer feedback paths are provided: J11 pin 2 and resistors R23 and R24 for the Electrocraft motor; J11 pin 1 and resistors R129 and R24 for the Printed Motors, Inc. motor. The overall gain of the tachometer input is $(R15 + R17) / (R23 + R24)$ for the Electrocraft, and $(R15 + R17) / (R129 + R24)$ for the Printed Motors, Inc. motor. Potentiometer R13 has been added in later versions to allow the rewind speed to be adjusted.

J14 and J18 connect the take-up and supply tension arm sensors to the reel servo amplifiers on the Servo and Power Supply - A PCBA.

The take-up servo circuit is a conventional dc amplifier with transient phase lead compensation. The low frequency gain is defined by the ratio of resistors $(R48 + R44 + R43)$ to $(R31 + R30)$. This gain can be changed using variable resistor R30 to compensate for variations in tension arm sensor sensitivity. The low frequency gain is approximately 3 when R30 is set at the mid-point. The high frequency gain is increased to 14 by capacitors C12 and C13 and resistor R125. Output transistors Q16 and Q18 are located on the heatsink.

In the Rewind mode the characteristics of the reel servo amplifier are altered in the following manner.

- (1) The loop gain is increased by a factor of 2 (approximately) by switching resistor R46 into the circuit. This is accomplished from the rewind ramp command waveform via transistors Q19 and Q21.

- (2) An offset signal is fed to the servo amplifier via R32.
- (3) The +18v (D) return voltage is raised to +36v by switching in the 36v "regulator" circuit Q22, Q23, Q24, and Q25. The appropriate diode on the power supply module isolates the +36v supply from the +18v supply.

Items (1) and (2) result in a reduction in the arm movement required in the Rewind mode.

A current limiting circuit consisting of resistor R40 and transistor Q14 is used to hold the reel servo current in the -18v supply to less than 9 amps when the take-up tension arm is released, e. g., when tape tension is lost at the end of an unload operation.

The supply servo operates in exactly the same manner except that:

- (1) The gain switching utilizes resistor R78.
- (2) The offset voltage is supplied via resistor R74.
- (3) The current limiting components, resistor R94 and transistor Q39 are in the +18v supply.
- (4) The -18v (D) return voltage is increased to -36v by the components Q26, Q27, Q28, and Q29.

5.2.4 SERVO AND POWER SUPPLY - B (Schematic 101261 and Assembly 101262)

The Servo and Power Supply - B PCBA is approximately 18 inches long and contains the reel servo amplifiers, capstan servo amplifier, regulators, write enable and interlock circuitry, and the basic EOT/BOT sensor amplifier. The power transistors associated with the circuits are mounted on an 18-inch long heatsink. The PCBA is secured to the heatsink by screws that also serve as connections between the transistor cases and the printed circuit.

Connections are made to the board via connectors which are strategically located with respect to their associated circuitry. These connections are used to:

- (1) Connect all deck-mounted assemblies to the board, e. g. , power supply, motors, tension arm sensors, photo-tab sensors, Write Lockout assembly, and the tension arm limit switch.
- (2) Feed power and signal levels to the Tape Control PCBA.

5.2.4.1 Circuit Description (Schematic 101261, Assembly 101262)

The description of the circuit board consists of a discussion of the circuits associated with each of the connectors.

J17 is used to connect the tension arm interlock switch, the write lockout switch, and write lockout solenoid to the associated circuitry.

When the LOAD switch is depressed, the junction of resistors R138 and R139 is no longer grounded and base current is supplied to relay driver transistor Q53, turning it on. Relay K1 energizes, closing contacts 9 and 10, thus establishing an alternate source of base current for transistor Q53 via the interlock switch. When the LOAD control is released, the relay remains energized, completing the circuits for the capstan and reel servo motors and supplying write power from the +5v line to the write circuits via relay contacts 9 and 10.

For the capstan motor, the relay contact is placed in the ground return from the motor. For the reel motors, one side of each motor is grounded and the other connected to the appropriate amplifier output via the relay contact. When the relay is de-energized, the contacts connect the two reel motors together by a resistor (R76). This provides optimum regenerative braking conditions.

Diodes CR2, CR3, CR14, CR15, CR8, and CR9 prevent arcing of the relay contacts when they are opened.

Write lockout solenoid driver transistor Q54 is turned on by the appearance of the WRT POWER level and causes the write lockout solenoid to retract the write enable ring probe.

The relay voltage is derived from an auxiliary supply that decays rapidly upon loss of line voltage. This ensures that the relay drops out, removing motor power (and write current) before the main power supplies have had time to decay to the point where inadvertent motor motion (or writing) could occur.

J13 connects the photo-tab sensors mounted on the head plate to the Servo and Power Supply - B PCBA via the EOT/BOT Amplifier PCBA which is mounted on the Write Lockout bracket at the rear of the tape deck. Note that, with the inclusion of this EOT/BOT Amplifier PCBA, potentiometers R2 and R10 on the Servo and Power Supply board are no longer used for adjustments and should always be set fully clockwise. Refer to Paragraph 5.5.1 for a description of the EOT/BOT Amplifier circuit.

The EOT sensor output drives emitter-follower transistor Q2 via an RC network (R128, C32) which filters any spurious signals. The output of the emitter-follower is fed to the interface transmitter on the Tape Control board and is not used elsewhere.

The BOT signal is fed via an RC network (R4, C1) to a Schmitt trigger circuit to remove the possibility of multiple pulses at the leading and trailing edges of the BOT tab. The Schmitt trigger uses one-half of a dual operational amplifier IC (U1-A) connected in a positive feedback mode and set to switch at approximately 2.3v. The output of the BOT

phototransistor drops upon detection of the photo-tab. The output of the Schmitt trigger is inverted by transistor Q1 and connected to the Tape Control board by J9.

J15 and J16 connect unregulated +18v and -18v, +45v and -45v, and the auxiliary 14v ac for the relay to the Servo and Power Supply - B PCBA. The +18v and -18v supplies are also fed via power diodes and power resistors in the power supply module (see Figure 4-2) to form the lines labeled +18v (D), -18v (D), +18v (R), and -18v (R), which are used in the reel servos and are connected to the Servo and Power Supply - B PCBA via J15 and J16.

Two pins are allocated to the high current lines to reduce the current density in the pins.

Two regulators supply +5v and -5v to the digital ICs, photo-tab sensors, tension arm sensor lamps, indicator lamps, etc., and consist of two identical circuits whose outputs are set up by potentiometers R116 and R117. The +5v and -5v references are zener diodes CR16 and CR19. Diodes CR17 and CR18 improve the temperature stability of the supplies.

The zener diode references are also used by the +10v and -10v regulators. The majority of the current for the zener diodes is supplied from the +10v and -10v regulators via resistor R134 and diode CR20 for the +5v reference, and by resistor R119 and diode CR2 for the -5v reference. Resistors R115 and R118 provide the currents to prime the regulators.

A "crowbar" over-voltage protection circuit is provided and uses zener diode CR24 to detect an increase in the +5v level to +8v, in which case the SCR (SCR1) is fired, which blows the +18v fuse on the power supply module and removes the +18v from the regulators.

J11 connects the capstan motor assembly to the associated servo amplifier and relay contact. When the relay is energized, the ground return path of the motor is completed to 0v (S). The capstan servo amplifier uses one-half of a dual operational amplifier as an input stage and discrete transistors Q3, Q4, Q5, Q6, Q7, and Q8 to drive the high currents in the motor. Output transistors Q6 and Q8 are mounted on the heatsink.

In operation, defined currents are fed to the virtual ground input of the IC amplifier (pin 9 and U1-B) from either the Forward/Reverse ramp generator or the Rewind ramp generator (depending on the operation mode of the transport). These currents are amplified and cause the capstan motor-tachometer to rotate. The output voltage from the tachometer is fed back to the virtual ground input of the IC in such phase as to produce negative feedback. This system is a velocity servo in which the motor rotates at a speed such that the current from the tachometer is equal and opposite to that from the ramp generator.

The system is designed so that motors/tachometers from two different manufacturers (Electrocraft Corp. and Printed Motors, Inc.) can be used interchangeably. The tachometer voltage constants are different in the two cases, therefore two different tachometer feedback paths are provided: J11 pin 2 and resistors R18 and R19 for the Electrocraft motor; J11 pin 1 and resistor R17 and R19 for the Printed Motors, Inc. motor. The overall gain of the tachometer input is $(R23 + R21) / (R18 + R19)$ for the Electrocraft, and $(R23 + R21) / (R17 + R19)$ for the Printed Motors, Inc. Potentiometer R14 allows the Rewind speed to be adjusted.

J14 and J18 connect the take-up and supply tension arm sensors to the reel servo amplifiers on the Servo and Power Supply - B PCBA.

The take-up servo circuit is a conventional dc amplifier with lead-lag compensation. The low frequency gain is defined by the ratio of resistors R54 to (R34 + R35) and is approximately 33. The high frequency gain is increased by capacitors C11 and C12. Output transistors Q15 and Q17 are located on the heatsink.

The reel motor current is limited to approximately 8 amps by amplifying (via U3B) the voltage developed by the reel motor current across resistor R77 and feeding this in proper phase to the input of the reel servo amplifier via pick-off diodes CR6 and CR7. Potentiometer R32 adjusts the amplitude of the take-up arm swing.

In the Rewind mode, the characteristics of the reel servo amplifier are altered so that the +18v (D) return voltage is raised to +36v. This is accomplished by switching in the 36v regulator circuit Q20, Q21, Q22, and Q23. An appropriate diode on the power supply module isolates the +36v supply from the +18v supply.

The supply servo operates in the same manner; potentiometer R81 adjusts the amplitude of the supply arm swing. In Rewind, the -18v (D) return voltage is increased to -36v by the components Q24, Q25, Q26, and Q27 which are supplied by unregulated -45v. The reel motor current limiting components are U3A, R114, CR12, and CR13.

5.2.5 TAPE CONTROL C1

The following is a description of the Tape Control C1 PCBA (refer to Schematic No. 101240 and Assembly No. 101241).

The Tape Control C1 board contains the control logic together with command ramp generators for the capstan servo. The Tape Control board is approximately 16.5 inches long with an edge connector (J101) at one end. This is the interface connector and is slotted to mate with a key in the mating plug. At the same end of the board is a row of connectors which are used to connect the manual control switches to the Tape Control board. In addition, two connectors (J9 and J10) transmit power and control levels from the Servo and Power Supply PCBA to the Tape Control while connector J8 supplies power and control levels to the Data PCBA. The power supplies (+10v and -10v, +5v and -5v, and 0v) as well as the MOTION, NWRT, and WRT POWER signals associated with the writing of data, are picked off from this latter connector.

5.2.5.1 Circuit Description

A description of the logic sequences used in the Tape Control PCBA is detailed in Paragraphs 4.3.5 through 4.3.5.11. Table 5-2 will assist in identifying the major components in the system; however, 100 percent correspondence is not possible since Figure 4-17 is a logic diagram, while the schematic shows every component.

The remaining circuitry on the Tape Control is concerned with the generation of ramp command signals for the capstan servo and the BOT single-shot.

J101 is the interface connector for tape motion commands and status signals. ISFC, ISRC, and IRWC commands are received and gated with the SRO (Selected, Ready, and On-line) signal. They then pass on to the

Table 5-2
Cross Reference Chart

Figure 4-17 Reference Designation	Schematic 101240 Reference Designation
U1	U11-A, U11-B
U2	U11-C, U13-C
U15	U17-A
U16	U17-B
U17	U15-B
U18	U15-A
U20	U7-B
U25	U8-F, U8-C
U26	U7-A
U31	U9-A, U9-B
SS	Circuit 700
U12	U13-B
U13	U18-B
U10	U13-D
U9	U13-A
U6	U21-A
U8	U21-D
U38	U12-B

ramp generator (circuit 900), where the digital signals are converted to analog levels with controlled transition times, which are the inputs to the capstan servo. The SFC and SRC are fed via transistors Q1 and Q2 to the dual operational amplifier circuit (U17-A, U17-B) whose output levels are determined by the +5v and -5v lines, and the ratios of R905 and R907 to R913; the circuit rise and fall times are determined by the +5v and -5v lines, R915, R916, and C904. The transition times are varied by means of variable resistor R915. The forward and reverse speeds are determined by the variable resistor R29 and associated circuitry which is contained on the Servo and Power Supply PCBA.

The REWIND command is fed to circuit 800, which includes transistors Q801 and Q802. The rewind speed is determined by the -5v line to which transistor Q802 saturates when a rewind is in process, feeding an associated resistor in the capstan servo amplifier located on the Servo and Power Supply PCBA.

The rise and fall times of the rewind ramp are determined by resistors R801 and R802 in conjunction with capacitors C801 and C802.

The BOT single-shot consists of the components in circuit 700. The circuit is triggered by the leading edge of the BOT waveform, producing a pulse approximately 0.5-second wide. This width is determined by capacitors C701 and C702 in conjunction with resistors R703 and R704. The single-shot pulse (NBOTD) is inverted and the trailing edge is differentiated by capacitor C5 in conjunction with resistors R24 and R25 and fed to inverter U14A. In this manner, a narrow pulse (BOTDP) is generated whose width is determined by capacitor C5 in conjunction with resistors R24 and R25.

The Write Power Enable circuit is basically an R-C ramp utilizing a Darlington-pair transistor circuit. Write power is applied to the circuit from the Servo and Power Supply PCBA via J9 pin 4.

NOTE

A Write Enable ring must be installed on the supply reel to complete the Write Power interlock circuit.

When a Write or Overwrite operation is initiated, voltage at pin A of circuit 1000 drops sharply to 0v and the +5v charge on capacitor C1 discharges toward 0v. (The RC time of discharge determined by the values of C1, R1.) Transistor Q1 conducts and causes transistor Q2 to conduct. The rate of conduction is determined by the discharge time of C1. The voltage at the collector of Q2 rises toward +5v as determined by the current flow through R4 and Q2. The output voltage is supplied via J8 pin 4 to the Write logic on the Data PCBA.

Termination of a Write or Overwrite operation causes the voltage at pin A of circuit 1000 to rise sharply to +5v. Conduction of transistors Q1 and Q2 decrease toward cutoff at a rate determined by $(R34 + R1) C1$. The output voltage at the collector of Q2 ramps from +5v to 0v as Q2 cuts off.

5.2.6 EOT/BOT AMPLIFIER PCBA

The following is a description of the EOT/BOT Amplifier PCBA (refer to Schematic No. 101948 and Assembly No. 101949).

5.2.6.1 Circuit Description

J1 connects the photo-tab sensor, mounted on the head plate to the EOT/BOT Amplifier PCBA which is mounted on a bracket at the rear of the tape deck.

The amplifier is designed to operate on the differential output from the EOT and BOT sensors (both tabs are never allowed to be under the sensors simultaneously). This system is basically insensitive to changes in ambient conditions.

In operation, when neither the BOT tab nor the EOT tab is under the photosensor, the outputs of the BOT and EOT sensors are high (approximately +4v) and are adjusted to be equal within 0.1v by the use of variable resistors R9 and R3. The bases of Q2 and Q4 are therefore at approximately +4v so that diodes CR1 and CR2 are both forward biased by current flowing via R6 to ground. Thus, the base of Q3 is 0.6v below that of Q2, and the base of Q4 is 0.6v below that of Q5. Hence, Q2 and Q1 and Q5 and Q6 are cut off and the NBOT and NEOT outputs are high (pulled up by resistors on the Servo and Power Supply PCBA).

The characteristics of the photosensors are such that the "no tab" voltages, once set to be equal, track adequately with changes in ambient conditions to ensure that the NBOT and NEOT outputs remain high.

When the BOT tab moves under the sensor, its output drops toward 0v. Thus, the base of Q5 goes negative while that of Q4 remains referenced to the still high output of the EOT sensor. When the difference of voltage between the bases of Q5 and Q4 exceeds 0.6v, current flows in Q5, turning Q6 on. The NBOT output therefore goes low as required. Similarly, when the EOT tab moves under the sensor, the NEOT output goes low.

The output of the EOT/BOT amplifier board is connected to J13 on the Servo and Power Supply PCBA.

SECTION VI
MAINTENANCE AND TROUBLESHOOTING

6.1 INTRODUCTION

This section provides information necessary to perform electrical and mechanical adjustments, parts replacement, and troubleshooting. Sections IV and V contain the theory of operation and schematics required for reference when electrical adjustments or troubleshooting are necessary.

6.2 FUSE REPLACEMENT

Fuses are located on the Power Supply module at the rear of the transport.

Line Fuse: 5 amp, 3AG, slow-blow, 125v ac and below, or
 3 amp, 3AG, slow-blow, 190v ac, and above

+18v dc Fuse: 10 amp, 3AG

-18v dc Fuse: 10 amp, 3AG

6.3 SCHEDULED MAINTENANCE

The tape transport is designed to operate with a minimum of maintenance and adjustments. Replacement of parts is designed to be as simple as possible. Repair equipment is kept to a minimum and only common tools are required in most cases. A list of tools required to maintain the tape transport is given in Paragraph 6.8.

To assure that the transport operates at its optimum design potential and to assure high MTBF, a program of scheduled preventive maintenance is recommended. This schedule is given in Table 6-1.

Table 6-1
Preventive Maintenance Schedule

Maintenance Operation	Frequency (Hours)	Quantity to Maintain	Time Required (Minutes)	Manual Paragraph Reference
Clean Head, Guides, Roller Guides, and Capstan	8 (or start of operating day)	—	5	6.4
Clean Tape Cleaner	50	1	5	6.4
Check Skew, Tape Tracking, and Speed	500	—	15	6.7.5, 6.7.6, 6.6.10
Check Head Wear	2,500	1	3	6.7.8
Replace Reel Motors and Capstan Motor	10,000	3	30	6.7.11

6.4 CLEANING THE TRANSPORT

The transport requires cleaning in these major areas: head and associated guides, capstan, roller guides, and tape cleaner.

To clean the head and guides, use a lint-free cloth or cotton swab moistened in isopropyl alcohol or Du Pont Freon TF. Wipe the head carefully to remove all accumulated oxide and dirt.

CAUTION

ROUGH OR ABRASIVE CLOTHS SHOULD NOT BE USED TO CLEAN THE HEAD AND HEAD GUIDES. USE ONLY ISOPROPYL ALCOHOL OR DU PONT FREON TF. OTHER SOLVENTS, SUCH AS CARBON TETRACHLORIDE, MAY RESULT IN DAMAGE TO THE HEAD LAMINATION ADHESIVE.

To clean the capstan, use only a cotton swab moistened with isopropyl alcohol or Du Pont Freon TF to remove accumulated oxide and dirt.

To clean the roller guides, use a lint-free cloth or cotton swab moistened in isopropyl alcohol or Du Pont Freon TF. Wipe the guide surfaces carefully to remove all accumulated oxide and dirt.

CAUTION

DO NOT SOAK THE GUIDES WITH EXCESSIVE SOLVENT. EXCESSIVE SOLVENT MAY SEEP INTO THE PRECISION GUIDE BEARINGS, CAUSING CONTAMINATION AND A BREAKDOWN OF THE BEARING LUBRICANT.

Clean the tape cleaner by removing the Allen head retaining screw accessible at the top of the cleaner assembly. Remove the cleaner from the tape deck by firmly grasping the cleaner and pulling straight upward and away from the tape deck. When removed, loosen two side screws holding the cleaner blade to the housing and remove the blade. The accumulated oxide and dirt is then blown out of the housing and the blade and housing are cleaned with a cotton swab moistened with isopropyl alcohol or Du Pont Freon TF. Care should be taken to avoid particles of the cotton swab from adhering to the blade. The blade is then re-located on the housing and the two side retaining screws are tightened. The tape cleaner is reinstalled on the deck.

CAUTION

CARE SHOULD BE TAKEN TO ENSURE THAT THE TAPE CLEANER BLADE SURFACE IS PARALLEL TO THE TAPE AND THAT THE TAPE IS WRAPPED SYMMETRICALLY AROUND THE TAPE CLEANER (THE ENTRY ANGLE IS EQUAL TO THE EXIT ANGLE).

6.5 PART REPLACEMENT ADJUSTMENTS

Table 6-2 indicates the adjustments necessary when a part is replaced. The details of the adjustments are given in Paragraphs 6.6 through 6.7.16.

6.6 ELECTRICAL ADJUSTMENTS

Paragraphs 6.6.2 through 6.6.14 describe the test configurations, test procedures, adjustment procedures, and related adjustments for the +5v and -5v regulators, BOT and EOT amplifiers, ramp timing, tape speed, reel servo gain, read amplifier gain, read staticiser, and write deskewing.

The following equipment (or equivalent) is required.

- (1) Oscilloscope, Tektronix 561 (vertical and horizontal sensitivity specified to ± 3 percent accuracy).
- (2) Digital Volt Meter, Fairchild 7050 (± 0.1 percent specified accuracy).
- (3) Counter Timer, Monsanto Model 100B (± 0.1 percent specified accuracy).
- (4) Master Skew Tape, IBM No. 432640.
- (5) Optical Encoder, 500-Line, PERTEC No. 512-1100.

6.6.1 ADJUSTMENT PHILOSOPHY

Acceptable limits are defined in each adjustment procedure, taking into consideration the assumed accuracy of the test equipment specified in Paragraph 6.6.

When the measured value of any parameter is within the specified acceptable limits NO ADJUSTMENTS should be made. Should the measured value fall outside the specified acceptable limits, adjustment should be made in accordance with the relevant procedure.

Table 6-2
Part Replacement Adjustments

Part Replaced	Auxiliary Adjustments	Time Required (Minutes)	Manual Paragraph Reference
Control Switch	None	2	—
Photo-Tab Sensor	EOT/BOT Potentiometers on EOT/BOT Amplifier PCBA or Servo and Power PCBA	10	6.7.9
Tension Arm Sensor	Tension Arm Shutter	10	6.7.2, 6.7.3, or 6.7.4
Limit Switch Assembly	None	10	—
Capstan Drive Assembly	Tape Speed, Ramp on Tape Control PCBA	30	6.7.11
Reel Motors Assembly	Belt Tension	10	6.7.15
Power Supply Assembly	None	20	—
Tape Control	Ramp Timing and Tape Speed	20	6.6.9, 6.6.10
Data PCBA	Read Amplifier Gain, Read Staticiser, Write Deskew		6.6.12, 6.6.14, 6.7.6.2
EOT/BOT Amplifier Assembly	None	10	—
Head	Skew Adjustment, Read Amplifier Gain	30	6.7.5, 6.7.6, 6.6.12
Write Lockout Assembly	None	10	—
Servo and Power Supply PCBA	+5v and -5v Regulators, EOT/BOT Amplifiers, Reel Servo Gain, Rewind Speed (Servo and Power - B Only), Capstan Offset and Tension Arm	25	6.6.3, 6.6.4, 6.6.6, 6.6.7, 6.6.11

When adjustments are made, the value set should be the exact value specified (to the best of the operator's ability).

CAUTION

SOME ADJUSTMENTS MAY REQUIRE CORRESPONDING ADJUSTMENTS IN OTHER PARAMETERS. ENSURE CORRESPONDING ADJUSTMENTS ARE MADE AS SPECIFIED IN THE INDIVIDUAL PROCEDURES. THE +5 AND -5 REGULATOR VOLTAGES MUST BE CHECKED PRIOR TO ATTEMPTING ANY ELECTRICAL ADJUSTMENT.

6.6.2 SERVO AND POWER SUPPLY PCBA TYPES

One of two types of the Servo and Power Supply PCBA may be installed in the transport. See Paragraph 5.2.2 for details regarding these differences.

NOTE

The procedures relevant to different types of the Servo and Power Supply PCBA are written independently for each Servo and Power Supply type, where different procedures are affected. Care must be taken to ensure that the appropriate adjustments and reference designators apply to a particular transport.

6.6.3 +5V AND -5V REGULATORS
(Servo and Power Supply - A, Assembly No. 101021 Only)

The +5v and -5v regulators are located on the Servo and Power Supply - A circuit board (101021) and are adjusted by means of variable resistors R102 and R103. The numerical value of the voltage difference, disregarding polarity, between the +5v and -5v lines must be less than 0.07v.

6.6.3.1 Test Configuration (Assembly No. 101021 Only)

- (1) Load a reel of tape on the transport.
- (2) Apply power to the transport.
- (3) Depress and release the LOAD control to establish interlock and tension the tape.
- (4) Depress and release the LOAD control a second time.
Tape will advance to the load point and stop.

6.6.3.2 Test Procedure (Assembly No. 101021 Only)

- (1) Using a Fairchild DVM Model 7050 (or equivalent) measure and note the voltage difference between TP18 (+5v) on the Tape Control PCBA, and TP17 (0v) on the Servo and Power Supply - A PCBA.
- (2) Using a Fairchild DVM Model 7050 (or equivalent) measure and note the voltage difference between TP19 (-5v) on the Tape Control PCBA, and TP17 (0v) on the Servo and Power Supply - A PCBA.
- (3) Acceptable Limits
 - (a) +5v Regulator
 - +4.85v minimum
 - +5.15v maximum
 - (b) -5v Regulator
 - -4.85v minimum
 - -5.15v maximum

- (4) Compare the voltages obtained in Steps (1) and (2). Voltages must fall within the acceptable limits and the absolute difference between the +5v and -5v lines must be less than 0.07v.

6.6.3.3 Adjustment Procedure (Assembly No. 101021 Only)

When the acceptable limits are exceeded or the voltage difference between the +5v and -5v lines exceed 0.07v, the following adjustments are performed.

- (1) Adjust variable resistor R102 on Servo and Power Supply - A PCBA to +5.0v as observed at TP18 on the Tape Control PCBA (using TP17 on the Servo and Power Supply - A as the 0v reference).
- (2) Adjust variable resistor R103 on the Servo and Power Supply - A PCBA to -5.0v as observed at TP19 on the Tape Control PCBA (using TP17 on the Servo and Power Supply - A as the 0v reference).

6.6.3.4 Related Adjustments (Assembly No. 101021 Only)

The following areas must be checked and adjusted subsequent to adjusting the +5v and -5v regulators.

- (1) Ramp Timing (Paragraph 6.6.9).
- (2) Tape Speed (Paragraph 6.6.10).

6.6.4 +5V AND -5V REGULATORS
(Servo and Power Supply - B, Assembly No. 101262 Only)

The +5v and -5v regulators are located on the Servo and Power Supply - B circuit board (101262) and are adjusted by means of variable resistors R116 and R117. The numerical value of the voltage difference, disregarding polarity, between the +5v and -5v lines must be less than 0.07v.

6.6.4.1 Test Configuration (Assembly No. 101262 Only)

- (1) Load a reel of tape on the transport.
- (2) Apply power to the transport.
- (3) Depress and release the LOAD control to establish interlock and tension the tape.
- (4) Depress and release the LOAD control a second time.
Tape will advance to the load point and stop.

6.6.4.2 Test Procedure (Assembly No. 101262 Only)

- (1) Using a Fairchild DVM Model 7050 (or equivalent) measure and note the voltage difference between TP18 (+5v) on the Tape Control PCBA, and TP19 (0v) on the Servo and Power Supply - B PCBA.
- (2) Using a Fairchild DVM Model 7050 (or equivalent) measure and note the voltage difference between TP19 (-5v) on the Tape Control PCBA, and TP19 (0v) on the Servo and Power Supply - B PCBA.
- (3) Acceptable Limits
 - (a) +5v Regulator
 - +4.85v minimum
 - +5.15v maximum
 - (b) -5v Regulator
 - -4.85v minimum
 - -5.15v maximum

- (4) Compare the voltages obtained in Steps (1) and (2).
Voltages must fall within the acceptable limits and the absolute difference between the +5v and -5v lines must be less than 0.07v.

6.6.4.3 Adjustment Procedure (Assembly No. 101262 Only)

When the acceptable limits are exceeded or the voltage difference between the +5v and -5v lines exceed 0.07v, the following adjustments are performed.

- (1) Adjust variable resistor R116 on Servo and Power Supply - B PCBA to +5.0v as observed at TP18 on the Tape Control PCBA (using TP19 on the Servo and Power Supply - B as the 0v (ground) reference).
- (2) Adjust variable resistor R117 on the Servo and Power Supply - B PCBA to -5.0v as observed at TP19 on the Tape Control PCBA (using TP19 on the Servo and Power Supply - B as the 0v (ground) reference).

6.6.4.4 Related Adjustments (Assembly No. 101262 Only)

The following areas must be checked and adjusted subsequent to adjusting the +5v and -5v regulators.

- (1) Ramp Timing (Paragraph 6.6.9).
- (2) Tape Speed (Paragraph 6.6.10).
- (3) EOT/BOT Amplifier (Paragraph 6.6.6).

6.6.5 EOT/BOT AMPLIFIER SYSTEMS

One of two different EOT/BOT amplifier systems may be installed in the transport.

Two systems are in use in conjunction with Servo and Power Supply - A (Assembly 101021), and Servo and Power Supply - B (assembly 101262). Both assemblies have the EOT/BOT circuitry integrated on the board, and in some cases an additional EOT/BOT amplifier system has been included. This amplifier assembly (101949) is mounted on a small PCBA (approximately 2 by 4 inches) located on the Write Lockout bracket at the rear of the tape deck.

Paragraphs 6.6.6 through 6.6.8.4 detail the test and adjustment procedures associated with these Servo and Power Supply PCBAs.

6.6.6 EOT/BOT AMPLIFIER - Schematic 101948 and Assembly 101949
The EOT/BOT Amplifier is mounted on a small PCBA located on the Write Lockout bracket at the rear of the tape deck. The following procedure is employed in testing and adjusting the EOT/BOT Amplifier PCBA.

NOTE

The +5 v and - 5 v regulator voltages must be checked and adjusted prior to adjusting the EOT/BOT amplifier system. Measurements and adjustments should be made at room temperature.

6.6.6.1 Test Configuration (Assembly No. 101949)

- (1) Load a reel of tape on the transport.
- (2) Apply power to the transport.

- (3) Depress and release the LOAD control to establish interlocks and tension the tape.
- (4) Depress and release the LOAD control a second time. Tape will advance to the Load Point and stop.

6.6.6.2 Test Procedure (Assembly No. 101949)

- (1) Advance tape until the reflective tab is past the photosensor.
- (2) Using a Fairchild DVM Model 7050 (or equivalent) measure and note the off-tab voltage between TP1 (EOT) on the EOT/BOT Amplifier PCBA and TP17 (0v) on the Servo and Power Supply PCBA.
- (3) Using a Fairchild DVM Model 7050 (or equivalent) measure and note the off-tab voltage between TP2 (BOT) on the EOT/BOT Amplifier PCBA and TP17 (0v) on the Servo and Power Supply PCBA.
- (4) Acceptable Limits (off-tab)
 - +2.00v minimum
 - +4.50v maximum
- (5) Compare the voltages obtained in Steps (2) and (3). Voltages must fall between the acceptable limits and the difference between TP1 (EOT) and TP2 (BOT) voltages must be less than 0.25v.
- (6) Manually position tape until the reflective BOT tab is located under the photosensor.
- (7) Measure and note the on-tab voltage between TP2 (BOT) on the EOT/BOT Amplifier PCBA and TP17 (0v) on the Servo and Power Supply PCBA.
- (8) Advance tape until the EOT tab is positioned under the photosensor.

- (9) Measure and note the on-tab voltage between TP1 (EOT) on the EOT/BOT Amplifier PCBA and TP17 (0v) on the Servo and Power Supply PCBA.
- (10) Acceptable Limits (on-tab)
 - On-tab voltages measured in Steps (7) and (9) must be 0.8v less than voltages measured in Steps (3) and (2).

6.6.6.3 Adjustment Procedure (Assembly No. 101949)

When the acceptable limits are exceeded or the off-tab voltage difference compared in Paragraph 6.6.6.2, Step (5) is greater than 0.25v the following adjustments are performed.

- (1) Verify that the adjusting screws of variable resistors R2 and R10 located on the Servo and Power Supply PCBA are turned fully clockwise.
- (2) Position tape so that the EOT and BOT reflective tabs are clear of the photosensor area.
- (3) Adjust variable resistor R3 on the EOT/BOT Amplifier PCBA to +4.0v as observed at TP1.
- (4) Adjust variable resistor R9 on the EOT/BOT Amplifier PCBA to +4.0v as observed at TP2.
- (5) Verify that the voltage at TP1 on the EOT/BOT Amplifier PCBA is within 0.25v of the voltage at TP2. Repeat Steps (3) and (4) if required.
- (6) Position tape so that the EOT reflective tab is located under the photosensor.
- (7) Verify that the on-tab voltage at TP1 of the EOT/BOT Amplifier PCBA falls within the limits specified in Paragraph 6.6.6.2, Step (10).

- (8) Depress and release the REWIND control. Tape will rewind to the BOT, enter a load sequence, and stop.
- (9) Verify that the on-tab voltage at TP2 of the EOT/BOT Amplifier PCBA falls within the limits specified in Paragraph 6.6.6.2, Step (10).

6.6.6.4 Related Adjustments (Assembly No. 101949)

- None.

6.6.7 BOT AMPLIFIER

On transports not equipped with an EOT/BOT Amplifier PCBA, circuitry connected to J13 on the Servo and Power Supply PCBA is utilized as the BOT amplifier. The following test and adjustment procedure is used.

NOTE

The +5 v and -5 v regulator voltages must be checked and adjusted prior to adjusting the BOT amplifier system. Measurements and adjustments should be made at room temperature.

6.6.7.1 Test Configuration

- (1) Load a reel of tape on the transport.
- (2) Apply power to the transport.
- (3) Depress and release the LOAD control to establish interlock and tension the tape.
- (4) Depress and release the LOAD control a second time. Tape will advance to the Load Point and stop.

6.6.7.2 Test Procedure

- (1) Manually position the BOT reflective tab clear of the photosensor area.
- (2) Using a Fairchild DVM Model 7050 (or equivalent) measure and note the off-tab voltage between TP4 and TP17 (0v) on the Servo and Power Supply PCBA.
- (3) Manually position tape so that the BOT reflective tab is positioned under the photosensor.
- (4) Using a Fairchild 7050 (or equivalent) measure and note the on-tab voltage between TP4 and TP17 (0v) on Servo and Power Supply PCBA.
- (5) Acceptable Limits
 - (a) On-Tab
 - +0.9v maximum
 - (b) Off-Tab
 - +3.0v minimum

6.6.7.3 Adjustment Procedure

When the acceptable limits are exceeded the following adjustments are performed.

- (1) Position the BOT reflective tab under the photosensor.
- (2) Adjust variable resistor R2 to obtain an on-tab voltage of +0.85v as observed at TP4.
- (3) Position the BOT reflective tab clear of the photosensor.
- (4) Check TP4 to ensure that the off-tab voltage is +3.0v (minimum).

6.6.7.4 Related Adjustments

- None.

6.6.8 EOT AMPLIFIER

On transports not equipped with an EOT/BOT Amplifier PCBA, circuitry connected to J13 on the Servo and Power Supply PCBA is used as the EOT amplifier. The following test and adjustment procedure is used.

NOTE

The +5 v and -5 v regulator voltages must be checked and adjusted prior to adjusting the EOT amplifier system. Measurements and adjustments should be made at room temperature.

6.6.8.1 Test Configuration

- (1) Load a reel of tape on the transport.
- (2) Apply power to the transport.
- (3) Depress and release the LOAD control to establish interlock and tension the tape.
- (4) Depress and release the LOAD control a second time. Tape will advance to the Load Point and stop.

6.6.8.2 Test Procedure

- (1) Manually position the EOT reflective tab clear of the photosensor area.
- (2) Using a Fairchild DVM Model 7050 (or equivalent) measure and note the off-tab voltage between TP6 and TP17 (0v) on the Servo and Power Supply PCBA.
- (3) Manually position the EOT reflective tab under the photosensor.
- (4) Using a Fairchild 7050 (or equivalent) measure and note the on-tab voltage between TP6 and TP17 (0v) on Servo and Power Supply PCBA.

- (5) Acceptable Limits
 - (a) On-Tab
 - +0.3v maximum
 - (b) Off-Tab
 - +2.8v minimum

6.6.8.3 Adjustment Procedure

When the acceptable limits are exceeded the following adjustments are made.

- (1) Position the EOT reflective tab under the photosensor.
- (2) Adjust variable resistor R10 to obtain an on-tab voltage of +0.2v as observed at TP6.
- (3) Position the EOT reflective tab clear of the photosensor.
- (4) Check TP6 to ensure the off-tab voltage is +2.8v (minimum).

6.6.8.4 Related Adjustments

- None.

6.6.9 RAMP TIMING

The four tape acceleration and deceleration ramps (Forward and Reverse, Start and Stop) are controlled by a single potentiometer adjustment located on the Tape Control PCBA. This adjustment controls the Start/Stop time, and is dependent upon the tape speed.

The ramp adjustment time is chosen to ensure that the correct Start/Stop distance is correlated to the specified Start/Stop time.

NOTE

The +5v and -5v regulator voltages must be checked and adjusted prior to adjusting Ramp Timing. Measurements and adjustments should be made at room temperature.

6.6.9.1 Test Configuration

- (1) Load a reel of tape on the transport.
- (2) Apply power to the transport.
- (3) Depress and release the LOAD control to establish interlocks and tension tape.
- (4) Depress and release the LOAD control a second time. Tape will advance to the Load Point and stop.

6.6.9.2 Test Procedure

- (1) Connect a signal probe of a Tektronix Model 561 (or equivalent) oscilloscope to TP5 on the Tape Control PCBA.
- (2) Connect the oscilloscope reference probe to TP17 (0v) on Tape Control PCBA.
- (3) Apply a 5 Hz symmetrical square wave with a 3v amplitude (+3.0v to 0v) to the interface line ISFC (J101 pin C or TP14).
- (4) Trigger the oscilloscope externally on the negative-going edge of the square wave input.
- (5) Adjust the oscilloscope variable vertical (volt/div) control to display 0 to 100 percent of the ramp waveform over four large divisions of the oscilloscope graticule.
- (6) Observe that the ramp adjustment time intersets 90 percent of the ramp amplitude (18 small divisions of oscilloscope graticule). Figure 6-1 illustrates ramp levels and timing.

NOTE

For reverse operation the ramp is a negative-going waveform.

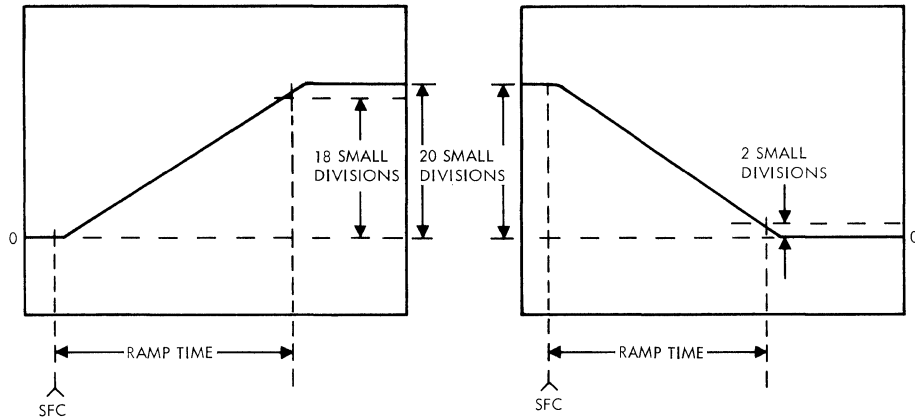


Figure 6-1. Ramp Levels and Timing

- (7) Acceptable Limits (90 percent of actual speed)
- (a) 45 ips transports
 - 6.2 - 6.9 milliseconds
 - (b) 37.5 ips transports
 - 7.3 - 8.1 milliseconds
 - (c) 25 ips transports
 - 11.6 - 12.8 milliseconds
 - (d) 22.5 ips transports
 - 13.1 - 14.5 milliseconds.
 - (e) 18.75 ips transports
 - 16.0 - 17.6 milliseconds
 - (f) 12.5 ips transports
 - 24.7 - 27.3 milliseconds
- (8) Remove the square wave input from J101 pin C (ISFC) and apply the square wave input to ISRC line (J101 pin E or TP13).
- (9) With the oscilloscope connected as specified in Step (5) observe that the reverse ramp timing is within the limits specified in Step (7).

6.6.9.3 Adjustment Procedure

When the acceptable limits are exceeded, the following adjustments are performed.

- (1) Establish test configuration described in Paragraph 6.6.9.1.
- (2) Perform test procedure described in Paragraph 6.6.9.2 Steps (1) through (5).
- (3) Adjust variable resistor R915 on Tape Control PCBA to obtain ramp adjustment time as follows.
 - (a) 45 ips transports
 - 6.5 milliseconds
 - (b) 37.5 ips transports
 - 7.7 milliseconds
 - (c) 25 ips transports
 - 12.2 milliseconds
 - (d) 22.5 ips transports
 - 13.8 milliseconds
 - (e) 18.75 ips transports
 - 16.8 milliseconds
 - (f) 12.5 ips transports
 - 26.0 milliseconds

NOTE

Specified time results in oscilloscope display illustrated in Figure 6-1. The ramp adjustment time intersects 90 percent of ramp amplitude when accelerating and 10 percent of ramp amplitude when decelerating.

- (4) Remove the square wave input from ISFC line (J101 pin C) and apply the square wave input to the interface line ISRC (J101 pin E or TP13).
- (5) Observe oscilloscope display of reverse ramp and re-adjust R915 to obtain ramp time as specified in Step (3).

6.6.9.4 Related Adjustments

- None.

6.6.10 TAPE SPEED

Only the Synchronous Forward speed is adjustable. The Synchronous Reverse function utilizes the same voltage reference as Synchronous Forward and is not independently adjustable.

NOTE

The +5 v and -5 v regulator voltages must be checked and adjusted prior to adjusting Tape Speed. Measurements and adjustments should be made at room temperature.

Two methods of tape speed adjustments are given. Paragraphs 6.6.10.1 through 6.6.10.4 describe the optical encoder method; Paragraphs 6.6.10.5 through 6.6.10.9 describe the strobe disk method.

6.6.10.1 Tape Speed - Optical Encoder Adjustment

Table 6-3 lists the nominal optical encoder counter frequency readings to which the 6000 Series transports are adjusted.

Table 6-3
Counter Frequency Readings

Tape Speed	Counter Frequency (Hz)
45.0	4500
37.5	3750
25.0	2500
22.5	2250
18.75	1875
12.5	1250

Tape speed may be calculated from the following formula used in conjunction with the specified counter timer.

$$V \text{ ips} = \text{Counter Frequency (Hz)} \times \frac{C}{500} \text{ inches}$$

where

C = Capstan circumference

NOTE

Capstan circumference for the 6000 Series transports is 5.00 inches.

6.6.10.2 Test Configuration (Optical Encoder Method)

- (1) Couple an Optical Encoder PERTEC Part No. 512-1100 to the front of the capstan shaft. Five volts dc must be applied to the Optical Encoder lamp input (pins 1 and 2). This voltage can be obtained between TP19 (-5v) and TP17 (0v) on the Tape Control PCBA.
- (2) Load a reel of tape.

- (3) Apply power to the transport.
- (4) Depress and release the LOAD control to establish interlocks and tension tape.
- (5) Depress and release the LOAD control a second time. Tape will advance to the Load Point and stop.

6.6.10.3 Test Procedure (Optical Encoder Method)

- (1) Connect input probes of Counter Timer Monsanto Model 100B (or equivalent) to pins 6 and 7 of the Optical Encoder PERTEC Part No. 512-1100.
- (2) Depress and release the FORWARD control. Tape will move in the forward direction.
- (3) Adjust the sample interval of the counter timer to monitor the encoder output over a one second interval.
- (4) Acceptable Limits
 - (a) 12.5 ips
 - 1262 Hz maximum
 - 1238 Hz minimum
 - (b) 18.75 ips
 - 1893 Hz maximum
 - 1857 Hz minimum
 - (c) 22.5 ips
 - 2273 Hz maximum
 - 2227 Hz minimum
 - (d) 25.0 ips
 - 2525 Hz maximum
 - 2475 Hz minimum
 - (e) 37.5 ips
 - 3787 Hz maximum
 - 2475 Hz minimum
 - (f) 45.0 ips
 - 4545 Hz maximum
 - 4455 Hz minimum

- (5) Depress and release the FORWARD control. Tape will decelerate to stop. Depress and release the REVERSE control. Tape will move in the reverse direction.
- (6) With the Counter Timer connected as specified in Step (1) monitor the output of the optical encoder.
- (7) The reverse tape speed, as monitored with the Counter Timer, must be within the following limits.
 - (a) 12.5 ips
 - 1286 Hz maximum
 - 1214 Hz minimum
 - (b) 18.75 ips
 - 1929 Hz maximum
 - 1821 Hz minimum
 - (c) 22.5 ips
 - 2317 Hz maximum
 - 2183 Hz minimum
 - (d) 25.0 ips
 - 2575 Hz maximum
 - 2425 Hz minimum
 - (e) 37.5 ips
 - 3861 Hz maximum
 - 3639 Hz minimum
 - (f) 45.0 ips
 - 4635 Hz maximum
 - 4365 Hz minimum

6.6.10.4 Adjustment Procedure (Optical Encoder Method)

When the forward or reverse tape speeds exceed the specified limits the following adjustments are performed.

- (1) Establish the test configuration described in Paragraph 6.6.10.2.
- (2) Perform the test procedure described in Paragraph 6.6.10.3, Steps (1) through (3).
- (3) Depress the FORWARD control. Tape will move in the forward direction.
- (4) Adjust the variable resistor R29 on the Tape Control PCBA for the following counter timer values.
 - (a) 45 ips transports
 - 4500 Hz
 - (b) 37.5 ips transports
 - 3750 Hz
 - (c) 25.0 ips transports
 - 2500 Hz
 - (d) 22.5 ips transports
 - 2250 Hz
 - (e) 18.75 ips transports
 - 1875 Hz
 - (f) 12.5 ips transports
 - 1250 Hz
- (5) Monitor the counter timer to ensure that the reverse speed is within the acceptable limits established in Paragraph 6.6.10.3, Step (7). Repeat Steps (2) through (5) as required.

6.6.10.5 Tape Speed - Strobe Disk Adjustment

The capstan mounted strobe disk may be used when making fine adjustments to the tape speed on 6000 Series Tape Transports.

Tape speed adjustments made using the strobe disk are accomplished by illuminating the capstan hub from a fluorescent light source and adjusting the capstan servo until the disk image, created by the pulsating light source, becomes stationary. Table 6-4 lists the available disks, synchronous tape speeds, and light source frequencies.

Some strobe disks have two or three concentric sets of strobe markings on each disk. The following rules apply to disks marked with multiple sets of strobe markings.

- (1) Part No. 101744-02 (12.5/25 ips). The outer ring is used when the fluorescent light source is 60 Hz. The inner ring is used when the fluorescent light source is 50 Hz.
- (2) Part No. 101744-03 (18.75/37.5 ips). There are three sets of strobe markings on this disk. The outer ring is used when checking and adjusting synchronous tape speeds of 18.75 or 37.5 ips from a 60 Hz fluorescent light source. The middle ring is used at a tape speed of 37.5 ips and from a 50 Hz light source. The inner ring is used at a tape speed of 18.75 ips from a 50 Hz light source.
- (3) Part No. 101744-04 (20/40 ips). The outer ring is used when the fluorescent light is from a 60 Hz source. The inner ring is used when the fluorescent light source is from 50 Hz.
- (4) Part No. 101744-05 (22.5/45 ips). The outer ring of strobe markings is used when checking and adjusting a

Table 6-4
Strobe Disks

PERTEC Part No.	Tape Speed (ips)	Light Source Frequency (Hz)
101744-02	12.5/25	60/50
101744-03	18.75/37.5	60/50
101744-04	20/40	60/50
101744-05	22.5/45	60/50
101744-06	24	60
101744-07	30	60/50

tape speed of 45 ips from a 60 Hz fluorescent light source. The middle ring is used at a tape speed of 22.5 ips from a 60 Hz light source. The inner ring is used at a tape speed of 22.5 ips from a 50 Hz light source.

- (5) Part No. 101744-07 (30 ips). The outer ring is used when the fluorescent light source is 60 Hz. The inner ring is used when the fluorescent light source is 50 Hz.

The use of the capstan-mounted strobe disk should be limited to fine tape adjustments of the synchronous tape speed. When it is necessary to make gross speed adjustments (e. g., when replacing a Servo and Power Supply PCBA) refer to the test and adjustment procedures described in Paragraphs 6.6.10.1 through 6.6.10.4.

6.6.10.6 Test Configuration (Strobe Disk Method)

- (1) Load a reel of tape on the transport.
- (2) Apply power to the transport.
- (3) Depress and release the LOAD control to establish interlocks and tension the tape.

- (4) Depress and release the LOAD control a second time; tape will advance to the Load Point and stop.
- (5) Illuminate the capstan mounted strobe disk with a fluorescent light source at the appropriate frequency.

6.6.10.7 Test Procedure (Strobe Disk Method)

- (1) Establish the test configuration described in the foregoing paragraph.
- (2) Depress and release the FORWARD control tape will move in the forward direction.
- (3) Observe the appropriate strobe disk image; the image should appear stationary.
- (4) On dual speed transports, Steps (2) and (3) must be repeated at the second speed.

6.6.10.8 Adjustment Procedure (Strobe Disk Method)

- (1) Establish test configuration previously described.
- (2) Adjust potentiometer R29 on the Tape Control PCBA until the strobe disk image appears stationary for the appropriate tape speed.

6.6.11 REWIND SPEED (Applies to Servo and Power Supply - B, Assembly 101262)

The rewind speed should be between the following limits.

- 135 ips minimum
- 165 ips maximum

NOTE

The +5 v and -5 v regulator voltages must be checked and adjusted prior to adjusting the tape speed. Measurements and adjustments should be made at room temperature.

6.6.11.1 Test Configuration (Assembly 101262)

- (1) Couple an Optical Encoder PERTEC Part No. 512-1100 to the front of the capstan shaft. Five volts dc must be applied to the Optical Encoder lamp input (pins 1 and 2). This voltage can be obtained between TP19 (-5v) and TP17 (0v) on the Tape Control PCBA.
- (2) Load a reel of tape.
- (3) Apply power to the transport.
- (4) Depress and release the LOAD control to establish interlocks and tension the tape.
- (5) Depress and release the LOAD control a second time. Tape will advance to the Load Point and stop.

6.6.11.2 Test Procedure (Assembly 101262)

- (1) Connect input probes of Counter Timer Monsanto Model 1100B (or equivalent) to pins 6 and 7 of the Optical Encoder.

- (2) With a full reel of tape on the take-up reel, depress and release the REWIND control.
- (3) Adjust the sample interval of the counter timer to monitor the encoder output over a one-second interval.
- (4) Acceptable limits
 - 16,500 Hz maximum
 - 13,500 Hz minimum

6.6.11.3 Adjustment Procedure (Assembly 101262)

- (1) Establish the test configuration described in Paragraph 6.6.11.1.
- (2) Perform the test procedure described in Paragraph 6.6.11.2.
- (3) Adjust the variable resistor R14 on Servo and Power Supply to obtain a counter timer value of
 - 15,000 Hz

This corresponds to 150 ips rewind speed.

6.6.11.4 Related Adjustments (Assembly 101262)

- None

6.6.12 READ AMPLIFIER GAIN

The gain of each of the read amplifiers located on the Data PCBA is independently adjustable.

NOTE

The tape speed must be checked and adjusted prior to adjusting the Read Amplifier Gain.

Read amplifier gain may be determined by reading (in the Read Only mode) an all-ones tape which was recorded on the transport. Paragraph 6.6.13 details a method for generating an all-ones tape.

6.6.12.1 Test Configuration

- (1) Clean the head assembly and tape path as described in Paragraph 6.4.
- (2) Load a pre-recorded all-ones tape.
- (3) Apply power to the transport.
- (4) Depress and release the LOAD control to establish interlocks and tension tape.
- (5) Depress and release the LOAD control a second time; tape will advance to the Load Point and stop.

6.6.12.2 Test Procedure

- (1) Depress and release the FORWARD control; tape will move forward at the specified velocity.
- (2) Using the signal probe of a Tektronix 561 oscilloscope (or equivalent) measure and record the peak-to-peak amplitude of the read amplifier waveforms viewed at the TP103 through TP903 on the Data E9 PCBA, or TP103 through TP703 on the Data E7 PCBA.

NOTE

Oscilloscope vertical sensitivity should be set to display 2v per division.

- (3) Acceptable limits (peak-to-peak when utilizing an all-ones tape generated on the transport):
 - 11.75v maximum
 - 8.5v minimum

6.6.12.3 Adjustment Procedure

When the acceptable limits are exceeded the following adjustments are performed.

- (1) Establish test configuration described in Paragraph 6.6.12.1.
- (2) Depress and release the FORWARD control.
- (3) Using the signal probe of a Tektronix 561 oscilloscope (or equivalent) observe TP103 through TP903 on the Data E9 PCBA, OR TP103 through TP703 on the Data E7 PCBA. Adjust variable resistors R112 through R912 associated with test points to 10.5v peak-to-peak.

6.6.12.4 Related Adjustments

- None.

6.6.13 GENERATION OF ALL-ONES TAPE

An all-ones tape may be generated as follows.

- (1) Ensure that head assembly and tape path are clean.
- (2) Load a good quality work tape.
- (3) Bring transport to Load Point as described in Paragraph 6.6.3.1.
- (4) Apply a ground to the interface line ISWS (J101 pin K).
- (5) Apply a ground to the interface line ISFC (J101 pin C).
- (6) Apply a ground to the interface lines WDP-WD7 (J102 pins L, M, N, P, R, S, T, U, and V).
- (7) Apply negative-going pulses (+3v to 0v) of 2 μ seconds duration at the specified transfer rate to the interface line IWDS (J102 pin A).

- (8) Maintain the transport in this record mode for approximately 3 minutes.
- (9) Remove the signal source from the interface line IWDS (J102 pin A).
- (10) Remove the ground from the interface lines ISWS and ISFC (J101 pin K and J101 pin C, respectively).
- (11) Depress and release the REWIND control. Tape will rewind to the Load Point and stop.

In considering the overall gain of the read system, it is important to note that the output of the read head is particularly dependent upon the type of magnetic tape used and the condition of the tape, i. e. , new or used.

The read amplifier output should be adjusted as detailed in Paragraph 6.6.12.3, Step (3). A read amplifier gain adjusted too high will result in amplifier saturation; gain set too low will increase the susceptibility to data errors due to drop-outs.

6.6.14 READ STATICISER DENSITY ADJUSTMENT

The duration of the read character gate is adjusted by means of variable resistors located on the Data PCBA. Nominally, the duration of the character gate is one-half of the character time.

It is important to note that only one density (800 cpi) is relevant to the Data E9 (9-track) PCBA, while dual density operation can be selected on the Data E7 (7-track) PCBA through use of the HI DEN manual control, or remotely through use of the optional IDDS interface line.

There are three combinations of two densities available for 7-track: 800/556, 800/200, and 556/200 cpi. The particular combination in any transport will depend upon the version of the circuit board.

NOTE

Tape Speed and Read Amplifier Gain must be checked and adjusted prior to adjusting the Read Staticiser Density.

6.6.14.1 Test Configuration

- (1) Load a reel of tape on the transport.

NOTE

An all-ones tape, recorded at the lower of the two densities, should be utilized. Refer to Paragraph 6.6.13 for details on generating an all-ones tape.

- (2) Apply power to the transport.
- (3) Depress and release the LOAD control to establish the interlock and tension tape.
- (4) Depress and release the LOAD control a second time. Tape will advance to the Load Point and stop.

6.6.14.2 Test Procedure

- (1) Depress and release the FORWARD control. Tape will move forward at the specified velocity.
- (2) Using the signal probe of a Tektronix 561 oscilloscope (or equivalent) measure and note the duration of the waveform observed at TP11 on the Data PCBA.

NOTE

The oscilloscope should be set to trigger on the positive-going edge of the observed waveform.

- (3) Calculate the ideal character gate duration using the following formula.

$$t (\mu\text{sec}) = \frac{10^6}{2 DV} = \text{one-half character time.}$$

where

D = density in cpi (recorded tape)

V = tape speed in ips

- (4) Acceptable limits (given for 25 ips only; for other speeds, see Step (3) above and calculate the limits based on $\pm 5\%$ of nominal).
 - (a) 800 cpi density, 25 ips, for Data E7 and Data E9 PCBAs
 - 26.2 μsec maximum
 - 23.8 μsec minimum
 - (b) 556 cpi density, 25 ips, for Data E7 PCBA
 - 37.8 μsec maximum
 - 34.2 μsec minimum
 - (c) 200 cpi density, 25 ips, for Data E7 PCBA
 - 105.0 μsec maximum
 - 95.0 μsec minimum

6.6.14.3 Adjustment Procedure (7-track Transports)

When the acceptable limits are exceeded the following procedure is performed.

- (1) Establish test configuration described in Paragraph 6.6.14.1.
- (2) Depress and release the FORWARD control. Tape will move forward at the specified velocity.
- (3) Select the lower of the two packing densities (HI DEN control extinguished) on versions equipped for dual-density operation.
- (4) Connect a signal probe of a Tektronix 561 oscilloscope (or equivalent) to TP11 on the Data E7 PCBA.
- (5) Connect the oscilloscope reference probe to TP12 on the Data E7 PCBA.
- (6) Adjust variable resistor R32 on the Data E7 PCBA to display a character gate waveform according to speed and density as follows (see Paragraph 6.6.14.2 for other speeds).
 - (a) 556 cpi density, 25 ips
 - 36 μ sec
 - (b) 200 cpi density, 25 ips
 - 100 μ sec
- (7) Select the higher of the two densities (HI DEN control illuminated) on versions equipped for dual density operation .
- (8) Adjust variable resistor R27 on the Data E7 PCBA to display a character gate waveform according to speed as follows (see Paragraph 6.6.14.2 for other speeds).
 - (a) 800 cpi density, 25 ips
 - 25 μ sec

(b) 556 cpi density, 25 ips

- 36 μ sec

NOTE

The foregoing adjustments must be performed in the order specified.

6.6.14.4 Adjustment Procedure (9-track Transports)

When the acceptable limits are exceeded, the following adjustments are performed.

- (1) Establish test configuration described in Paragraph 6.6.14.1.
- (2) Depress and release the FORWARD control. Tape will move forward at the specified velocity.
- (3) Connect a signal probe of a Tektronix 561 oscilloscope (or equivalent) to TP11 on the Data E9 PCBA.
- (4) Connect the oscilloscope reference probe to TP12 on the Data E9 PCBA.
- (5) Adjust R32 on the Data E9 PCBA to display the positive-going portion of the character gate waveform as follows for 800 cpi at 25 ips (see Paragraph 6.6.14.2 for other speeds).
 - 25 μ sec

6.6.14.5 Related Adjustments

- None.

6.7 MECHANICAL ADJUSTMENTS

6.7.1 TENSION ARM LIMIT SWITCH

When the tension arm is resting against its backstop the position of the limit switch roller, with respect to the cam, should be as shown in Figure 6-2 (Section A-A). At this time the switch contacts should be open. If the relative positions of the roller and cam are not as illustrated, the following adjustment is performed.

- (1) Loosen the cam retaining set-screw.
- (2) Rotate the cam on its shaft until the limit switch roller is in the position illustrated in Figure 6-2.
- (3) Firmly tighten the cam retaining set-screw.

CAUTION

THE CAM RETAINING SET-SCREW MUST BE TIGHTENED SUFFICIENTLY TO PREVENT ROTATION OF THE CAM WHEN THE TENSION ARM IMPACTS ON ITS BACKSTOP.

The limit switch plate is slotted at one mounting screw and may be rotated about the second screw to facilitate setting the switching point of the limit switch. The plate should be rotated to a position where the limit switch trips with its roller one-half of the distance up the slope from its rest position. The switch should be closed when the roller moves on the cam lobe between the semi-circular cutouts.

Replacement of the limit switch is accomplished as follows.

- (1) Unplug the limit switch connector P17 from J17 of the Servo and Power Supply PCBA.
- (2) Remove yellow and green leads from the limit switch connector (P17) using an extractor tool.

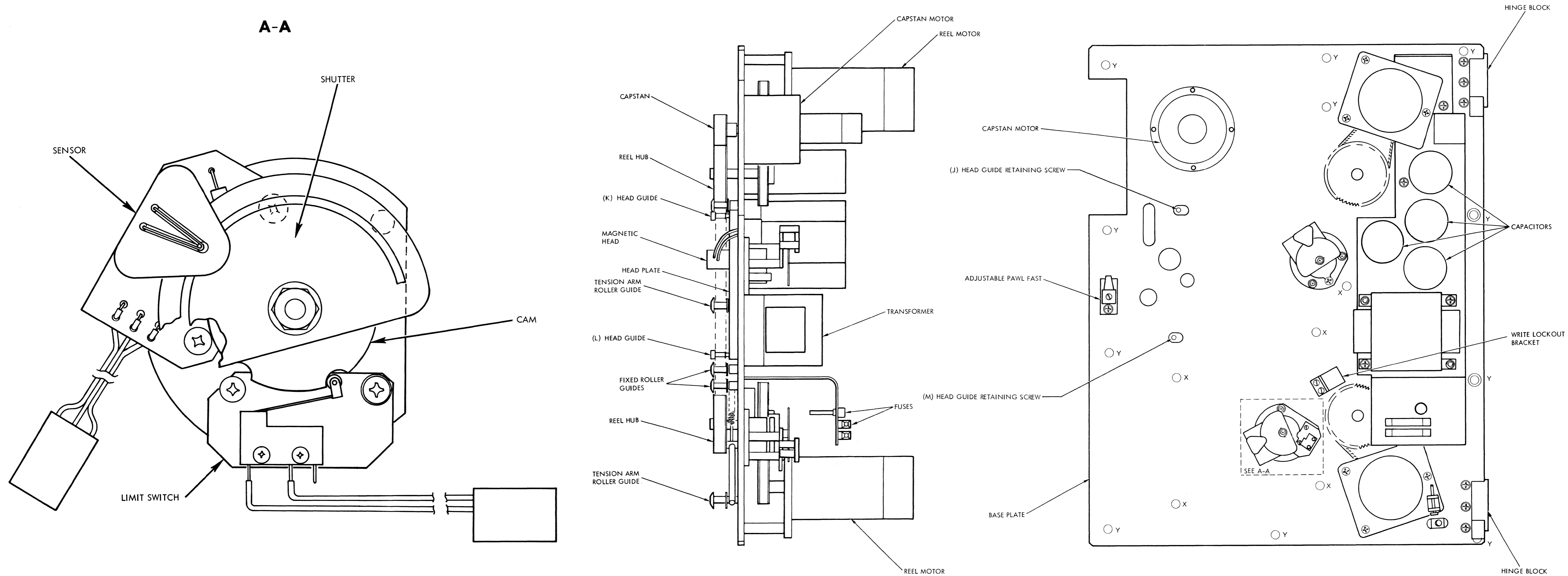


Figure 6-2. Tape Deck Diagram, Rear View

- (3) Remove the two mounting screws which mount the limit switch to its plate and remove the switch.
- (4) Attach the new limit switch to the plate using the two mounting screws removed in Step (3).
- (5) Adjust the limit switch position as described in the preceding paragraph.
- (6) Tighten the two mounting screws and recheck position of the limit switch roller.
- (7) Connect the limit switch connector (P17) to J17 of the Servo and Power Supply PCBA.
- (8) Plug the connector (P14 for take-up reel sensor, P18 for supply reel sensor) into the respective jack on the Servo and Power Supply circuit board.
- (9) Perform the relevant adjustment procedure.

6.7.2 TENSION ARM POSITION SENSOR (Applies to Servo and Power Supply - A, Assembly 101021)

There are two tension arm position sensors: one on the take-up tension arm, and the second on the supply arm. Each of the sensors has a 3-pin plug which connects the output of the sensor to the reel servo amplifier on the Servo and Power Supply PCBA.

CAUTION

ENSURE THAT THE 5V REGULATORS, RAMP TIMING, AND TAPE SPEEDS ARE CORRECT AS DETAILED IN PARAGRAPHS 6.6.3 (OR 6.6.4), 6.6.10, AND 6.6.11, RESPECTIVELY, BEFORE ADJUSTING THE TENSION ARM POSITION SENSORS.

6.7.2.1 Preliminary Adjustment (Assembly 101021)

The tension arm photosensors on the supply reel and take-up reel are initially adjusted as follows.

- (1) Loosen the No. 10 retaining nut securing the shutter on the tension arm shaft in such a way that the shutter can be rotated by hand.

NOTE

Ensure that there is sufficient friction to prevent the setting from changing when the nut is tightened.

- (2) To place the shutter in approximately the correct position, remove tape from the transport and rotate the shutter until moving the tension arm to the middle of its range stops reel motion.

NOTE

The LOAD control must be continuously depressed or the limit switch shorted to facilitate this procedure.

- (3) Load tape on the transport.
- (4) Establish an environment which ensures that the tension arm sensors are shielded from high ambient light. Failure to do so could result in a shift in the arm operating region when the unit is rack-mounted.

6.7.2.2 Take-up Arm Adjustment (Assembly 101021)

When the preliminary adjustments are completed, proceed as follows.

- (1) Ensure that the take-up reel is nearly empty.

- (2) Place the arm movement measuring tool PERTEC Part No. 101137 in position against the fixed guide near the top of the arm swing. The words "Top Arm" should be visible on the tool.
- (3) Alternately depress the FORWARD and REVERSE controls to cause tape to "shuttle" back and forth.
- (4) If Step (3) causes loss of tape tension by moving the supply arm to either switch point of the limit switch, re-tension tape by depressing LOAD. Move the supply arm shutter so that the arm rests in the center of its travel. Adjust R72 on the Servo and Power Supply PCBA 5 turns CW so as to reduce the total arm movement. Repeat this step as required.
- (5) Note the total arm movement.
- (6) Adjust variable resistor R30 on the Servo and Power Supply PCBA until the total arm movement is equal to the distance between the appropriate marks on the tool.

NOTE

The actual arc of movement may not coincide with that specified on the tool because the shutter may not yet be in the correct position.

- (7) Readjust the shutter position so that the arm of the arm movement and the mark on the tool coincide.
- (8) The arm position in Forward and Reverse motion should coincide with the marks on the tool within +0.0, -0.5 inch.
- (9) Torque the optical shutter retaining nut to 30 in/lbs, taking care that the shutter does not move.

6.7.2.3 Supply Arm Adjustment (Assembly 101021)

When the preliminary adjustments are completed, proceed as follows.

- (1) Ensure that the supply reel is nearly empty.
- (2) Place the arm movement measuring tool PERTEC Part No. 101137 in position against the fixed guide near the bottom of the arm stroke. The words "Bottom Arm" should be visible on the tool.
- (3) Adjust the shutter, if necessary, so that the supply arm rests in the center of its travel.
- (4) Alternately depress the FORWARD and REVERSE controls to cause tape to "shuttle" back and forth.
- (5) Note the total arm movement.
- (6) Adjust variable resistor R72 on the Servo and Power Supply PCBA until the total arm movement is equal to the distance between the appropriate marks on the tool.

NOTE

The actual arc of movement may not coincide with that specified on the tool because the shutter may not yet be in the correct position.

- (7) Readjust the shutter position so that the arm of the arm movement and the mark on the tool coincide.
- (8) The arm position in Forward and Reverse motion should coincide with the mark on the tool within +0.0, -0.5 inch.
- (9) Torque the optical shutter retaining nut to 30 in/lbs, taking care that the shutter does not move.

6.7.3 TENSION ARM POSITION SENSOR (Applies to Servo and Power Supply - B, Assembly 101262)

There are two tension arm position sensors: one on the take-up tension arm, and the second on the supply arm. Each of the sensors has a 3-pin plug which connects the output of the sensor to the reel servo amplifier on the Servo and Power Supply PCBA.

CAUTION

ENSURE THAT THE 5V REGULATORS, RAMP TIMING, AND TAPE SPEEDS ARE CORRECT AS DETAILED IN PARAGRAPHS 6.6.3 (OR 6.6.4), 6.6.10, AND 6.6.11, RESPECTIVELY, BEFORE ADJUSTING THE TENSION ARM POSITION SENSORS.

6.7.3.1 Preliminary Adjustment (Assembly 101262)

The tension arm photosensors on the supply reel and take-up reel are initially adjusted as follows.

- (1) Loosen the No. 10 retaining nut securing the shutter on the tension arm shaft in such a way that the shutter can be rotated by hand.

NOTE

Ensure that there is sufficient friction to prevent the setting from changing when the nut is tightened.

- (2) To place the shutter in approximately the correct position, remove tape from the transport and rotate the shutter until moving the tension arm to the middle of its range stops reel motion.

NOTE

The LOAD control must be continuously depressed or the limit switch shorted to facilitate this procedure.

- (3) Load tape on transport.
- (4) Establish an environment which ensures that the tension arm sensors are shielded from high ambient light. Failure to do so could result in a shift in the arm operating region when the unit is rack-mounted.

6.7.3.2 Take-up Arm Adjustment (Assembly 101262)

When the preliminary adjustments are completed, proceed as follows.

- (1) Ensure that the take-up reel is nearly empty.
- (2) Place the arm movement measuring tool PERTEC Part No. 101137 in position against the fixed guide near the top of the arm swing. The words "Top Arm" should be visible on the tool.
- (3) Move the take-up shutter so that the arm rests approximately in the center of its travel.
- (4) Alternately depress the FORWARD and REVERSE controls to cause tape to "shuttle" back and forth.
- (5) If Step (4) causes loss of tape tension because the supply arm exceeds its operating range, re-tension tape by depressing LOAD. Adjust R81 on Servo and Power Supply PCBA 5 turns CCW so as to reduce the total supply arm movement. Repeat this step as required.
- (6) Adjust variable resistor R32 on Servo and Power Supply PCBA until the extreme arm movement is equal to the distance between the appropriate marks on the tool.

NOTE

The actual arc of movement may not coincide with that specified on the tool because the shutter may not yet be in the correct position.

- (7) Readjust the shutter position so that the arc of the arm movement and the mark on the tool coincide.
- (8) The arm position in Forward and Reverse motion should coincide with the marks on the tool within +0.0, -0.5 inch.
- (9) Torque the optical shutter retaining nut to 30 in/lbs, taking care that the shutter does not move.

6.7.3.3 Supply Arm Adjustment (Assembly 101262)

When the preliminary adjustments are completed, proceed as follows.

- (1) Ensure that the supply reel is nearly empty.
- (2) Place the arm movement measuring tool PERTEC Part No. 101137 in position against the fixed guide near the bottom of the arm stroke. The words "Bottom Arm" should be visible on the tool.
- (3) Adjust the shutter, if necessary, so that the supply arm rests in the center of its travel.
- (4) Alternately depress the FORWARD and REVERSE controls to cause tape to "shuttle" back and forth.
- (5) Note the total arm movement.
- (6) Adjust variable resistor R81 on the Servo and Power Supply PCBA until the extreme arm movement is equal to the distance between the appropriate marks on the tool.

NOTE

The actual arc of movement not not coincide with that specified on the tool because the shutter may not yet be in the correct position.

- (7) Readjust the shutter position so that the arm of the arm movement and the mark on the tool coincide.

- (8) The arm position in Forward and Reverse motion should coincide with the marks on the tool within +0.0, -0.5 inch.
- (9) Torque the optical shutter retaining nut to 30 in/lbs, taking care that the shutter does not move.

6.7.4 TENSION ARM SENSOR REPLACEMENT

The tension arm optical sensors are replaced as follows.

- (1) Loosen the No. 10 retaining nut which secures the optical shutter to the tension arm.
- (2) Rotate the shutter to clear the countersunk screws which retain the tension arm sensor printed circuit board to the deck standoffs.
- (3) Remove two retaining screws from the tension arm sensor printed circuit board.

NOTE

Retain the two screws removed in Step (3). They will be used to mount the replacement sensor.

- (4) Unplug the connector (P14 for take-up reel sensor, P18 for supply reel sensor) from the Servo and Power Supply PCBA and remove sensor assembly.
- (5) Mount the replacement assembly on the deck standoffs using the two screws which were removed in Step (3).
- (6) Plug the connector (P14 for take-up reel sensor, P18 for supply reel sensor) into the respective jack on the Servo and Power Supply PCBA.
- (7) Perform the relevant adjustment procedure.

6.7.5 READ SKEW MEASUREMENT AND ADJUSTMENT

Dynamic and static skew can be measured and adjusted by using an 800-cpi master tape (which can be obtained from IBM) and an oscilloscope.

6.7.5.1 Read Skew Measurement

An indication of the total read system skew may be obtained by observing the algebraic sum of the peak detectors at TP15 on the Data PCBA.

Figure 6-3 illustrates an example of correctly adjusted skew; Figure 6-4 is an example of poorly adjusted tape skew. This method of determining the system read skew is accomplished as follows.

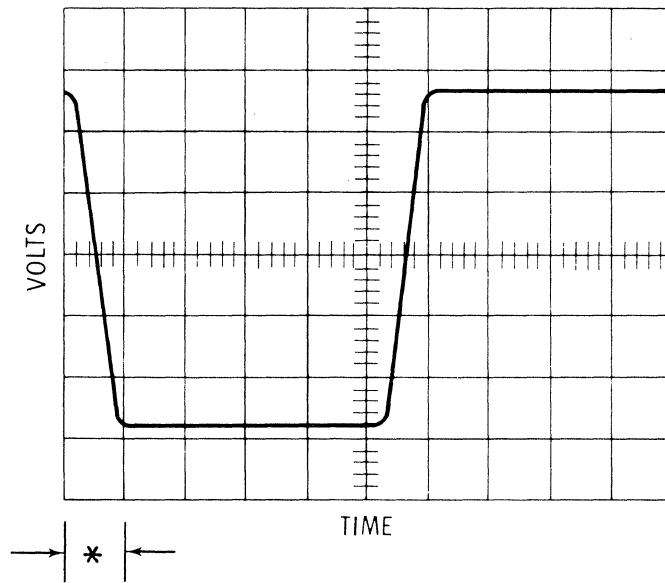
- (1) Set the vertical sensitivity on the oscilloscope to 1.0v/cm.
- (2) Set the oscilloscope to trigger on Channel 1, negative slope, alternate mode.
- (3) Load an 800-cpi master tape on the transport, bring to BOT, and initiate an SFC by tying the interface input (pin C of J101) to 0v.
- (4) Observe oscilloscope waveform and adjust the horizontal time/division fixed and variable controls to display one complete cycle.

NOTE

With an 800 cpi tape, each cycle represents 1250 μ inches. The scope graticule is divided into 10 major divisions, each of which is divided into 5 divisions; therefore

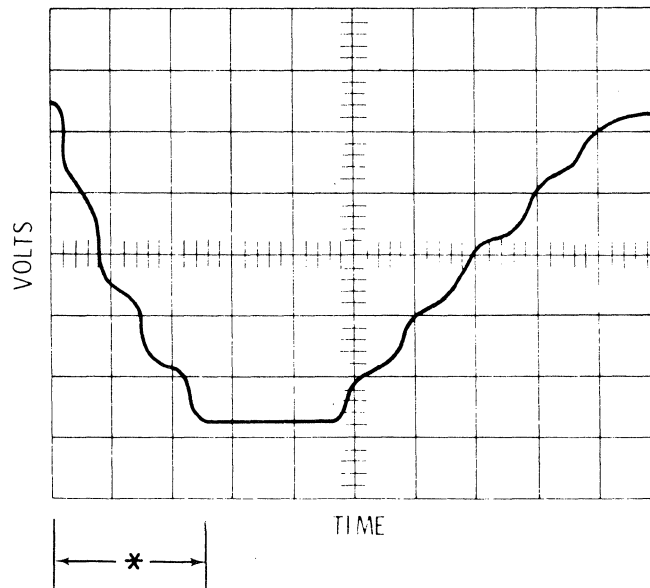
$$\frac{1250 \mu\text{inch}}{50 \text{ divisions}} = 25 \mu\text{inch/division}$$

- (5) Observe that the fall time of the waveform viewed at TP15 is less than six small divisions of the oscilloscope graticule, i. e., 150 μ inches. This measurement should be taken between the 95- and 5-percent points of the waveform.



* FALL TIME MUST BE LESS THAN ONE DIVISION

Figure 6-3. Skew Waveform (Good)



* FALL TIME EXCEEDS ONE DIVISION

Figure 6-4. Skew Waveform (Poor)

6.7.5.2 Read Skew Adjustment

To reduce skew to within acceptable limits, the following procedure is performed.

- (1) Perform the measurement procedure described in Paragraph 6.7.5.1.
- (2) While observing the waveform at TP15 on the Data PCBA, with tape moving in the forward direction, ease the edge of the tape off the head guide cap toward the spring-loaded washer. This should be done on first one guide, then the other.

NOTE

Moving tape one- to two-thousandths of an inch from one of the guides will reduce the skew to within the specified range.

- (3) Observe the waveform and determine which movement (upper guide or lower guide) improves the display. If moving the tape off the upper guide improved the display, the lower guide should be shimmed.

NOTE

The shims are burr-free, etched, one-half of a thousandths inch thick beryllium copper.

- (4) Remove the SFC by removing the 0v to interface input (pin C of J101).
- (5) Remove the head guide retaining screw (accessible from the rear of the deck) and remove the guide.

NOTE

When removing the guide care should be taken not to drop the spring and washer.

- (6) Observe and note the fall time of the waveform observed at TP15 with the oscilloscope set up as described in Paragraph 6.7.5.1, Step (4).
- (7) Since the character spacing at 800 cpi is 1250 μ inches, the actual skew can be calculated. The skew correction provided by the addition of one shim (each shim is 500 μ inches thick) is $\frac{500}{12} = 42$ μ inches. The number of shims used must satisfy the following.
 - (a) Skew must be reduced to a minimum consistent with the maximum number of shims allowable.
 - (b) The maximum number of shims used must not exceed four.

Therefore, if, for example, the measured skew is 180 μ inches, four shims will yield a skew correction of 168 μ inches (i. e., $4 \times \frac{500}{12} = 168$ μ inches). This satisfies the requirements listed in (a) and (b).

- (8) Insert the required number of shims and replace the head guides.

NOTE

Shim only one head guide.

- (9) Recheck skew measurement as described in Paragraph 6.7.5.1.

6.7.6 WRITE SKEW MEASUREMENT AND ADJUSTMENT

The read skew measurement and adjustment should be accomplished prior to adjustment of the write skew.

6.7.6.1 Write Skew Measurement

Measurement of write skew is accomplished by writing and simultaneously reading an all-ones tape. This is accomplished as follows.

- (1) Set the vertical sensitivity of a Tektronix 561 oscilloscope (or equivalent) to 1.0v/cm and the horizontal range to 5 μ sec/cm.
- (2) Set the oscilloscope to trigger on Channel 1, negative slope, alternate mode.
- (3) Ensure that head assembly and tape path are clean.
- (4) Load a good quality work tape with a write enable ring in place on the transport.
- (5) Bring the transport to Load Point.
- (6) Put the transport on-line.
- (7) Apply a ground to TP9 on the Tape Control PCBA.
- (8) Apply a ground to the interface line ISLT (J101 pin J) on the Tape Control PCBA.
- (9) Apply a ground to the interface line ISFC (J101 pin C) on the Tape Control PCBA.
- (10) Apply a ground to interface lines IWDP and IWD0 through IWD7 (J102 pins L, M, N, P, R, S, T, U, and V) of the Data PCBA.

- (11) Apply negative-going pulses (+3v to 0v) of 2 μ sec duration at the specified transfer rate to the interface line IWDS (J102 pin A) on the Data PCBA.

NOTE

$$\text{Transfer Rate} = D \cdot V$$

where D = Density in cpi

V = Speed in ips

i. e., 20Kc at 800 cpi, 25 ips

- (12) Connect the oscilloscope signal probe to TP15 on the Data PCBA and adjust the horizontal time/division "variable" control to display one complete cycle.

NOTE

With an 800 cpi tape, each cycle represents 1250 μ inches. The scope graticule is divided into 10 major divisions, each of which is divided into 5 divisions; therefore

$$\frac{1250 \mu\text{inch}}{50 \text{ divisions}} = 25 \mu\text{inch/division}$$

- (13) Observe that the fall time of the waveform viewed at TP15 is less than eight small divisions of the oscilloscope graticule, i. e., 200 μ inches. Note that this value includes the effect of gap scatter of the read head. Tape will actually be recorded with less than 150 μ inches of skew.

6.7.6.2 Write Skew Adjustment

To reduce write skew to within acceptable limits, the following procedure is performed.

- (1) Perform the write skew measurement procedure described in Paragraph 6.7.6.1.
- (2) While observing the waveform viewed at TP11 on the Data PCBA, adjust R18 on the Data PCBA to reduce skew to less than eight small divisions of the oscilloscope graticule, i. e., 200 μ inches. (See Paragraph 6.7.6.1, Step (13).)

6.7.7 FLUX GATE ADJUSTMENT

Crosstalk can be checked and, if necessary, reduced to within acceptable limits by mechanically positioning the flux gate. The check and adjustment procedure is accomplished as follows.

- (1) Load a reel of tape with a write enable ring installed on the transport. Do not pass tape over the capstan.
- (2) Apply power to the transport.
- (3) Bring the transport to Load Point artificially by placing a white card between the tape and photosensor assembly and depressing the LOAD control.
- (4) Place the transport on-line.
- (5) Apply a ground to TP9 on the Tape Control PCBA.
- (6) Apply a ground to interface line ISLT (J101 pin J) on the Tape Control PCBA.
- (7) Apply a ground to interface line ISFC (J101 pin C) on the Tape Control PCBA.
- (8) Apply a ground to interface lines IWDP and IWD0 through IWD7 (J102 pins L, M, N, P, S, T, U, and V) on the Data PCBA.
- (9) Apply negative-going (+5v to 0v) pulses of 2 μ second duration to the interface line IWDS (J102 pin A) on the Data PCBA.
- (10) Using a Tektronix 561 oscilloscope (or equivalent) observe the waveforms at TP103 through TP903 on the Data E9 PCBA or TP103 through TP703 on the Data E7 PCBA.

- (11) Observe that the waveforms viewed in Step (10) are approximately sinusoidal with no pronounced peaks. The maximum allowable crosstalk voltage is 1.0v peak-to-peak.

NOTE

If the observed waveforms in Step (10) falls within the limit specified in Step (11) no adjustment should be attempted.

- (12) Partially loosen the screws which secure the flux gate assembly. Care should be taken to ensure that the flux gate spring does not move the assembly.
- (13) Place a white card (e. g. , business card) between the flux gate and the magnetic head and press the flux gate assembly lightly against the head.
- (14) One of two flux gates may be installed on the 6X40 transport. Figure 6-5 (A or B) illustrates the correct relationship between the magnetic head and the flux gate.

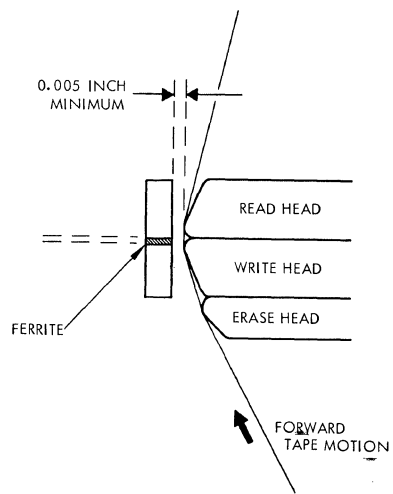
NOTE

It may be necessary to move or rotate the assembly slightly to achieve the best compromise between all tracks.

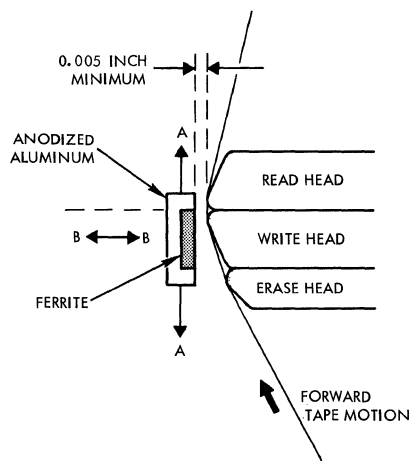
- (15) Tighten the flux gate assembly screws and repeat Steps (1) through (11).

CAUTION

ENSURE ADEQUATE CLEARANCE BETWEEN THE FLUX GATE AND THE MAGNETIC HEAD (0.005 INCH MINIMUM). FAILURE TO ALLOW CORRECT CLEARANCE WILL RESULT IN DAMAGE TO THE HEAD.



A



B

Figure 6-5. Flux Gate Adjustment

6.7.8 HEAD REPLACEMENT

The head may require replacement for one of two reasons: internal fault in the head or cable, or wear. The first reason can be established by performing a read-after-write operation on the transport; the second can be verified by measuring the depth of the wear on the head crowns. In those heads which have "guttering" (grooves cut on the crown, each side of the tape path), the head should be replaced when it has worn down to the depth of the gutter. In those heads which do not have guttering, the head wear should be measured with a brass shim that is ten-thousandths of an inch thick. The shim width should be less than the minimum tape width (0.496 inch). The shim should be placed in the worn portion of the head crown with one side butted against the outer worn step. When the upper surface of the shim is below the unworn surface of the head crown (i. e. , the head has worn to a depth of greater than 0.010 inch) the head should be replaced.

Replacement of the head is accomplished as follows.

- (1) Remove the head cover.
- (2) Disconnect the head connectors from the Data PCBA.
- (3) Loosen the screws that retain the overlay.
- (4) Remove the two screws that attach the head to the deck.
- (5) Ease the head cable through the hole in the deck.
- (6) Check the replacement head for particles adhering to the mounting surface.

NOTE

The mounting surface must be free of all foreign substances or excessive skew will result.

- (7) Route the head connectors and cable through the overlay and the deck.

- (8) Plug the read head connector into J3, and the write head connector into J2 on the Data PCBA.
- (9) Attach the head with the two screws removed in Step (4).
- (10) Set up the read amplifier gains and skew as described in Paragraphs 6.6.12, 6.7.5, and 6.7.6, respectively.

NOTE

Shim only one head guide.

- (11) Replace the head cover.

6.7.9 PHOTO-TAB SENSOR REPLACEMENT

Replacement of the photo-tab sensor is accomplished as follows.

- (1) Disconnect the cable connecting the photo-tab sensor to the Servo and Power Supply PCBA or the EOT/BOT Amplifier PCBA, as applicable.
- (2) Remove the screw that retains the sensor assembly; the screw is accessible from the rear of the deck.
- (3) Loosen the screws that retain the overlay.
- (4) Remove the pins from the plug by using the extractor tool and feed the pins through the hole in the deck then through the hole in the head plate.
- (5) Insert the cable of the replacement photosensor through the head plate and deck.
- (6) Replace the connector pins in the plastic connector body as follows.
 - (a) Brown wire - pin 1
 - (b) Red wire - pin 2
 - (c) Orange wire - pin 3
 - (d) Yellow wire - pin 4

- (7) Align the surface of the photosensor parallel to the tape and tighten the retaining screw.
- (8) Adjust the relevant BOT and EOT amplifiers as previously described.

6.7.10 REMOVAL OF TRIM AND OVERLAY

Some adjustments require removal of the vinyl overlay and trim on the front deck of the transport. The following procedure is followed when access is required.

- (1) Loosen the two screws at the top of the door that secure the mounting block to the plastic door (do not remove the screws).
- (2) Slide the door with respect to the mounting to align the hole in the door with the corresponding hole in the block.
- (3) Insert a rod of less than 1/16-inch diameter in a hole at the top of the door and push down the spring plunger, releasing the top of the door.
- (4) Carefully pull the top of the door forward approximately two inches. Ease the door downward to clear the bottom spring plunger and remove the door.
- (5) Remove the spring plungers from the hinge blocks using the Vlier spring plunger wrench (No. VW-52).
- (6) Unplug the Molex and magnetic tape head connectors from the Tape Control and Data PCBAs, and remove the boards.

NOTE

Ensure each cable bundle is identified to enable correct re-installation.

- (7) Remove and identify three wires from the POWER switch/indicator.

- (8) Remove the supply reel, take-up reel, and head cover.
- (9) Remove the tape guide shields.
- (10) Remove the ten 4-40 screws around the outer perimeter of the trim assembly identified as "Y" on Figure 6-2.
- (11) Remove the six 4-40 screws holding the overlay to the base plate identified as "X" on Figure 6-2.
- (12) Ease the trim slowly out past the tape guides and the head. Gently pry out the plastic trim to clear the hinge blocks. Remove the trim and overlay, taking care to clear the door stop arm.

6.7.11 CAPSTAN MOTOR ASSEMBLY REPLACEMENT

Replacement of the capstan motor assembly is accomplished as follows.

- (1) Remove trim as described in Paragraph 6.7.10.
- (2) Disconnect the capstan motor connector from J11 of the Servo and Power Supply PCBA.
- (3) Remove the four mounting screws from the capstan motor assembly. Remove the motor. Discard any shims under the motor mounting screws.
- (4) Mount the replacement capstan assembly and replace the four retaining screws.

NOTE

The mounting surface must be free of all foreign substances to ensure the perpendicularity of the capstan to the tape path.

- (5) Connect the plug which connects the motor to J11 of the Servo and Power Supply PCBA.
- (6) Perform a check of the read system skew as described in Paragraph 6.7.5.

6.7.12 TAPE PATH ALIGNMENT

Alignment of the supply and take-up guide rollers to the head guides is accomplished by using PERTEC Tape Alignment Tool Part No. 102173-01. This alignment tool is also used to establish guide roller parallelism and the positioning of each tape reel.

CAUTION

THE TOOL IS PRECISION MADE. IT MUST BE HANDLED WITH CARE TO AVOID DAMAGE, ESPECIALLY TO ALL SURFACES. WHEN NOT IN USE, ATTACH THE CROSSBAR TO THE U-FRAME USING THE THUMBSCREWS LOCATED AT EACH END OF THE CROSSBAR. STORE IN A PROTECTIVE AREA.

6.7.12.1 Transport Preparation

Refer to Figure 3-1 for location of parts referred to in Steps (1) and (3).

- (1) Remove the protective cover enclosing the head and the tape guides by firmly grasping the cover and pulling away from the tape deck.
- (2) Remove the upper and lower plastic tape guide caps; the Phillips head screws that secure the caps in place are accessible from the rear of the tape deck.
- (3) Protect the tape path area of the head from damage and contamination.
- (4) Remove trim and overlay as outlined in Paragraph 6.7.10.

CAUTION

WHEN REMOVING OVERLAY, CARE MUST BE TAKEN TO PREVENT OVERLAY FROM COMING IN PHYSICAL CONTACT WITH THE HEAD.

- (5) Remove guide caps from the fixed head guides with an Allen wrench. Prevent loosening of the guide post retaining screws "J" and "M" (accessible from the rear of the transport) by engaging and holding a second Allen head wrench into each respective screw head to prevent turning (refer to Figure 6-2). Removal of the guide caps will enable installation of the tape alignment tool U-frame onto the tape guide posts.

6.7.13 TAKE-UP GUIDE ROLLER ALIGNMENT

Perform Transport Preparation procedure described in Paragraph 6.7.12.1.

6.7.13.1 Take-up Guide Roller Height Check

- (1) Install the U-frame to the guide posts. Ensure that the wide end of the U-frame is toward the top of the tape deck. Insert a thumbscrew through mounting hole "b", and one through mounting hole "c" (see Figure 6-6). Tighten each thumbscrew finger tight.
- (2) Install the crossbar to the underside of the wide end of the U-frame through the mounting hole "a" as shown in Figure 6-6. Use threaded screw hole at either end of the crossbar. Do not tighten thumbscrew until Step (3) is completed.
- (3) Place the crossbar between the flanges of the take-up arm guide roller with the take-up arm positioned away from its end stop, shown as crossbar position "A" in Figure 6-6. Tighten the crossbar thumbscrew finger tight to the U-frame.
- (4) Determine that the crossbar is centered between the flanges of the guide roller. If not centered, a guide roller height adjustment is required.

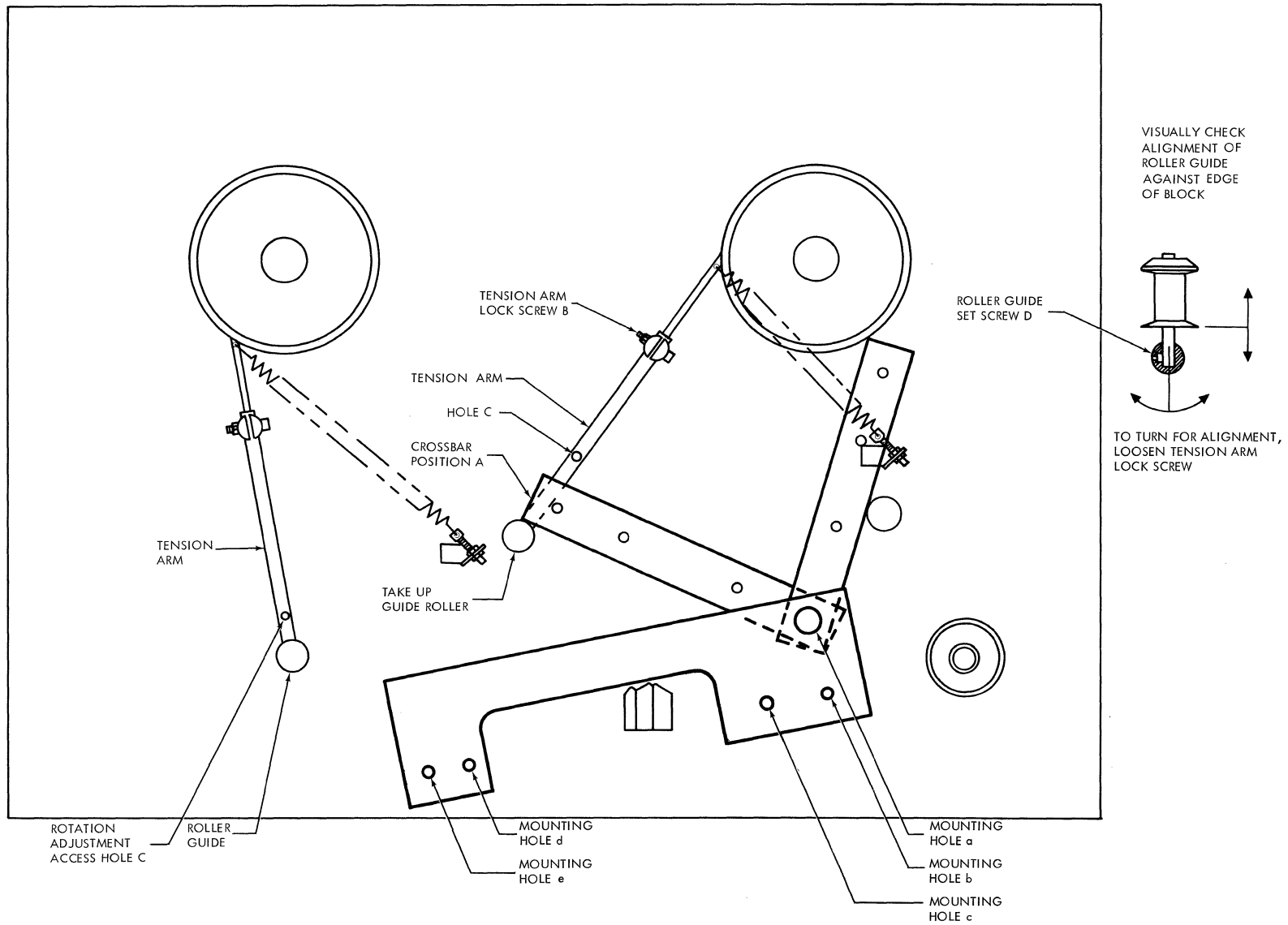


Figure 6-6. Take-up Guide Roller Alignment

6.7.13.2 Take-up Guide Roller Height Adjustment

If the take-up arm height check performed in Paragraph 6.7.13.1 indicates that a height adjustment is required, proceed as follows.

- (1) With the crossbar placed as in Step (3), Paragraph 6.7.13.1, and the guide roller still positioned away from its end stop, loosen take-up guide roller set-screw "D" located on the take-up tension arm. (See Figure 6-6.)
- (2) Center the guide roller flanges on the crossbar.
- (3) When height is established, tighten the take-up guide roller set-screw "D".

6.7.13.3 Take-up Guide Roller Parallelism Check

- (1) Install the tape path alignment tool as described in Paragraph 6.7.13.1, Steps (1) through (4).
- (2) Observe an equal, but minimal, space between the flat (tape) area of the take-up guide roller and the bottom (narrow surface) of the crossbar.
- (3) If the space is unequal from edge to edge, or if it is greater at one end, an adjustment between the two surfaces is required.

6.7.13.4 Take-up Guide Roller Parallelism Adjustment

If the take-up tape guide roller parallelism check performed in Paragraph 6.7.13.3 indicates that an adjustment is required, proceed as follows.

- (1) Engage an Allen wrench in the head of tension arm lock-screw "B" (Figure 6-6) and, by using an open-end wrench loosen the tension arm lock-nut. Loosen the lock-nut so that the tension arm can be rotated by inserting a suitable rod or tool into the through-hole "C" on the tension arm.

- (2) Rotate the tension arm until the face of the guide roller and the narrow crossbar surface are parallel. Test by observing a minimum and equal amount of light between the two adjacent surfaces.
- (3) Recheck height of guide roller.
- (4) Tighten tension arm lock-screw "B" to a torque setting of 25 in/lbs, nominal.

6.7.13.5 Take-up Reel Flange Centering Check and Adjustment

Install the tape path alignment tool as described in Paragraph 6.7.13.1, Step (1).

- (1) Remove the crossbar and retaining thumbscrew.
- (2) Install the crossbar so that it falls between the flanges of the take-up reel shown as crossbar position "B" in Figure 6-6. Tighten thumbscrew finger tight.
- (3) With the crossbar secured in place, observe centering of the narrow surfaces of the crossbar between the take-up reel flanges.
- (4) If one surface of the crossbar is closer to one edge of the reel flange than the other, center the reel by loosening the two reel hub retaining screws located on the take-up reel hub. Equalize flange-to-crossbar distances and retighten hub screws.

6.7.13.6 Reassembly

After take-up adjustments have been completed, the following operations are performed.

- (1) Clean and install guide caps, overlay, and trim.

- (2) Make a general inspection of tape deck to ensure that all items removed or disconnected are in place and ready to function.
- (3) Refer to Paragraph 6.7.14.7 for the care of the alignment tool.

6.7.14 SUPPLY GUIDE ROLLER ALIGNMENT

Perform Transport Preparation procedure described in Paragraph 6.7.12.1.

6.7.14.1 Supply Guide Roller Height Check

- (1) Install the U-frame to the guide posts. Ensure that the wide end of the U-frame is toward the bottom of the tape disk. Insert a thumbscrew through mounting hole "b" and one through mounting hole "e" (see Figure 6-7). Tighten each thumbscrew finger tight.
- (2) Install the crossbar to the underside of the wide end of the U-frame through mounting hole "a" as shown in Figure 6-7. Use threaded screw hole at either end of the crossbar. Do not tighten thumbscrew until Step (3) is completed.
- (3) Place the crossbar between the flanges of the supply arm guide roller with the supply arm positioned away from its end stops. Tighten the thumbscrew finger tight on to the U-frame.
- (4) Determine that the crossbar is centered between the flanges of the supply guide roller. If not centered, a guide roller height adjustment is required.

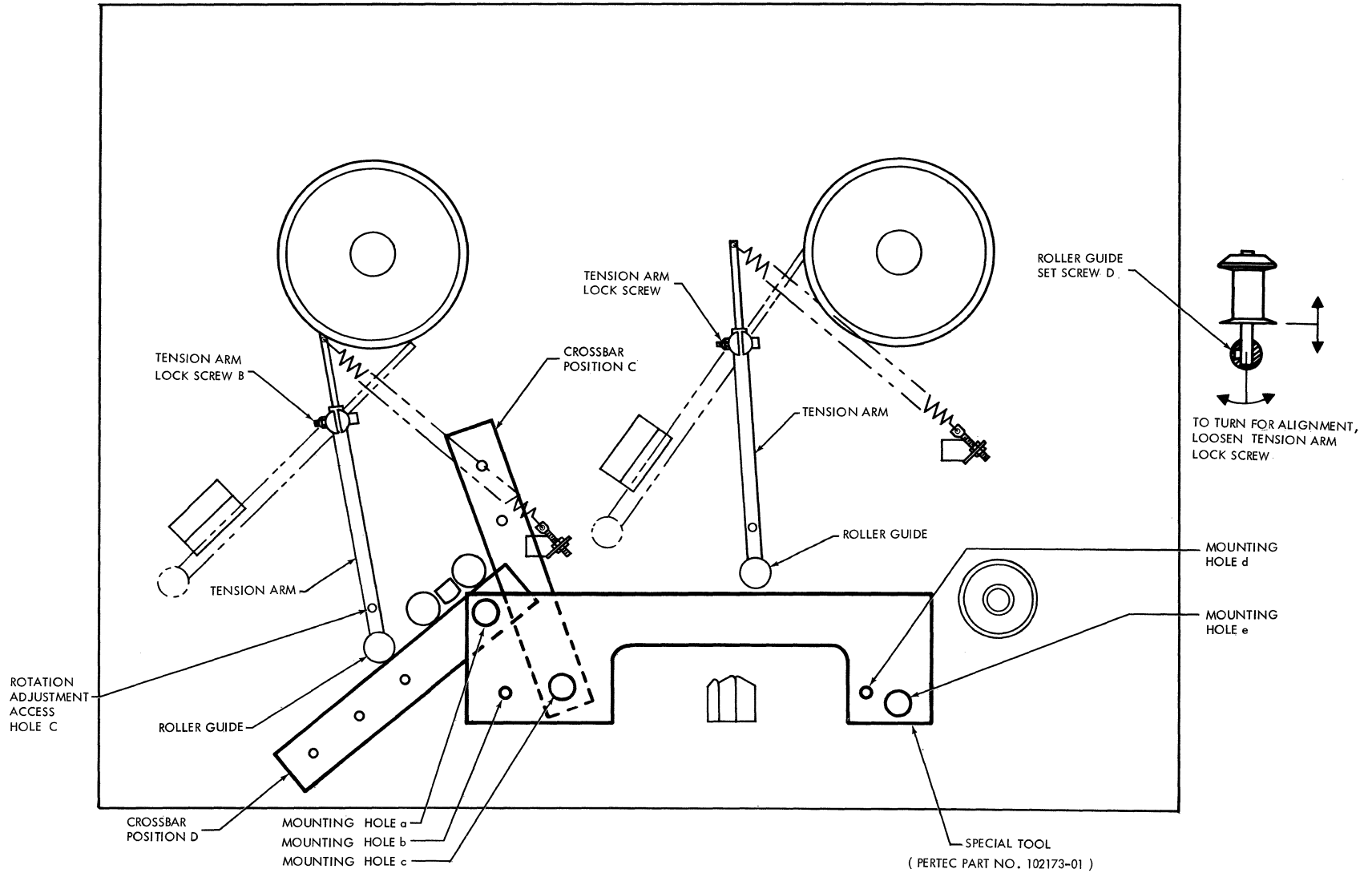


Figure 6-7. Supply Guide Roller Alignment

6.7.14.2 Supply Guide Roller Height Adjustment

If the supply guide roller check performed in Paragraph 6.7.14.1 indicates that a height adjustment is required, proceed as follows.

- (1) With the crossbar placed as in Step (3), Paragraph 6.7.12.1, and the guide roller still positioned away from the end stop, loosen supply guide roller set-screw "D" located on the supply tension arm (see Figure 6-7).
- (2) Center the guide roller flanges on the crossbar.
- (3) When height is established, tighten supply guide roller set-screw "D".

6.7.14.3 Supply Guide Roller Parallelism Check

- (1) Perform Supply Guide Roller Height Check and Adjustment procedures detailed in Paragraphs 6.7.14.1 and 6.7.14.2, respectively.
- (2) With the crossbar installed as described in Paragraph 6.7.14.1, observe an equal, but minimal, space between the flat (tape) area of the supply roller and the bottom (narrow surface) of the crossbar.
- (3) If the space is unequal from edge to edge, or it is greater at one end, an adjustment between the two surfaces is required.

6.7.14.4 Supply Guide Roller Parallelism Adjustment

If the supply guide roller parallelism guide check performed in Paragraph 6.7.14.3 indicates that an adjustment is required, proceed as follows.

- (1) Engage an Allen wrench in the head of tension arm lock-screw "B" (Figure 6-7) and, by using an open end wrench,

loosen tension arm lock-nut. Loosen the lock-nut so that the tension arm can be rotated by inserting a suitable rod or tool into rotation adjustment through hole "C" in the tension arm.

- (2) Rotate the tension arm until the face of the guide roller and the narrow crossbar surface are parallel. Test by observing an equal, but minimum, amount of light between the two adjacent surfaces.
- (3) Recheck height of guide roller.
- (4) Tighten tension arm lockscrew "B" to a setting of 25 in/lbs nominal.

6.7.14.5 Supply Reel Flange Centering Check and Adjustment

Install the tape path alignment tool as described in Paragraph 6.7.14.1, Steps (1) through (4).

- (1) Remove the crossbar and retaining thumbscrew.
- (2) Place an empty tape reel onto the supply hub.
- (3) Install the crossbar with thumbscrew through mounting hole "C". Use threaded screw holes at either end of crossbar.
- (4) Swing crossbar into place between the flanges of the supply reel as shown in Figure 6-7, position "C". Tighten thumbscrew finger tight.
- (5) With crossbar secured in place, observe centering of the narrow surfaces of the crossbar between the supply reel flanges.
- (6) If one surface of the crossbar is closer to the edge of the reel flange than the other, center the reel by loosening the two reel hub retaining screws located on the supply reel hub. Equalize flange to crossbar distances and retighten the hub screws.

6.7.14.6 Reassembly

After supply adjustments have been completed, the following operations are performed.

- (1) Clean and install guide caps, overlay, and trim.
- (2) Make a general inspection of tape deck to ensure that all items removed or disconnected are in place and ready to function.

6.7.14.7 Care of Alignment Tool

For storage, assemble crossbar to U-frame using thumbscrews through mounting holes "C" and "D". Both thumbscrews will engage with threaded holes at each end of the crossbar.

The third thumbscrew should be threaded into one of the threaded holes on the crossbar for storage.

6.7.15 REEL SERVO BELT TENSION

The toothed belts that couple the motors to the reel hubs must have sufficient tension to prevent the teeth from skipping or servo instability due to backlash. The belts must not have excessive tension as this will cause overloading of the motor or reel shaft bearings in the radial direction. The belt tension can be adjusted as follows.

- (1) Loosen the three screws that fasten the motor mounting plate to the deck standoffs.

NOTE

The slots in the motor mounting plate allow motion of the motor in the line of action of belt tension.

- (2) Adjust the pulley so that the timing belt is snug. Note the last belt tooth that is completely seated in a slot on the large pulley (refer to Figure 6-8).
- (3) Count two to three teeth from the last engaged tooth. Hold the large pulley to ensure that it does not turn. Depress the toothed belt at the point between the second and third teeth with sufficient force to deflect the belt flush against the gear.

CAUTION

DO NOT APPLY EXCESSIVE FORCE ON THE TOOTHED BELT.

- (4) Adjust the drive motor assembly so that the second tooth is firmly engaged in a slot on the large pulley, but the third belt tooth is not engaged.
- (5) Tighten the three screws on the motor mounting plate and recheck for the condition in Step (2).

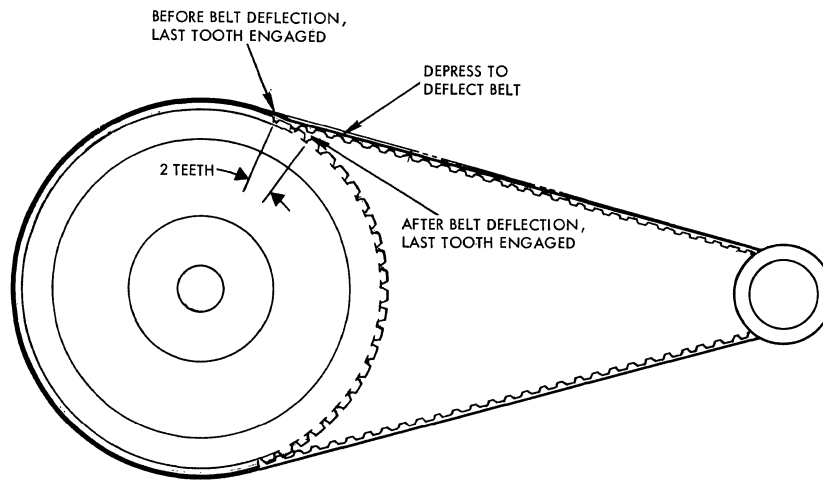


Figure 6-8. Reel Servo Belt Tension Adjustment

6.7.16 TAPE TENSION ADJUSTMENT

Tape tension is controlled by the spring attached to each of the tension arms. The tension is adjusted by means of the anchor screws.

Figure 6-9 shows the measurement and the adjustment of the supply tape tension. A 2-foot length of tape with loops at each end is used and, after moving the trim as described in Paragraph 6.7.10, tape is mounted as shown. A 1-pound force gauge is used to measure tape tension. Care must be taken to zero the scale in the correct orientation of the gauge and to pull on the tape in the direction shown. The anchor screw is adjusted until the tension is 8 ounces with the arm in the center of its operating region.

Figure 6-10 shows the measurement and adjustment of the take-up tape tension. Using the same piece of tape mounted as shown, with the gauge zeroed against the correct orientation, the anchor screw is adjusted until tape tension is 8 ounces with the arm in the center of its operating region.

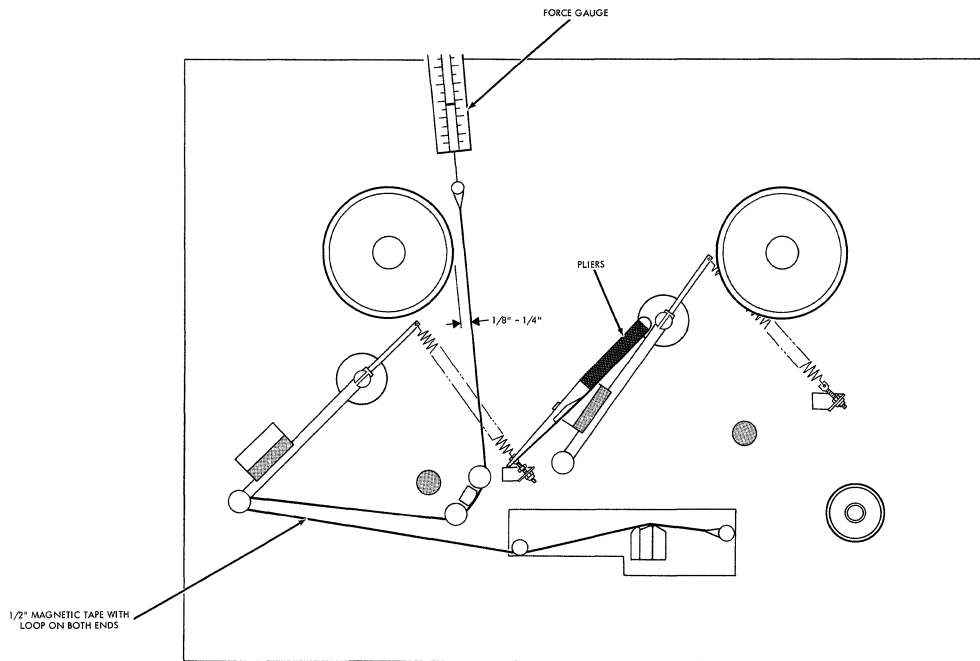


Figure 6-9. Supply Tape Tension Adjustment

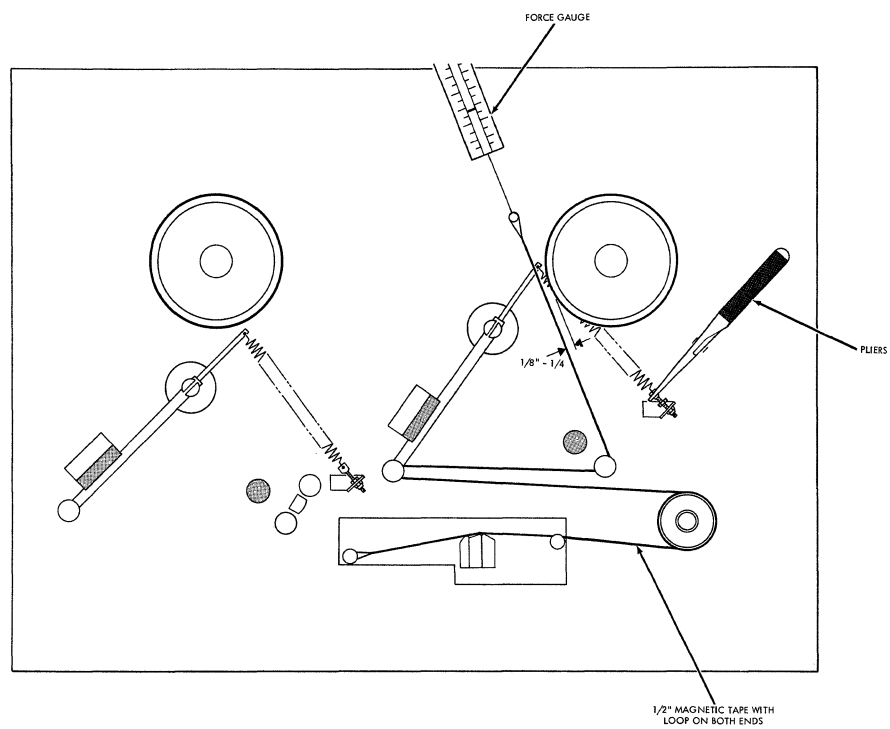


Figure 6-10. Take-up Tape Tension Adjustment

6.8 MAINTENANCE TOOLS

The following list of tools is required to maintain the tape transport.

- (1) Hex socket keys for 5/32, 1/8, 3/32 set screws, and a splined drive socket key for a 4-40 set screw.
- (2) Open-end wrenches for 3/16- 1/4, 5/16-, and 3/8-inch bolts.
- (3) Long-nose pliers.
- (4) Phillips screwdriver set.
- (5) Standard blade screwdriver set.
- (6) Soldering aid.
- (7) Soldering iron.
- (8) One-pound force gauge.
- (9) Lint-free cloth.
- (10) Cotton swabs.
- (11) Isopropyl alcohol or DuPont Freon TF.
- (12) Torque wrench, 0 - 35 in/lbs.
- (13) PERTEC Part No. 102173-01 Tape Path Alignment Tool (tension arm guide alignment).
- (14) PERTEC Part No. 101137 Arm Movement Measuring Tool (take-up arm adjustment).
- (15) Molex pin extractor.
- (16) Vlier, spring plunger wrench VW-52.

6.9 TROUBLESHOOTING

Table 6-5, System Troubleshooting chart, provides a means of isolating faults, possible causes, and remedies. The troubleshooting chart is used in conjunction with the schematics and assembly drawings in Section VII.

Table 6-5
System Troubleshooting

Symptom	Probable Cause	Remedy	Reference
Tape does not tension and the capstan shaft rotates freely when the LOAD control is depressed for the first time after threading tape.	Interlock relay K1 does not close.	Check operation of relay. Replace if necessary.	Paragraph 5.2.3 or 5.2.4
	LOAD control is not operative.	Check operation of control. Replace if necessary.	
	Relay driver defective.	Check collector voltage of Q56 with LOAD control depressed. It should be less than +1 volt. If greater, isolate defective relay driver component and replace.	
Tape is tensioned when the LOAD control is depressed, but tension is lost when control is released.	Relay latching contacts 9 and 10 do not make.	Check that voltage at J9-7 goes to +5 volts when LOAD control is depressed.	Paragraph 6.7.1
	Limit switch is not operative.	Adjust as described in Paragraph 6.7.1, 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 Figure 3-1).	Paragraph 3.3
	+5 or -5 volts is missing from tension arm sensor.	Check tension arm sensor lamps. Isolate problem if lamp is extinguished.	Paragraph 6.7.2
	Fault in reel servo amplifier.	Check that movement of reels responds to tension arm position without tape on the transport.	Paragraph 5.2.3.1, or 5.2.4.1

Table 6-5

System Troubleshooting (continued)

Symptom	Probable Cause	Remedy	Reference
Tape "runs away" or rewinds when LOAD control is depressed for the second time.	Fault on Tape Control or capstan motor assembly.	Replace or repair Tape Control PCBA or capstan motor assembly.	Paragraph 5.2.5 or 6.7.11
Tape runs past the BOT marker.	BOT tab dirty or tarnished.	Replace tab or increase sensitivity of photosensor amplifier.	Paragraph 6.6.6, 6.6.7, or 6.7.9
	Photosensor not properly adjusted.	Adjust photosensor amplifier.	
	Photosensor or amplifier defective.	Check for appropriate voltage levels in sensor systems with tab not over photosensor. Check appropriate voltage levels in sensor systems when tab is over photosensor.	
	Logic fault (Load flip-flop does not reset).	Replace or repair Tape Control PCBA.	Paragraph 5.2.5
Transport does not move in response to SYNCHRONOUS FORWARD or SYNCHRONOUS REVERSE commands.	Interface cable fault or receiver fault.	Check levels at outputs and inputs of receivers on Tape Control PCBA. Replace or repair cable or Tape Control PCBA.	Paragraph 5.2.3, 5.2.4, or 5.2.5
	Transport is not READY.	Replace or repair Tape Control PCBA.	
	Fault in ramp generator or capstan servo amplifier.	Check TP5 on Tape Control PCBA. Replace or repair Tape Control or Servo and Power PCBA.	

Table 6-5
System Troubleshooting (continued)

Symptom	Probable Cause	Remedy	Reference
Transport responds to SYNCHRONOUS 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 TPI on Tape Control PCBA (should be +5 volts for writing). Replace Write Lockout assembly if faulty. Check that WRT POWER level is +5 volts on Data E circuit board.	Paragraph 5.2.1 and 5.2.5
	Write status or MOTION signal to DATA E is not correct.	Check receiver on Tape Control PCBA for WRITE status and on Data E for WRITE status.	
		Check Data E for MOTION signal. Replace or repair Data E or Tape Control PCBAs if faulty.	
	WRITE DATA or WRITE DATA STROBE is not received correctly on Data E from interface.	Check presence of correct levels on Data E. Replace or repair Data E or interface cable if faulty.	Paragraph 5.2.1
	Heads not plugged in correctly.	Check J2 and J3 on Data E. Read head (cable enters head nearest the take-up reel) uses J3.	—

Table 6-5
System Troubleshooting (continued)

Symptom	Probable Cause	Remedy	Reference
Data are incorrectly written.	Incorrect data format.	Use correct format.	IBM Form A22-6589-3 (729 or 727 Series) IBM Form A22-6866-3 (2400 Series)
	Fault on 1 track due to failure in write circuits.	Check receiver and write amplifier on Data E. Replace or repair Data E if faulty.	Paragraph 5.2.1
	Intermittent WRT POWER, WRITE, MOTION, or WARS signal.	Examine those signals and replace or repair Tape Control PCBA or Write Lockout assembly on Data E if faulty.	Paragraph 5.2.1 and 5.2.5
	Write deskew circuit faulty.	Check TP10 for a sequence of 10 pulses for each WRITE DATA STROBE. Replace Data E if necessary.	Paragraph 5.2.1
Correct tape cannot be read.	Interface cable or transmitter fault.	Replace or repair interface cable or Data E.	
	Head is not plugged in.	Check J2 on Data E. Check J3 on Data E.	—
	Tape tracking on skew is badly adjusted.	Readjust according to description in Section VI.	Paragraph 6.7.5.2

Table 6-5
System Troubleshooting (continued)

Symptom	Probable Cause	Remedy	Reference
Correct tape cannot be read.	Head and guides need cleaning.	Clean head and guides.	Paragraph 6.4
	Tape cleaner needs emptying.	Remove tape cleaner and clean.	
	Read amplifier gains are incorrectly adjusted.	Check and adjust amplifier gains.	Paragraph 6.6.12
	Faulty write amplifier causes current to be passed through head while reading.	Check write amplifier output test points and replace or repair Data E if faulty.	Paragraph 5.2.1
	Component fault in read channel.	Check test points on Data E. Replace or repair Data E.	
	Read Staticiser adjustment faulty.	Check TP11 on Data E. Check duration of positive section of waveform is one-half of a bit time.	Paragraph 6.6.14

SECTION VII
SCHEMATICS, PARTS LISTS, LOGIC
LEVELS AND WAVEFORMS

7.1 INTRODUCTION

This section includes the schematics, assembly drawings, parts lists, and logic level and waveform definitions.

7.2 SPARE PARTS

Table 7-1 provides a description of the spare parts. The Customer should always include model number and serial number of the transports when ordering replacement parts.

7.3 PART NUMBER CROSS REFERENCE

Table 7-2, Part Number Cross Reference, provides a cross reference to manufacturer part numbers from PERTEC part numbers.

7.4 LOGIC LEVELS AND WAVEFORMS

The transport control and interface logic uses the DTL800 series of logic elements. Logic levels are defined as follows.

+5v	logical true
+0.4v	logical false

All basic waveform names are chosen to correspond to the logical true condition, e.g., SET WRITE STATUS (SWS) enables the write circuits when it is logically true (+5v), or disables the write circuits when it is logically false (0v).

The inverse of a waveform is denoted by the prefix 'N'. Therefore, NBOT will be 0.4v when the BOT tab is under the photosense head, or +5v otherwise.

All interface lines connecting the transport to the controller are prefixed by 'I'. Each line must be terminated at the receiver end of the cable by a 220/330-ohm divider chain between +5v and 0v.

All interface waveforms are low-true with logic levels as follows.

+3v	logical false
0.4v	logical true

For example, ISFC (SYNCHRONOUS FORWARD command) will be 0.4v when the transport is being driven in the forward direction, or +3v otherwise.

The Glossary contains the waveform mnemonics referred to in this manual.

Table 7-1
Spare Parts List

ITEM	PART NO.
1. Fixed Guide Assembly	101026-01
2. Roller Guide Assembly	100808-01
3. Hub	100792-01
4. Tension Arm Sensor	100858-02
5. Photo-tab Sensor	100807-02
6. Write Lockout Assembly	101003-01
7. Reel Servo Motor	101004-01
8. Capstan	100562-01
9. Capstan Drive Assembly	101073-01
10. Tape Cleaner	100811-01
11. Magnetic Head - 9-track	510-6189
7-track	510-6187
12. Tape Control C1 PCBA	101241-*
13. Data E9 PCBA	101011-*
E7 PCBA	101079-*
14. Servo and Power - A PCBA	101021-*
- B PCBA	101262-*
15. EOT/BOT Amplifier PCBA	101949-*
16. Servo Drive Belt	610-0007
17. Door Latch	615-4410
18. Front Door Assembly	101090-01**
19. Extender Card	101206-01
20. Grip Ring, Reel Retainer	100117-01
21. Controls Assembly	
(a) LOAD (Horizontal Marking)	505-1803
(Vertical Marking)	505-1814
(b) ON LINE (Horizontal Marking)	505-1804
(Vertical Marking)	505-1815
(c) REWIND (Horizontal Marking)	505-1805
(Vertical Marking)	505-1816
(d) WRT EN (Horizontal Marking)	505-1806
(Vertical Marking)	505-1817
(e) HI DEN (Horizontal Marking)	505-1807
(Vertical Marking)	505-1818
(f) FORWARD (Horizontal Marking)	505-1808
(Vertical Marking)	505-1819
(g) REVERSE (Horizontal Marking)	505-1809
(Vertical Marking)	505-1820
22. POWER Control (Horizontal Marking)	505-1801
(Vertical Marking)	505-1812
23. Fuse, 3AG, 5 Amp, SB	663-3550
3 Amp, SB	663-3530
24. Fuse, 3AG, 10 Amp, FB	663-3100
25. Relay, 4PDT, 12v, 3 Amp.	502-1242
26. Microswitch	506-6360
* Specify version as detailed on schematic.	
** Specify logo.	

Table 7-2
Part Number Cross Reference

PERTEC Part Number	Manufacturer (or equivalent)	Description or Part Number *
Carbon Comp. Resistors		
101 - 1525	Allen Bradley, Speer	RC20 (1500 ohms, 5%, 1/2 watt)
102 - 1525		RC32 (1500 ohms, 5%, 1 watt)
103 - 1525		RC42 (1500 ohms, 5%, 2 watts)
Precision Resistor		
104 - 2612	Corning, IRC	RL20C, (26,100 ohms, 1%, 1/4 watt)
Variable Resistors		
Multi-turn		
121 - 1020	Beckman Helipot	79PR1K, (1000 ohms, 10%, 3/4 watt)
121 - 1030		79PR10K (10,000 ohms, 10%, 3/4 watt)
Single turn		
122 - 5020	Spectrol	53-1-1-502 (5000 ohm, 10%, 1/2 watt)
Dipped Mica Capacitors		
130 - 1515	El Menco	CM05CJ03 (150 picofarads, 500 volts, 5%)
Mylar Capacitors		
131 - 1540	Cornell - Dubilier	WMF1P15 (0.15 μ farads, 100 volts, 10%)
Solid Tantalum Capacitors		
132 - 2752	Kemet	TK2R7W35 (2.7 μ farads, 35 volts, 20%)

* For resistors and capacitors typical part numbers only are shown.

Table 7-2
Part Number Cross Reference (continued)

PERTEC Part Number	Manufacturer (or equivalent)	Description or Part Number*
Aluminum Electrolytic Capacitors		
133 - 7060	Mallory	MTA70E20 (70 μ farads, 20V -10 +100%)
134 - 1892	Sprague	36D183G025BC2A (18,000 μ farads, 20V)
134 - 0840	Sprague	36D842G040BB2A (8,000 μ farads, 40V)
Transistors		
200 - 4123	Motorola	2N4123 (NPN switching)
200 - 4125	Motorola	2N4125 (PNP switching)
200 - 3053	RCA	2N3053 (NPN, T05, medium power)
200 - 4037	RCA	2N4037 (PNP, T05, medium power)
200 - 3055	RCA	2N3055 (NPN, T03, power)
200 - 5321	RCA	2N5321 (NPN, T05, medium power)
200 - 5323	RCA	2N5323 (PNP, T05, medium power)
200 - 3772	RCA	2N3772 (NPN, T03, power)
Diodes		
300 - 4002	Motorola	1N4002
300 - 4446	TI	1N4446 (logic diode)
300 - 4721	Motorola	1N4721, 3 amp, 200V
Rectifier Bridge		
320 - 9622	Motorola	MDA 962-2 (100V, 10 amp)

Table 7-2
Part Number Cross Reference (continued)

PEC Part Number	Manufacturer (or equivalent)	Description or Part Number*
Zener Diodes 330 - 0685	Motorola	1N4736A (6.8V, 5%)
OP Amplifier 400 - 1437	Motorola	MC1437L
SCR 201 - 4654	RCA	40654
Digital IC 700 - 8360	Fairchild	U6A993659
700 - 8440	Fairchild	U6A994459
700 - 8460	Fairchild	U6A994659
700 - 8530	Fairchild	U6A909359
700 - 7476	Texas Instruments	SN7476N
700 - 7496	Texas Instruments	SN7496N

APPENDIX A

GLOSSARY

GLOSSARY

Symbol	Description	Symbol	Description
B1B	Buffer 1 Busy	D8CT	Disable 8 Count
BCD10	Binary Coded Decimal	DBY	Data Busy
BOT*	Beginning of Tape	DDI	Data Density Indicator
BOTD	Beginning of Tape Delay	DDS	Data Density Select
BOTDP	Beginning of Tape Delay Pulse	DDSX	Data Density Select External
BOTI	Beginning of Tape Input	DMC	Disable Manual Controls
BOTO	Beginning of Tape Output	EAO	Encoder Amplifier Output
CBY	Command Busy	ECC	Enable Check Character
CCS	Check Character Strobe	ECD	Echo Check Disable
CMP1, 2	Clamp Waveform 1, 2	ECE	Echo Check Error
CPI	Characters Per Inch	ECO0 through ECO7	Echo Check Output, Channels 0 through 7
CRC0 through CRC7	Cyclic Redundancy Check, Channels 0 through 7	ECOP	Echo Check Output Parity
CRCC	Cyclic Redundancy Check Character	ECR	Echo Check Reset
CRCP	Cyclic Redundancy Check Parity	ECRC	Enable CRC
CT 0 through CT 7	Center Tap 0 through 7	EEC	Enable Echo Check
CTP	Center Tap Parity	EEP	Enable Encoder Pulse
CT4	Count 4	EF	Erase Winding Finish
CT8	Count 8	EFM	Enable File Mark
CUR	Clean-up Ramp	EOT*	End of Tape
		EOTI	End of Tape Input

* An N preceding these symbols indicates a false condition.

GLOSSARY (continued)

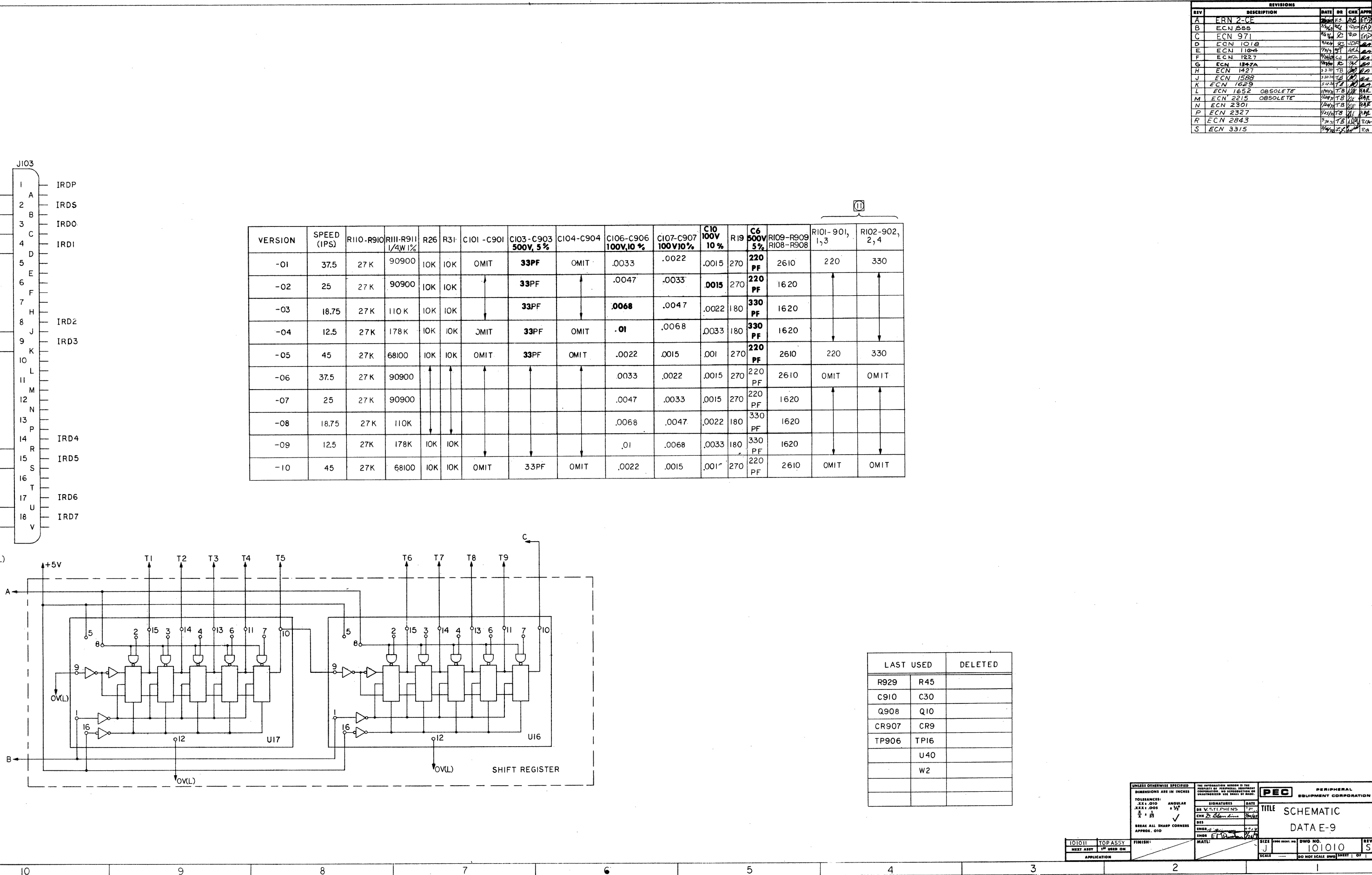
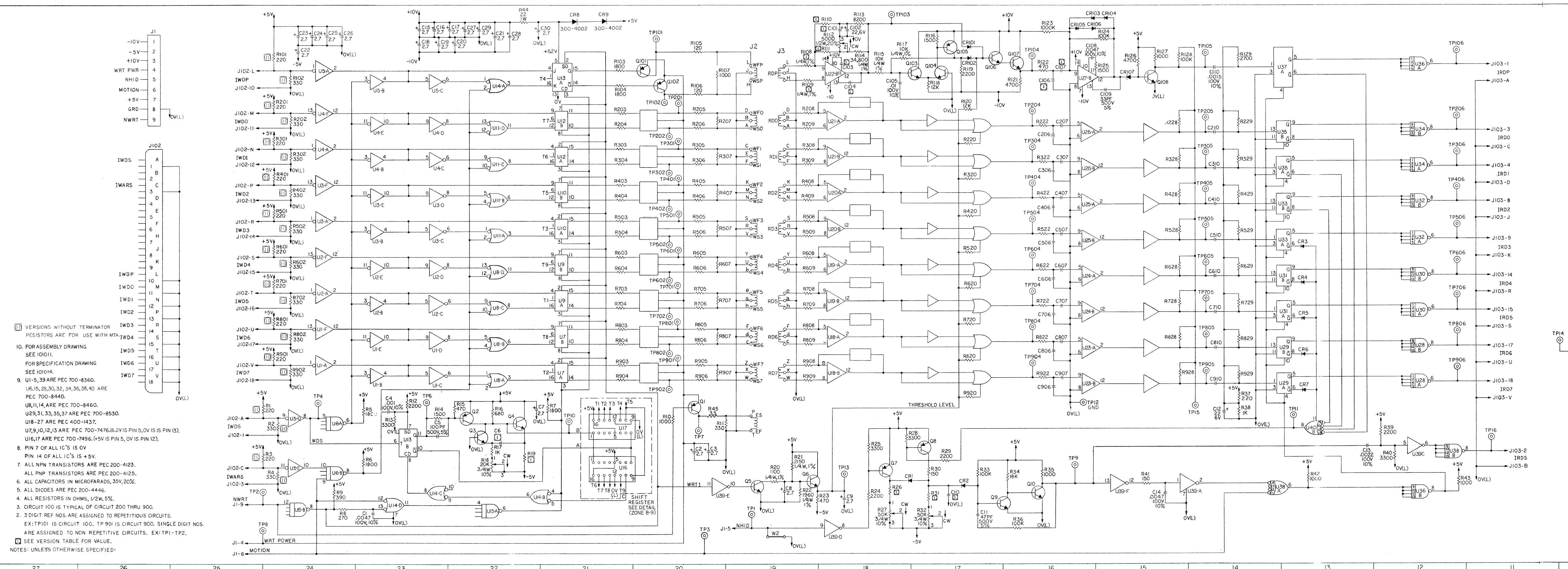
Symbol	Description	Symbol	Description
EOTO	End of Tape Output	MOTION	Tape Motion as a result of SFC or SRC Command
EPNP	Encoder Pulse Narrow Powerful	OFFC	Off-Line Input Command
EPS	Erase Power Start	OOLL	On-Line/Off-Line Lamp
EPW	Encoder Pulse Wide	ORD	OR'd Data
ES	Erase Winding Start	OVW	Overwrite
EWPC	Enable Write Power Control	PSO0 through PSO7	Peak Sensor Output, Channels 0 through 7
EWRS	Enable Write/Read Status	PSOP	Peak Sensor Output Parity
FGC	File Gap Command	PSP	Peak Sensor Parity
FGL	File Gap Lamp	RA01, RA02	Read Amplifier Track 0, Output 1, Output 2
FGR	File Gap Ramp	RA11, RA12, RA21, etc.	Read Amplifier Track n, Output 1 or 2
FLR	First Load - or Rewind	RAC	Read Amplifier Clamp
FM	File Mark	RACT	Read Amplifier Center Tap
FPT	File Protect	RAP1, RAP2	Read Amplifier Parity, Output 1, Output 2
GIP	Gap In Process	RD0 through RD7	Read Data, Channels 0 through 7
HID	Hi Density	RDI	Relay Driver Input
GRS	General Reset	RDP	Read Data Parity
INTLK	Transport Interlock Signal	RDS	Read Data Strobe
IRGC	Record Gap Command		
LD	Lamp Driver		
LDP	Load Point		
LFC	Load Forward Command		
LFR	Load Forward Ramp		
LRCC	Longitudinal Redundancy Check Character		

GLOSSARY (continued)

Symbol	Description	Symbol	Description
RDY	Ready	SFL1 through SFL4	Step Forward Level 1 through 4
RF0 through RF7	Read Finish 0 through 7	SLT	Select Transport
RFP	Read Finish Parity	SRC	Synchronous Reverse Command
RGC	Inter-Record Gap Command	SRO	Select, Ready, and On Line
RGR	Inter-Record Gap Ramp	SWS	Set Write Status
RRS	Remote Reset	TAD	Turnaround Delay
RS0 through RS7	Read Start 0 through 7	TBY	Turnaround Busy
RSP	Read Start Parity	TNT	Tape Not Tensioned
RST	Reset	TRR	Transport Ready
RTH	Read Threshold	WARS	Write Amplifier Reset
RTN1	Front Panel Switches Ground Return 1	WCRC	Write CRC
RWC	Rewind Command	WD0 through WD7	Write Data, Channels 0 through 7
RWD	Rewinding	WDP	Write Data Parity
RWR	Rewind Ramp	WDS	Write Data Strobe
RYC	Ready Command	WDSN	Write Data Strobe Narrow
SBY	Start Busy Delay	WDSW	Write Data Strobe Wide
SFC	Synchronous Forward Command	WF0 through WF7	Write Finish, Channels 0 through 7
SFCD	Synchronous Forward Command Delayed	WFM	Write File Mark

GLOSSARY (continued)

Symbol	Description	Symbol	Description
WFP	Write Finish Parity		
WLO	Write Lockout		
WPC	Write Power Control		
W/RF0 through W/RF7	Write/Read Head Winding Finish, Channels 0 through 7		
W/RFP	Write/Read Head Winding Finish Parity		
WRO	Write/Read Output		
WRP	Write Pulse		
WRS	Write/Read Status		
W/RS0 through W/RS7	Write/Read Head Winding Start, Channels 0 through 7		
W/RSP	Write/Read Head Winding Start, Parity		
WRT EN	Write Enable		
WS0 through WS7	Write Start, Channels 0 through 7		
WSC	Write Step Command		
WSP	Write Start Parity		



- (U) VERSIONS WITHOUT TERMINATOR RESISTORS ARE FOR USE WITH MTA.
 10. FOR ASSEMBLY DRAWING SEE IO101.
 FOR SPECIFICATION DRAWING SEE IO104.
 9. U1-5, 39 ARE PEC 700-8360. U6, 15, 28, 30, 32, 34, 36, 38, 40 ARE PEC 700-8440. U8, 11, 14 ARE PEC 700-8460. U29, 31, 33, 35, 37 ARE PEC 700-8530. U18-27 ARE PEC 400-1437. U7, 9, 10, 12, 13 ARE PEC 700-7476 (6.2V IS PIN 5, 0V IS PIN 13). U16, 17 ARE PEC 700-7496 (6.5V IS PIN 5, 0V IS PIN 12).
 8. PIN 7 OF ALL IC'S IS 0V. PIN 14 OF ALL IC'S IS +5V.
 7. ALL NPN TRANSISTORS ARE PEC 200-4123. ALL PNP TRANSISTORS ARE PEC 200-4125.
 6. ALL CAPACITORS IN MICROFARADS, 35V, 20%.
 5. ALL DIODES ARE PEC 200-4446.
 4. ALL RESISTORS IN OHMS, 1/2W, 5%.
 3. CIRCUIT 100 IS TYPICAL OF CIRCUIT 200 THRU 900.
 2. 3 DIGIT REF NOS. ARE ASSIGNED TO REPETITIVE CIRCUITS.
 EX: TP101 IS CIRCUIT 100. TP 901 IS CIRCUIT 900. SINGLE DIGIT NOS. ARE ASSIGNED TO NON REPETITIVE CIRCUITS. EX: TP1-TP2.
 () SEE VERSION TABLE FOR VALUE.
 NOTES: UNLESS OTHERWISE SPECIFIED:

VERSION	SPEED (IPS)	R110-R910	R111-R911	R26	R31	C101-C901	C103-C903	C104-C904	C106-C906	C107-C907	C10	R19	C6	R19	R109-R909	R101-901	R102-902
		1/4W, 1%	1/4W, 1%	10K	10K	OMIT	500V, 5%	100V, 10%	100V, 10%	100V, 10%	100V, 10%	270	220 PF	270	2610	220	330
-01	37.5	27K	90900	10K	10K	OMIT	33PF	OMIT	.0033	.0022	.0015	270	220 PF	270	2610	220	330
-02	25	27K	90900	10K	10K	↑	33PF	↑	.0047	.0033	.0015	270	220 PF	270	2610	220	330
-03	18.75	27K	110K	10K	10K	↑	33PF	↑	.0068	.0047	.0022	180	330 PF	180	1620	↑	↑
-04	12.5	27K	178K	10K	10K	↑	33PF	↑	.01	.0068	.0033	180	330 PF	180	1620	↑	↑
-05	45	27K	68100	10K	10K	OMIT	33PF	OMIT	.0022	.0015	.001	270	220 PF	270	2610	220	330
-06	37.5	27K	90900	↑	↑	↑	↑	↑	.0033	.0022	.0015	270	220 PF	270	2610	OMIT	OMIT
-07	25	27K	90900	↑	↑	↑	↑	↑	.0047	.0033	.0015	270	220 PF	270	1620	↑	↑
-08	18.75	27K	110K	↑	↑	↑	↑	↑	.0068	.0047	.0022	180	330 PF	180	1620	↑	↑
-09	12.5	27K	178K	10K	10K	↑	↑	↑	.01	.0068	.0033	180	330 PF	180	1620	OMIT	OMIT
-10	45	27K	68100	10K	10K	OMIT	33PF	OMIT	.0022	.0015	.001	270	220 PF	270	2610	OMIT	OMIT

LAST USED	DELETED
R929	R45
C910	C30
Q908	Q10
CR907	CR9
TP906	TP16
	U40
	W2

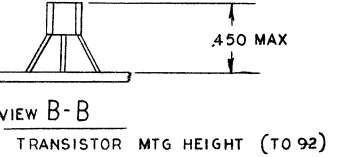
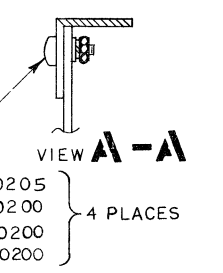
REV	DESCRIPTION	DATE	BY
A	FRN 2-VE	10/65	WJ
B	ECN 899	10/65	WJ
C	ECN 921	11/65	WJ
D	ECN 1018	11/65	WJ
E	ECN 1188	11/65	WJ
F	ECN 1257	11/65	WJ
G	ECN 1324	11/65	WJ
H	ECN 1429	11/65	WJ
I	ECN 1552 OBSOLETE	11/65	WJ
J	ECN 1624 OBSOLETE	11/65	WJ
K	ECN 1718 OBSOLETE	11/65	WJ
L	ECN 1830	11/65	WJ
M	ECN 1922	11/65	WJ
N	ECN 2043	11/65	WJ
O	ECN 2154	11/65	WJ
P	ECN 2243	11/65	WJ
Q	ECN 2315	11/65	WJ

TITLE: SCHEMATIC
 DATA E-9
 IO1010
 10/10/10

REV	DESCRIPTION	DATE	DR	CHK	APP
A	ERN 2-CN	7/23/62	JC	JC	JC
B	ECN 935	8/11/62	JD	JD	JD
C	ECN 966	9/16/62	JD	JD	JD
D	ECN 971	9/27/62	JD	JD	JD
E	ECN 1018	11/1/62	JD	JD	JD
F	ECN 1028	11/1/62	JD	JD	JD
G	ECN 1103	11/1/62	JD	JD	JD

H	ECN 1146	11/1/62	JD	JD	JD
J	ECN 1192	11/1/62	JD	JD	JD
K	ECN 1310	11/1/62	JD	JD	JD

L	ECN 1347A	11/1/62	JD	JD	JD
M	ECN 1428	11/1/62	TB	TB	TB
N	ECN 1548	11/1/62	TB	TB	TB
P	ECN 1587	11/1/62	TB	TB	TB
R	ECN 1723 OBSOLETE	11/1/62	TB	TB	TB
S	ECN 1723 OBSOLETE	11/1/62	TB	TB	TB
T	ECN 2319 OBSOLETE	11/1/62	TB	TB	TB
U	ECN 2301	11/1/62	TB	TB	TB
V	ECN 2327	11/1/62	TB	TB	TB
W	ECN 2843	11/1/62	TB	TB	TB
Y	ECN 3105A CANCELLED	11/1/62	TB	TB	TB
Z	ECN 3215	11/1/62	TB	TB	TB
AA	ECN 3111	11/1/62	TB	TB	TB



REFERENCE DESIGNATION	IPS VER	PART NUMBERS																			
		37.5	25	18.75	12.5	45	37.5	25	18.75	12.5	45										
R10-910	-01	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735	101-2735
R11-911	-01	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092	104-9092
R26	-01	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035
R31	-01	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035	101-1035
C103-903	-01	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305	130-3305
C104-904	-01	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220
C101-901	-01	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220
C107-907	-01	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220	131-2220
R19	-01	101-2715	101-2715	101-1815	101-1815	101-2715	101-2715	101-2715	101-2715	101-2715	101-2715	101-2715	101-2715	101-2715	101-2715	101-2715	101-2715	101-2715	101-2715	101-2715	101-2715
C6	-01	130-2215	130-2215	130-3315	130-3315	130-2215	130-2215	130-2215	130-2215	130-2215	130-2215	130-2215	130-2215	130-2215	130-2215	130-2215	130-2215	130-2215	130-2215	130-2215	130-2215
C106-906	-01	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320	131-3320
R109-909, 108-908	-01	104-2215	104-2215	104-1621	104-1621	104-2215	104-2215	104-2215	104-2215	104-2215	104-2215	104-2215	104-2215	104-2215	104-2215	104-2215	104-2215	104-2215	104-2215	104-2215	104-2215
R101-901, 1, 3	-01	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215	101-2215
R102-902, 2, 4,	-01	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315	101-3315

PART NO.	REF DESIGNATION
101-1025	R127-927, 10
101-1045	R123-923
101-1235	R118-918, 120-920
101-1515	R3041
101-1525	R118-915, 125-925, 14
101-1215	R105-905, 106-906
101-1825	R103-903, 104-904, 5, 6, 7
101-1835	R34
101-2215	R37
101-2225	R119-919, 12, 24, 29, 39
101-2715	R8
101-2725	R129-929
101-3315	R11
101-3325	R13, 25, 28, 40
101-3915	R9
101-4715	R15, 23, 122-922
101-4725	R121-921, 126-926
101-6815	R16
104-1002	R115-915, 117-917
104-2151	R21
101-3305	R45
104-1961	R22
104-2482	R114-914
104-1181	R20
121-2030	R18
101-8225	R113-913

PART NO.	REF DESIGNATION
121-5030	R27, 32
123-5020	R12-912
130-1015	C5
130-3305	C109-909
130-4705	C11
131-1020	C4
131-1030	C105-905
131-1520	C110-910
131-2220	C13
131-4720	C108-908, 1, 14
132-2262	C102-902, 12
132-2752	C2, 3, 7-9, 15-30
200-4123	C103-903, 104-904
	106-906, 107-907, 108-
	908, 3-6, 9, 10
200-4125	C101-901, 102-902, 105-
	905, 1, 2, 7, 8
300-4446	C101-901, 102-902, 103-
	903, 104-904, 105-905,
	106-906, 107-907, 1-7
400-1437	U18-27
700-7476	U7, 9, 10, 12, 13
700-7496	U16, 17
700-8360	U1-5, 39
700-8440	U15, 28, 30, 32, 34, 35,
	35, 40
700-8460	U8, 11, 14
700-8530	U29, 31, 33, 35, 37
503-0229	J2, 3
100373-01	W2
102-2205	R44
300-4002	CR 8, 9

7. VERSIONS WITHOUT TERMINATOR RESISTORS ARE FOR USE WITH MTA.

8. THIS ASSY SHALL BE MADE FROM PROCESS BOARD 101012-01 REV. E AND SUBSEQUENT.

9. FOR PART NO'S WHICH ARE AFFECTED BY VERSION NO. SEE TABLE II.

4. FOR PART NO'S WHICH ARE NOT AFFECTED BY VERSION NO. SEE TABLE I.

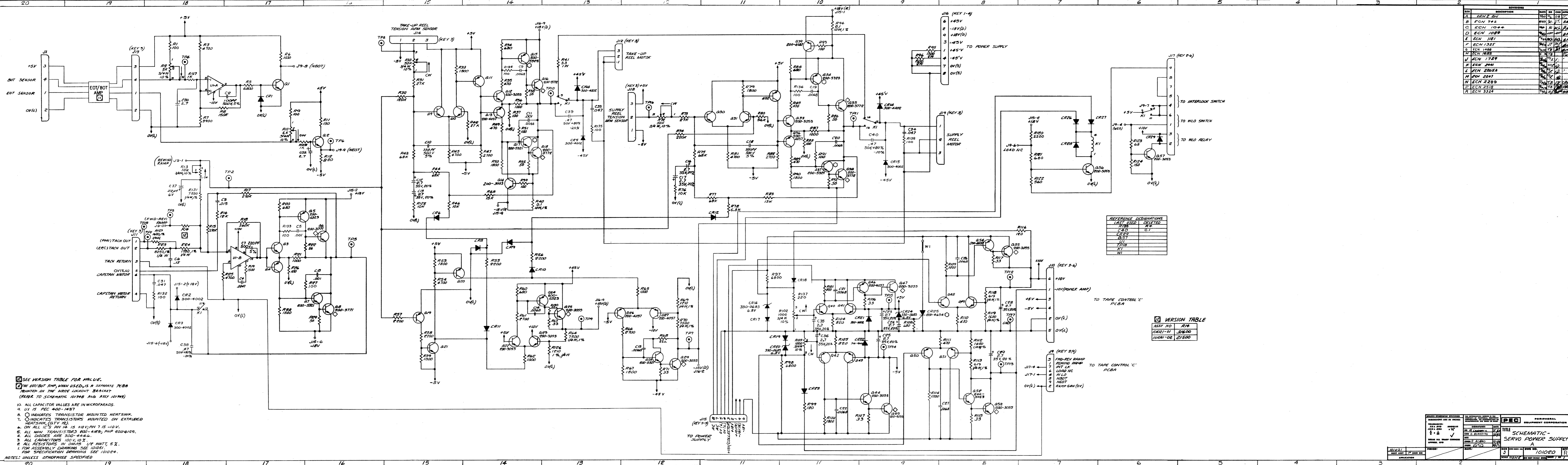
3. RUBBER STAMP PART NO. INCLUDING VERSION NO AND ISSUE LETTER.

2. ASSEMBLE PER STANDARD MANUFACTURING METHODS.

1. REF. DWGS: SCHEMATIC-10101 SPECIFICATION-101014

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES XX ± .010 XXX ± .005 1/16 ± .002 BREAK ALL SHARP CORNERS APPROX. .010		THE INFORMATION HEREON IS THE PROPERTY OF PERIPHERAL CORPORATION. NO REPRODUCTION OR DISSEMINATION IS TO BE MADE WITHOUT THE WRITTEN PERMISSION OF PERIPHERAL CORPORATION.		PEC PERIPHERAL CORPORATION TITLE: PCBA DATA E-9 DWG NO: 101011 SCALE: 1/1 DO NOT SCALE DWG SHEET: 101	
TOP ASSY: 6000	FINISH:	SIGNATURES: DR: [Signature] DATE: [Date]	SIZE: 4 1/2" x 5 1/2"	REV: AA	
NEXT ASSY: 1 ST USED ON:	APPLICATION:	CHK: [Signature]			



REV	DESCRIPTION	DATE	BY	CHK	APP
A	REV 2.0	10/27/60	WJ	WJ	
B	ECN 282	11/20/60	WJ	WJ	
C	ECN 1024	12/14/60	WJ	WJ	
D	ECN 1089	1/10/61	WJ	WJ	
E	ECN 1181	2/14/61	WJ	WJ	
F	ECN 1325	3/14/61	WJ	WJ	
G	ECN 1488	4/17/61	WJ	WJ	
H	ECN 1623	5/17/61	WJ	WJ	
I	ECN 1729	6/12/61	WJ	WJ	
J	ECN 2041	7/12/61	WJ	WJ	
K	ECN 2205A	8/12/61	WJ	WJ	
L	ECN 2287	9/12/61	WJ	WJ	
M	ECN 2289	10/12/61	WJ	WJ	
N	ECN 2318	11/12/61	WJ	WJ	
O	ECN 3324	12/12/61	WJ	WJ	

REFERENCE DESIGNATIONS	LAST USED	DELETED
R18	R	
C40	C	
CR29	C	
Q31	Q	
TP18	TP	
W1	W	

VERSION TABLE	
ASSY NO	DATE
10021-01	3/16/60
10021-02	2/13/60

1. SEE VERSION TABLE FOR VALUE.
 2. THE EOT/BOT AMP, WHEN USED, IS A SEPARATE PCB MOUNTED ON THE WHITE LOCKOUT BRACKET (REFER TO SCHEMATIC 10198B AND ASSY 10198).
 3. ALL CAPACITOR VALUES ARE IN MICROFARADS.
 4. U1 IS PEC #20-1437.
 5. INDICATES TRANSISTOR MOUNTED HEAT-SINK.
 6. INDICATES TRANSISTORS MOUNTED ON EXTRUDED HEAT-SINK (QTY 10).
 7. ON ALL IC'S PIN 14 IS +10V; PIN 7 IS -10V.
 8. ALL NPN TRANSISTORS 200-41E3; PNP 200-41E5.
 9. ALL DIODES ARE 300-444-6.
 10. ALL CAPACITORS 100V, 10%.
 11. ALL RESISTORS IN OHMS 1/8 WATT, 5%.
 12. FOR ASSEMBLY DRAWING SEE 101024.
 13. FOR SPECIFICATION DRAWING SEE 101024.

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES FINISHES: 1. 28-100 2. 28-100 3. 28-100 4. 28-100 5. 28-100 6. 28-100 7. 28-100 8. 28-100 9. 28-100 10. 28-100 11. 28-100 12. 28-100 13. 28-100 14. 28-100 15. 28-100 16. 28-100 17. 28-100 18. 28-100 19. 28-100 20. 28-100 21. 28-100 22. 28-100 23. 28-100 24. 28-100 25. 28-100 26. 28-100 27. 28-100 28. 28-100 29. 28-100 30. 28-100 31. 28-100 32. 28-100 33. 28-100 34. 28-100 35. 28-100 36. 28-100 37. 28-100 38. 28-100 39. 28-100 40. 28-100 41. 28-100 42. 28-100 43. 28-100 44. 28-100 45. 28-100 46. 28-100 47. 28-100 48. 28-100 49. 28-100 50. 28-100 51. 28-100 52. 28-100 53. 28-100 54. 28-100 55. 28-100 56. 28-100 57. 28-100 58. 28-100 59. 28-100 60. 28-100 61. 28-100 62. 28-100 63. 28-100 64. 28-100 65. 28-100 66. 28-100 67. 28-100 68. 28-100 69. 28-100 70. 28-100 71. 28-100 72. 28-100 73. 28-100 74. 28-100 75. 28-100 76. 28-100 77. 28-100 78. 28-100 79. 28-100 80. 28-100 81. 28-100 82. 28-100 83. 28-100 84. 28-100 85. 28-100 86. 28-100 87. 28-100 88. 28-100 89. 28-100 90. 28-100 91. 28-100 92. 28-100 93. 28-100 94. 28-100 95. 28-100 96. 28-100 97. 28-100 98. 28-100 99. 28-100 100. 28-100	PERIPHERAL EQUIPMENT CORPORATION TITLE: SCHEMATIC - SERVO POWER SUPPLY ASSY NO: 101020 DATE: 10/20/60 DRAWN BY: WJ CHECKED BY: WJ APPROVED BY: WJ DATE: 10/20/60
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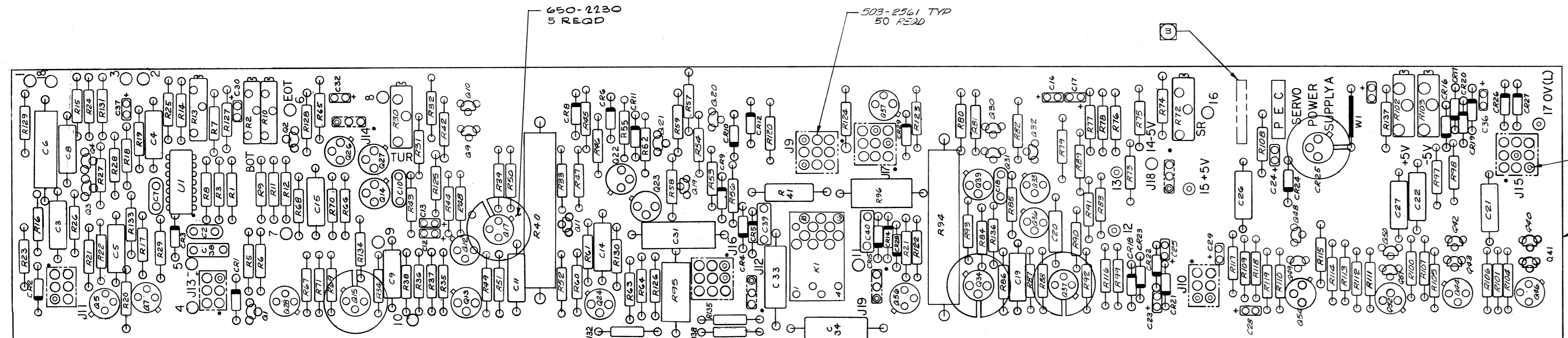


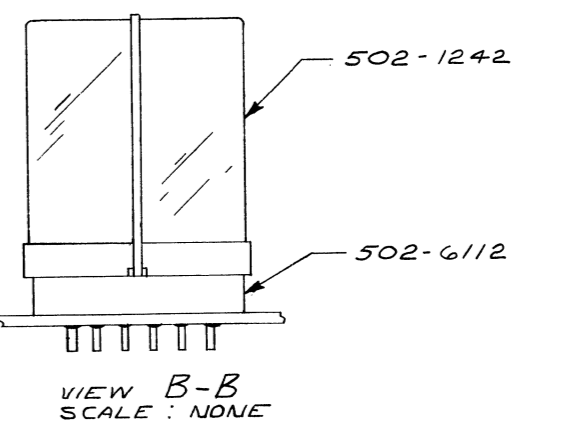
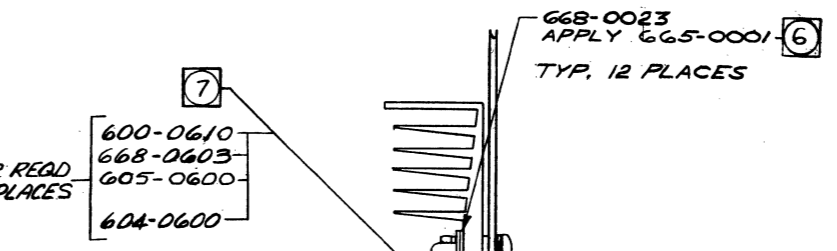
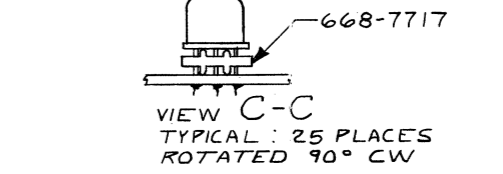
TABLE I

PART NO.	REF DESIGNATION
101-7015	R1,9,26,27,37,39,51,88
	91,93,132-136,138
101-1025	R6,21,36,62,65,87,127,128
101-1035	R46,76,125
101-1215	R99,116
101-1225	R109,114
101-1235	R16
101-1245	R32
101-1515	R11,124
101-1525	R19
101-1535	R43,83
101-1545	R8
101-1825	R28,33,50,53,59,67,73,90,100
101-5605	R22,29,38,53,86,92
101-5615	R122
101-2225	R55,56,57,58,120
101-2725	R47,61,66,82
101-2735	R31,2,73
101-2745	R15,17
101-6805	R12,3
101-3925	R7
101-4715	R35,49,85,89,110,111
101-4725	R32,45,54,81
101-5635	R82
101-5645	R18
101-6825	R5,37,98,78
101-6835	R43,44,73,77
101-8215	R12,101,104,105
102-0335	R41
103-1525	R95,96
104-1211	R69,126
104-1221	R17,119,129
101-2215	R137
101-6815	R20,34,62,84,108,121
101-2205	R68,130
101-2245	R74
101-3305	R43,76,106,107,115,117
121-1030	R13
100373-01	W1

TABLE I (CON'T)

PART NO.	REF DESIGNATION
104-6190	R113,118
104-1781	R24
104-8251	R23
115-0002	R139
104-1501	R44,70,131
110-0011	R40,94
121-1020	R102,103
121-5020	R10,12
121-5030	R30,72
130-3315	C10,18,
130-2215	C7
131-1020	C5,8,
131-1530	C3
131-1540	C6
131-4720	C4
131-6820	C14,15,21,22,26,27,91,119,20
132-2752	C12,13,16,17,23,24,25
	28,29,30,32,35,36
201-4654	CR25
300-4002	CR3,4,5,14,15,21,22
300-4446	CR1,6,8,9,10,11,12,
	17,18,19
	23,24,27,28,29
320-0685	CR16,20,24
500-1842	K1
220-3255	Q25,29,45,47,53,55
132-2242	C37
200-3772	Q16,18,35,38
220-4123	Q1,2,3,9,10,21,31
	31,40,41,48,49
200-4125	Q4,11,19,20,32,42,43,50,51
200-3711	Q6,8
220-3253	Q12,14,22,23,33,52
	44,46,57
220-4037	Q13,26,27,36,46,39,54
200-5321	Q17,37,28,7
220-5323	Q15,34,5,24
131-4730	C31,33,34
400-1437	U1
100-1015	C2
135-4740	C38,39,40

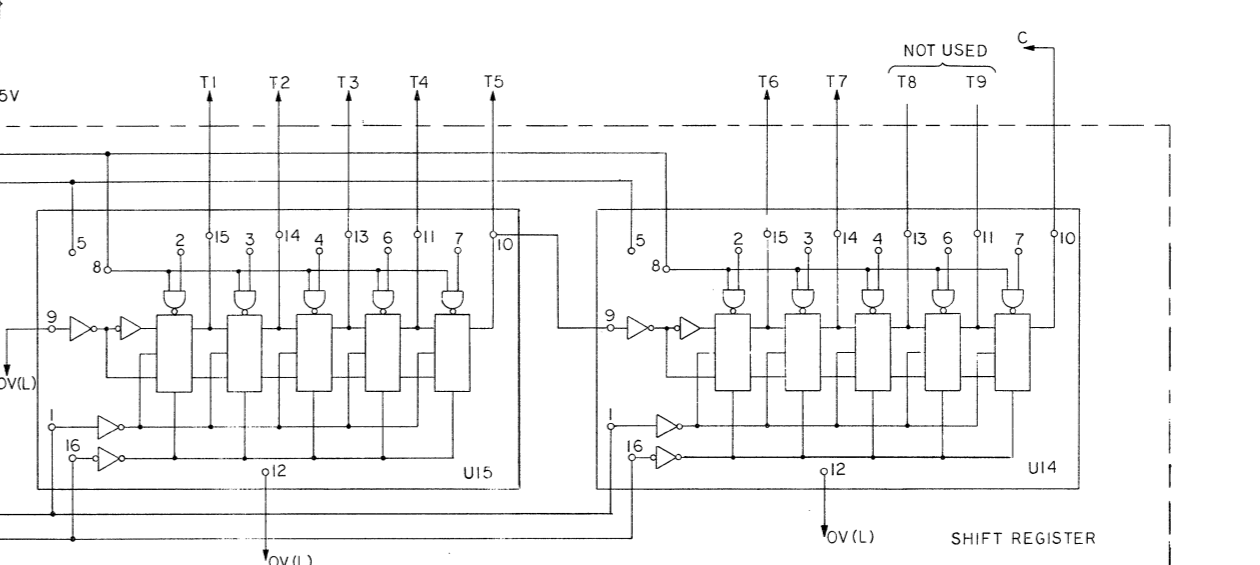
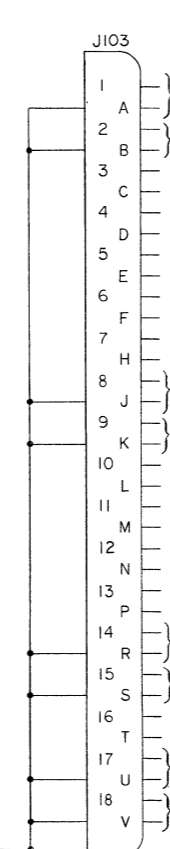
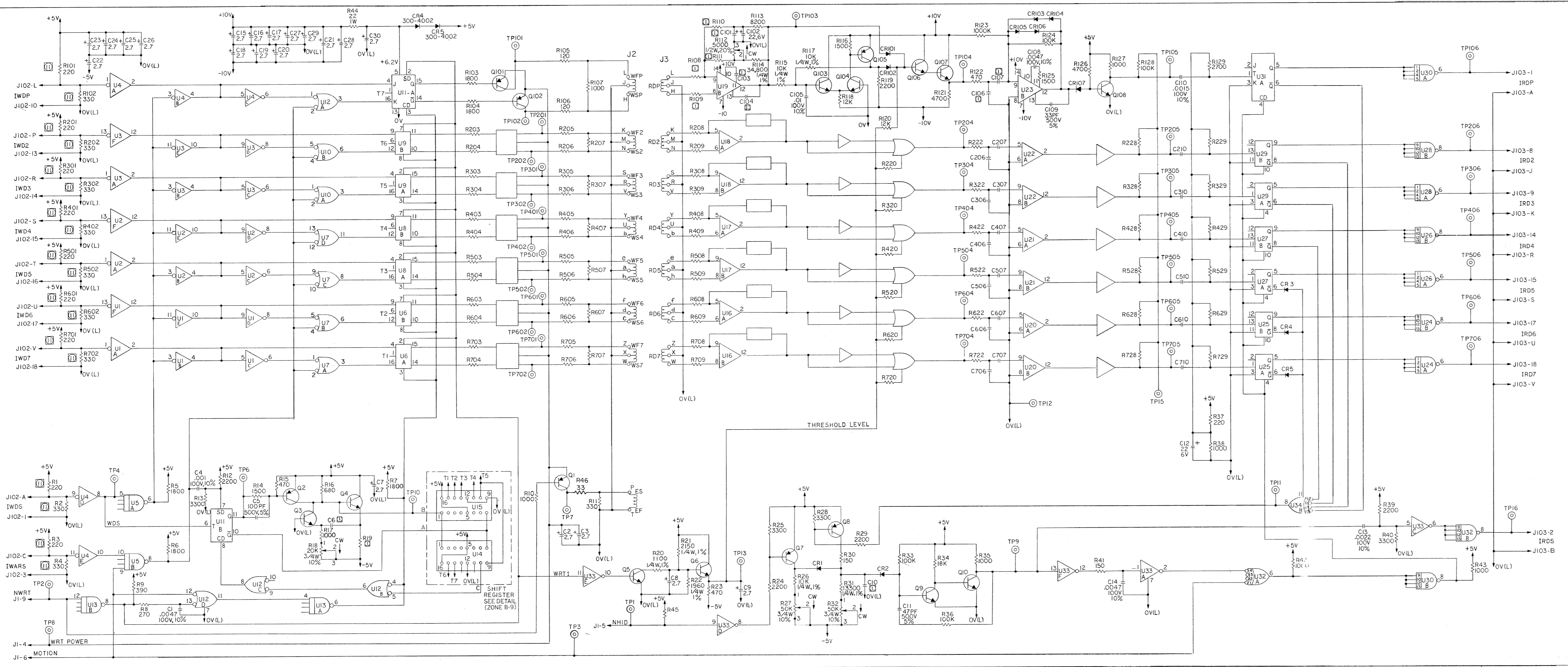
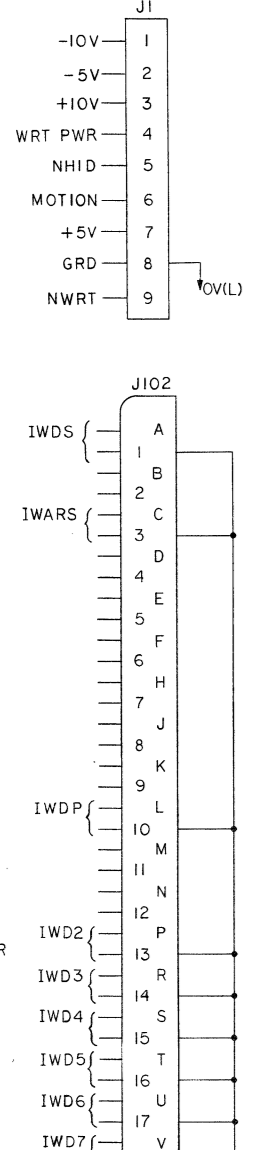
- 7 BEFORE INSTALLING TRANSISTORS TO HEATSINK EXTREME CARE MUST BE TAKEN TO SEE THAT ALL BURRS AND MISC. CHIPS OF METAL ARE WIPED OFF ENTIRE MOUNTING SURFACES.
 - 6 MINIMUM OF 90° COVERAGE REOD ON ALL TRANSISTORS ON HEATSINK (665-0001 SILICONE GREASE) APPLIED BOTH SIDES OF MICA WASHERS. ALL SCREWS (600-0610) MUST BE TORQUED 12" LBS (TYP ALL PLACES).
 - 5 THIS ASSY SHALL BE MADE FROM PROCESS BOARD 101022-01 REV 'M'
 - 4 FOR PART NO'S WHICH ARE NOT AFFECTED BY VERSION NO. SEE TABLE I.
 - 3 RUBBER STAMP PART NO., INCLUDING VERSION NO. AND ISSUE LETTER.
2. ASSEMBLE PER STANDARD MANUFACTURING METHODS.
1. REF DWGS: SCHEMATIC-101020 SPECIFICATION-101024
- NOTES: UNLESS OTHERWISE SPECIFIED



VERSION TABLE

ASSEMBLY	R14
101021-01	104-3162
101021-02	104-2152

UNLESS OTHERWISE SPECIFIED		THE INFORMATION HEREON IS THE PROPERTY OF PERIPHERAL EQUIPMENT CORPORATION. NO REPRODUCTION OR TRANSMISSION IS TO BE MADE WITHOUT WRITTEN PERMISSION.	
DIMENSIONS ARE IN INCHES		SIGNATURES	
TOLERANCES: .XX ± .010 ANGULAR .XXX ± .005 ± 1/2		DR <i>[Signature]</i>	DATE
BREAK ALL SHARP CORNERS APPROX. 0.10		CHK <i>[Signature]</i>	8-8-66
TOP ASSY 6000		ENGR <i>[Signature]</i>	8/14
NEXT ASSY 1ST USED ON		MATERIAL	
APPLICATION		SIZE: COND. NO. DWG. NO. REV	
		E 101021 48	
		SCALE 2/1 DO NOT SCALE DWG SHEET 6/1	



LAST USED	DELETED
R729	R46
C710	C30
Q708	Q10
CR707	CR7
TP706	TP16
	U34

VERSION TABLE														
ASSEMBLY	SPEED	R110-R710	R111-R711	R19	C101-C701	C103-C703	C104-C704	C106-C706	C107-C707	C10	CE	R108-R708	R101-701, 1, 3	R102-702
101079	(IPS)	U4,W,1%	U4,W,1%		500V, 5%	500V, 5%	100V, 10%	100V, 10%	100V, 10%	100V, 5%	220 PF	R109-709	220	330
-01	37.5	27K	90900	270	OMIT	33PF	OMIT	.0033	.0022	.0022	220 PF	2610	220	330
-02	25	8200	90900	270	OMIT	33PF	OMIT	.0047	.0033	.0033	220 PF	1620		
-03	18.75	27K	110K	180	OMIT	33PF	OMIT	.0068	.0047	.0047	330 PF	1620		
-04	12.5	27K	178K	180	OMIT	33PF	OMIT	.01	.0068	.0068	330 PF	1620		
-05	45	27K	68.1K	270	OMIT	33PF	OMIT	.0022	.0015	.0015	220PF	2610	220	330
-06	37.5	27K	90900	270				.0033	.0022	.0022	220PF	2610	OMIT	OMIT
-07	25	8200	90900	270				.0047	.0033	.0033	220PF	1620		
-08	18.75	27K	110K	180				.0068	.0047	.0047	330PF	1620		
-09	12.5	27K	178K	180				.01	.0068	.0068	330PF	1620		
-10	45	27K	68.1K	270	OMIT	33PF	OMIT	.0022	.0015	.0015	220PF	2510	OMIT	OMIT

REV	DESCRIPTION	DATE	BY	CHK	APP
A	REV. 1.0	10/10/79	JW	JW	
B	ECN 232	10/10/79	JW	JW	
C	ECN 1580	10/10/79	JW	JW	
D	ECN 1580	10/10/79	JW	JW	
E	ECN 1580	10/10/79	JW	JW	
F	ECN 1582	10/10/79	JW	JW	
G	ECN 2387	10/10/79	JW	JW	
H	ECN 2382	10/10/79	JW	JW	
J	ECN 2845	10/10/79	JW	JW	

- 1. VERSIONS WITHOUT TERMINATOR RESISTORS, ARE FOR USE WITH MTA.
- 10. FOR ASSEMBLY DRAWING SEE 101079.
- FOR SPECIFICATION DRAWING SEE 101082.
- 9. U1-4, 33 ARE PEC 700-8360.
- U5, 13, 24, 26, 28, 30, 32, 34 ARE PEC 700-8440.
- U7, 10, 12 ARE PEC 700-8460.
- U2, 5, 27, 29, 31 ARE PEC 700-8530.
- U16-23 ARE PEC 400-1437.
- U6, 8, 9, 11 ARE PEC 700-7476 (6.2V IS PIN 5, OV IS PIN 13).
- U14, 15 ARE PEC 700-7496 (6.5V IS PIN 5, OV IS PIN 12).
- 8. PIN 7 OF ALL IC'S IS OV.
- PIN 14 OF ALL IC'S IS +5V.
- 7. ALL NPN TRANSISTORS ARE PEC 200-4123.
- ALL PNP TRANSISTORS ARE PEC 200-4125.
- 6. ALL CAPACITORS IN MICROFARADS, 35V, 20%.
- 5. ALL DIODES ARE PEC 200-4446.
- 4. ALL RESISTORS IN OHMS, 1/2W, 5%.
- 3. CIRCUIT 100 IS TYPICAL OF CIRCUIT 200 THRU 700.
- 2. 3 DIGIT REF NOS. ARE ASSIGNED TO REPETITIVE CIRCUITS.
- EX: TP101 IS CIRCUIT 100. TP 701 IS CIRCUIT 700. SINGLE DIGIT NOS. ARE ASSIGNED TO NON REPETITIVE CIRCUITS. EX: TP1-TP2.
- 1. SEE VERSION TABLE FOR VALUE.
- NOTES: UNLESS OTHERWISE SPECIFIED:

TITLE SCHEMATIC
 DATA E-7
 101079
 REV. 1.0
 DATE 10/10/79
 BY JW
 CHK JW
 APP

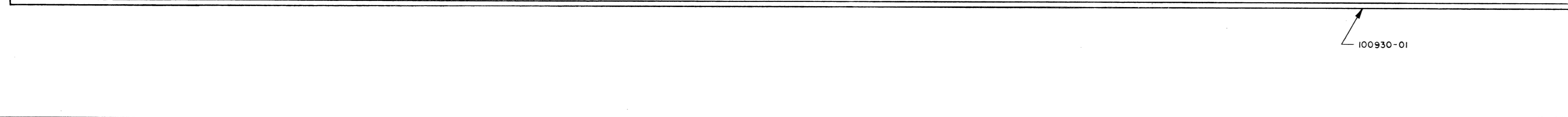
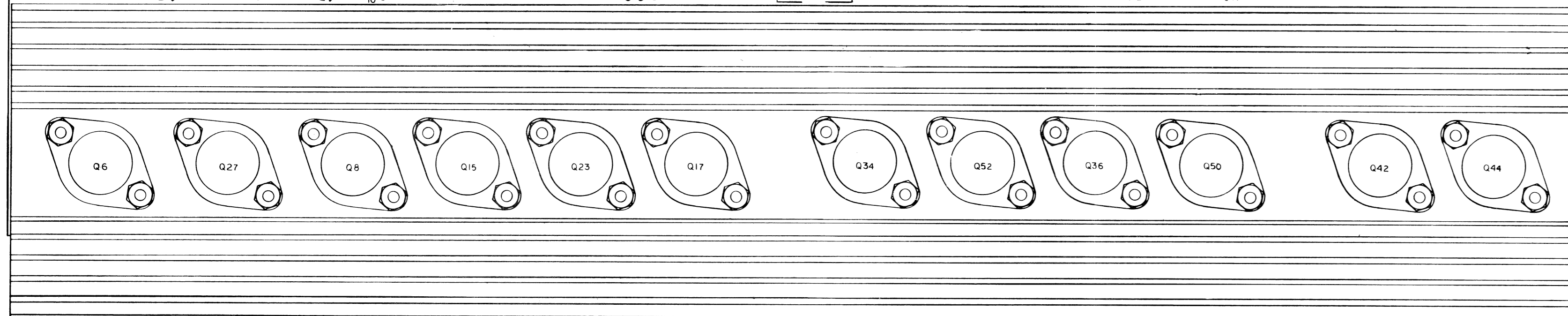
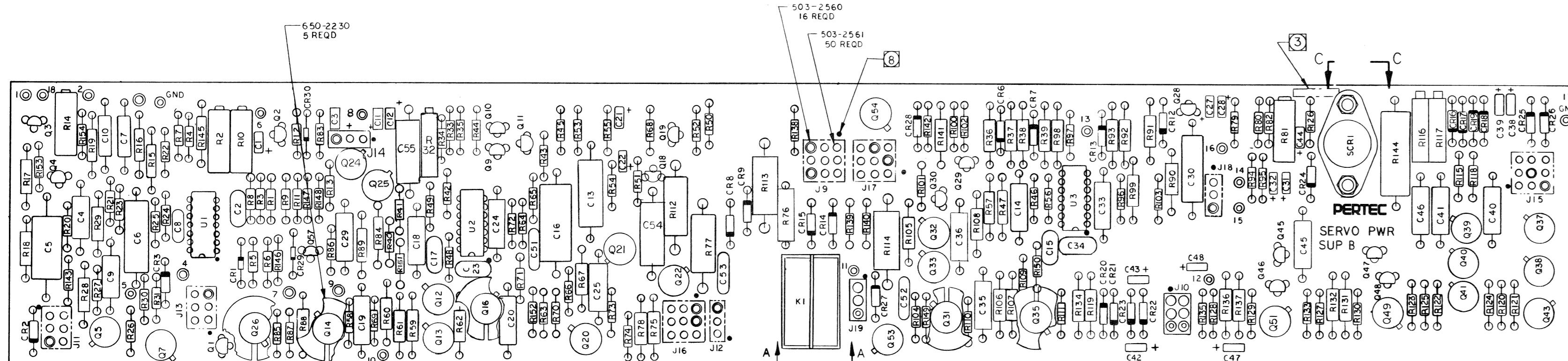


TABLE I (4)

PART NO.	REF DESIGNATION
100-1015	R1, 9, 35, 80, 149-154
100-5605	R27, 31, 69, 70, 110, 111
100-2215	R143
100-1035	R34, 64, 71, 79, 146
100-1225	R127, 128
100-1245	R41
100-1515	R11, 142
100-1525	R25, 46, 49, 72, 96
100-1545	R8
100-1825	R30, 63, 52, 85, 109, 123, 43, 101
100-2225	R50, 51, 138
100-2235	R20
100-3345	R54, 94
115-0002	R144
100-3925	R7
100-4725	R3, 22, 53, 103,
100-1535	R40, 42
100-5645	R21, 23, 24
100-5625	R44, 65, 102, 147, 148
100-6835	R55, 95
100-5615	R140
100-6815	R26, 104, 126, 139, 58, 66
100-8215	R13, 120, 121, 122
101-1215	R119, 134
101-1025	R28, 60, 106
101-4715	R59, 62, 105, 108
103-1525	R112, 113
115-0003	R77, 114
104-1001	R57, 98
104-1101	R19
104-1211	R75, 88
104-1472	R99, 47
104-1621	R131, 137
104-6190	R132, 136
104-7501	R78, 89
104-8251	R15
104-9091	R18
104-1961	R145

TABLE I (CONT)

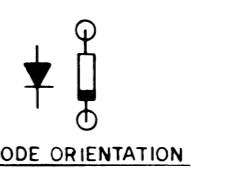
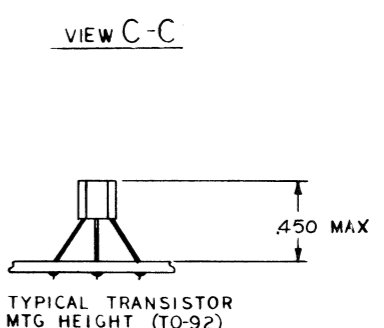
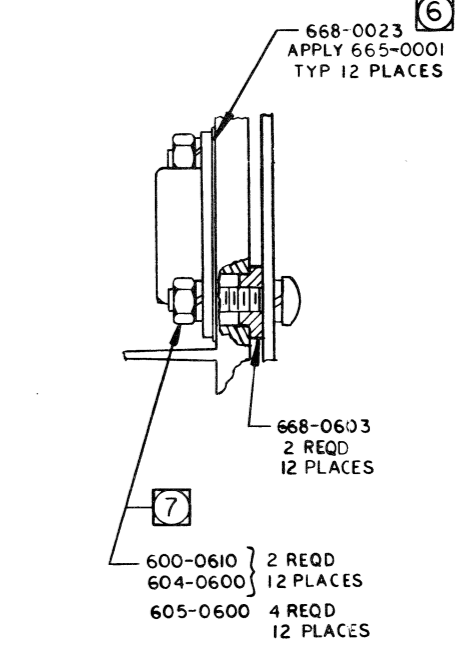
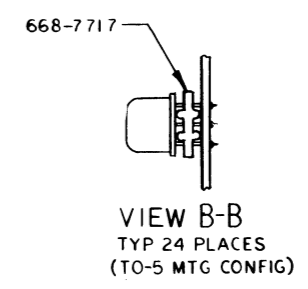
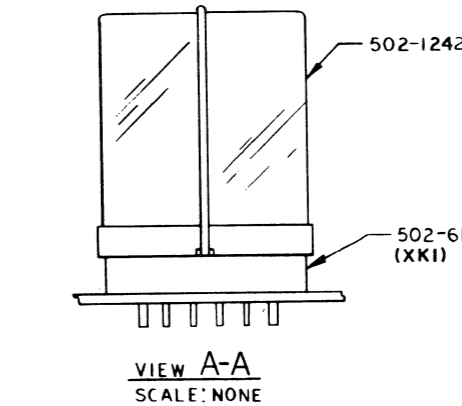
PART NO.	REF DESIGNATION
104-1962	R16
104-2871	R38, 92
104-3831	R37, 91
102-0335	R76
121-1020	R116, 117
121-2030	R32, 81
121-5020	R2, 10, 14
130-1015	C2
130-2215	C8, 15, 17, 23, 34
131-1020	C9, 10
131-1040	C5
131-1540	C16
131-4720	C7, 14, 18, 24, 33
131-4730	C6
131-6820	C4, 19, 20, 25, 29, 35, 36, 40, 41, 45, 46
132-2262	C11, 27
132-2752	C13, 21, 22, 31, 32, 38, 39, 42, 43, 44, 47, 48
100-1845	R48
100-1025	R4, 6, 12, 56, 68, 97
100-2205	R73, 86
100-4715	R83, 129, 130
101-1015	R29, 61, 107
101-2725	R67, 84
200-3053	Q12, 21, 22, 32, 37, 38, 41, 53, 54, 49
200-3055	Q23, 27, 42, 44, 50, 52
200-5323	Q14, 31, 5, 20
200-3771	Q6, 8
200-3772	Q15, 17, 34, 36,
200-4123	Q1, 2, 3, 9, 10, 19, 28, 29, 45, 46, 57
200-4125	Q4, 1, 18, 30, 47, 48,
200-4037	Q13, 51, 24, 25, 33, 39, 40, 43
200-5321	Q16, 35, 26, 7
132-1262	C12, 28
131-3330	C54, 55
130-1015	C2

TABLE I (CONT)

PART NO.	REF DESIGNATION
300-4002	CR2, 3, 8, 9, 14, 15, 22, 23
300-4446	CR1, 6, 7, 12, 13, 17, 18, 20, 21, 25, 26, 27, 28, 29, 30
201-3228	SCR1
330-0685	CR16, 19, 24,
131-6830	C13, 30
100-6825	R5, 33, 45, 82, 100, 115, 118
101-6805	R141
104-2371	R17
104-5621	R36, 39, 90, 93
502-1242	K1
502-6113	XX1
400-1437	U1, 2, 3
100-5605	R27, 31, 69, 70, 110, 111
100-3305	R74, 87, 124, 125, 133, 135
135-4740	C51, 52, 53

- 8 DOT INDICATES PIN 1 ON CONNECTORS AND IC'S.
 - 7 BEFORE INSTALLING TRANSISTORS TO HEATSINK EXTREME CARE MUST BE TAKEN TO SEE THAT ALL BURRS AND MISC. CHIPS OF METAL ARE WIPED OFF ENTIRE MOUNTING SURFACE.
 - 6 MINIMUM OF 90% COVERAGE REQD ON ALL TRANSISTORS ON HEATSINK, WITH 665-0001 SILICONE GREASE APPLIED BOTH SIDES OF MICA WASHERS. ALL SCREWS 600-0610 MUST BE TORQUED 12 IN. LBS. (TYP 12 PLACES).
 - 5 THIS ASSY SHALL BE MADE FROM PROCESS BOARD 101263-01 REV D AND SUBSEQUENT.
 - 4 FOR PART NOS WHICH ARE NOT AFFECTED BY VERSION NO. SEE TABLE I.
 - 3 RUBBER STAMP PART NO., INCLUDING VERSION NO. AND ISSUE LETTER.
2. ASSEMBLE PER STANDARD MANUFACTURING METHODS
1. REF DWGS: SCHEMATIC-101261 SPECIFICATION-101265

NOTES: UNLESS OTHERWISE SPECIFIED



REV	DESCRIPTION	DATE	DR	CHK	APP
B	ERN 2-VP				
C	ECN 2172	1/11/71	T.B.	W.H.	W.H.
D	ECN 2317A	1/11/71	T.B.	W.H.	W.H.
E	ECN 2351A	1/11/71	T.B.	W.H.	W.H.
F	ECN 2361A	1/11/71	T.B.	W.H.	W.H.
G	ECN 2370A	1/11/71	T.B.	W.H.	W.H.
H	ECN 2376 B	1/11/71	T.B.	W.H.	W.H.
J	ECN 2424A	1/11/71	T.B.	W.H.	W.H.
K	ECN 2395	1/11/71	T.B.	W.H.	W.H.
L	ECN 2592	1/11/71	T.B.	W.H.	W.H.
M	ECN 2680	1/11/71	EC	W.H.	W.H.
N	ECN 3167	1/11/71	EC	W.H.	W.H.

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES: .XX ± .010 ANGULAR .XX ± .005 ± 1/2° ± .35° BREAK ALL SHARP CORNERS APPROX. 0.10

PERIPHERAL EQUIPMENT CORPORATION

TITLE: PCBA-SERVO POWER SUPPLY 'B'

DATE: 2-20-71

DR: [Signature]

CHK: [Signature]

DES: [Signature]

ENGR: [Signature]

MAT: [Signature]

SIZE: 6000

FINISH: [Blank]

TOP ASSY: 6000

NEXT ASSY: 1ST USED ON [Blank]

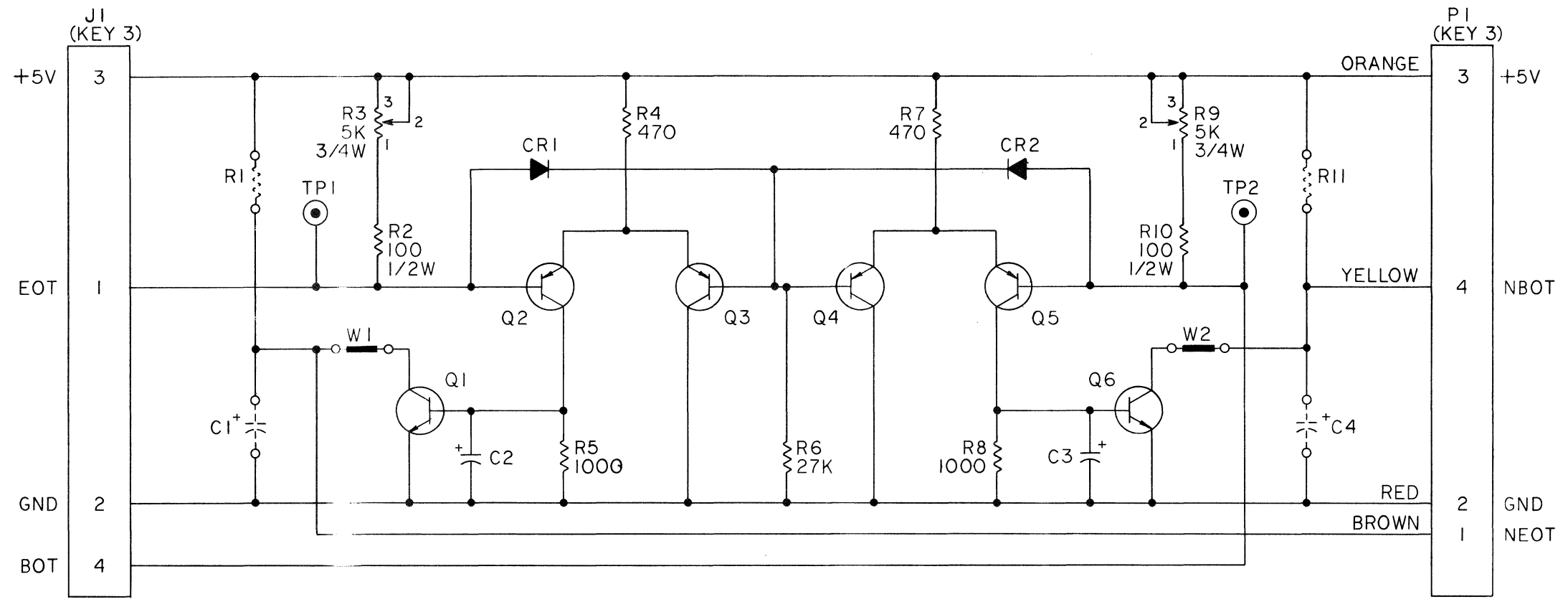
APPLICATION: [Blank]

SCALE: 2/1

DO NOT SCALE DWG

SHEET 1 OF 1

REVISIONS					
REV	DESCRIPTION	DATE	DR	CHK	APPR
A	ERN 2-UG	9/24/70	WJL	WJL	WJL



6. ALL DIODES ARE PEC 300-4446.
 5. ALL PNP TRANSISTORS ARE PEC 200-4125.
 4. ALL NPN TRANSISTORS ARE PEC 200-4123.
 3. ALL RESISTORS ARE 1/4W, ±5%.
 2. ALL CAPACITORS ARE 2.7UF, 35V, ±20%.
 1. REFERENCE DRAWINGS: ASSEMBLY-101949
 SPECIFICATION-101952
- NOTES: UNLESS OTHERWISE SPECIFIED:

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		THE INFORMATION HEREON IS THE PROPERTY OF PERIPHERAL EQUIPMENT CORPORATION. NO REPRODUCTION OR UNAUTHORIZED USE SHALL BE MADE.		PERIPHERAL EQUIPMENT CORPORATION	
TOLERANCES: .XX ± .010 .XXX ± .005 X X ± 1/32		ANGULAR ± 1/2° ✓		SIGNATURES	
BREAK ALL SHARP CORNERS APPROX. .010		DATE		TITLE	
FINISH:		DR. <i>[Signature]</i> 9/24/70		SCHEMATIC	
NEXT ASSY		CHK. <i>[Signature]</i> 9/24/70		DES.	
1 ST USED ON		ENGR. <i>[Signature]</i> 9/24/70		ENGR. <i>[Signature]</i> 9/24/70	
APPLICATION		MATERIAL:		SIZE	
101136	6000			D	
100800	7000			CODE IDENT. NO.	
101129	6000			DWG NO.	
				101948	
				REV	
				A	
				SCALE	
				DO NOT SCALE DWG	
				SHEET	
				OF	

REVISIONS					
REV	DESCRIPTION	DATE	DR	CHK	APPR
A	ERN 2-GR	8-1-69	EMG	WJL	EMG
B	ECN 2194	1-27-71	WJL	WJL	WJL
C	ECN 2367	3-23-71	Gd.	WJL	WJL
D	ECN 2746A	7-13-71	T.B.	WJL	WJL

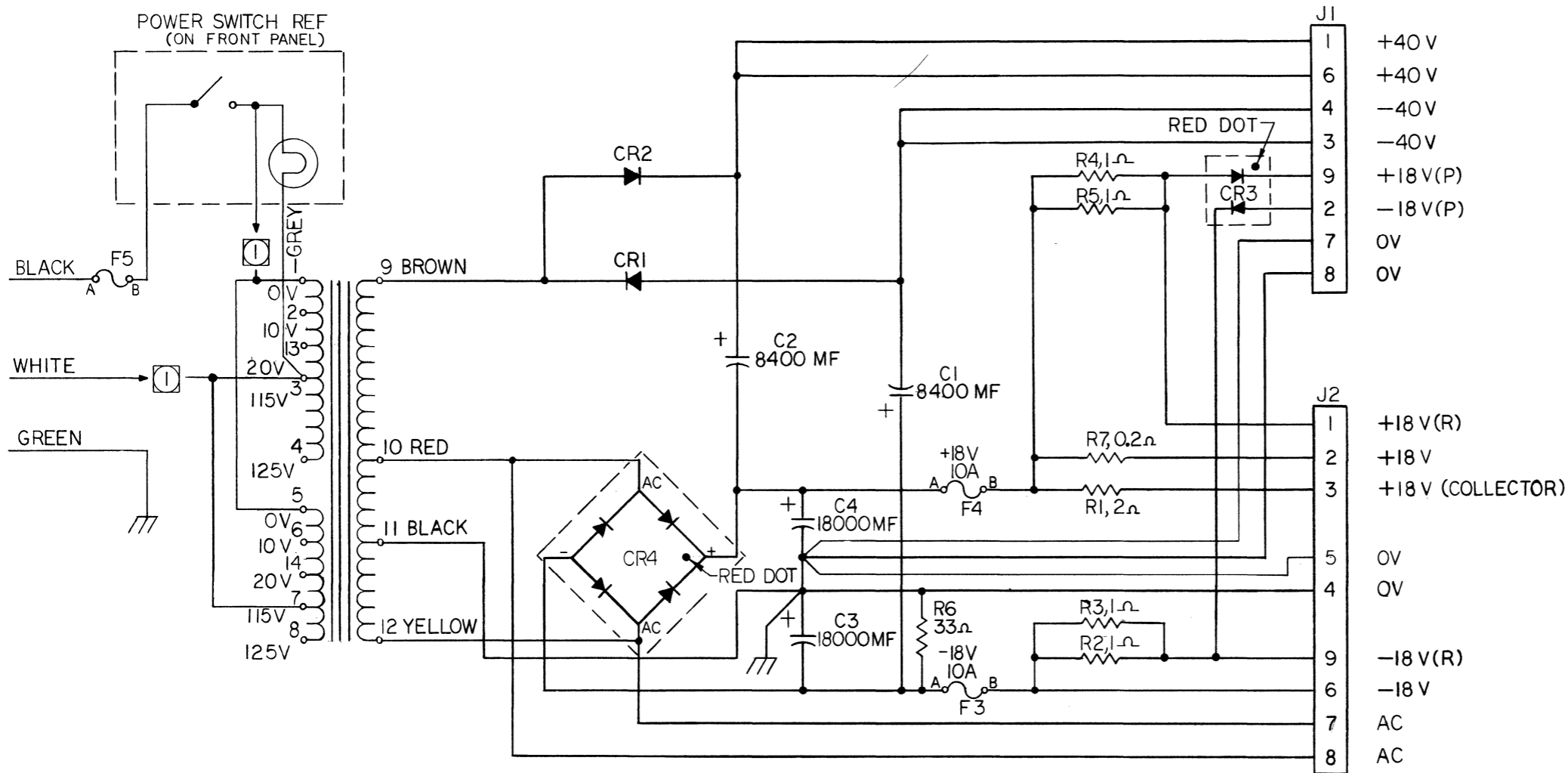


TABLE I
TERMINAL CONNECTORS
FOR LINE VOLTAGE VARIATIONS

LINE VOLTS	LINE INPUT (WHT)	LINE INPUT (BLK)	LAMP (GREY)	CONNECT
95	14	3	1	3 TO 7 & 13 TO 14
105	7	2	4	2 TO 6 & 3 TO 7
115	7	1	3	1 TO 5 & 3 TO 7
125	8	1	3	1 TO 5 & 4 TO 8
190	7	13	4	3 TO 14
210	7	2	4	3 TO 6
220	7	1	3	3 TO 6
230	7	1	3	3 TO 5
240	8	1	3	3 TO 5
250	8	1	3	4 TO 5

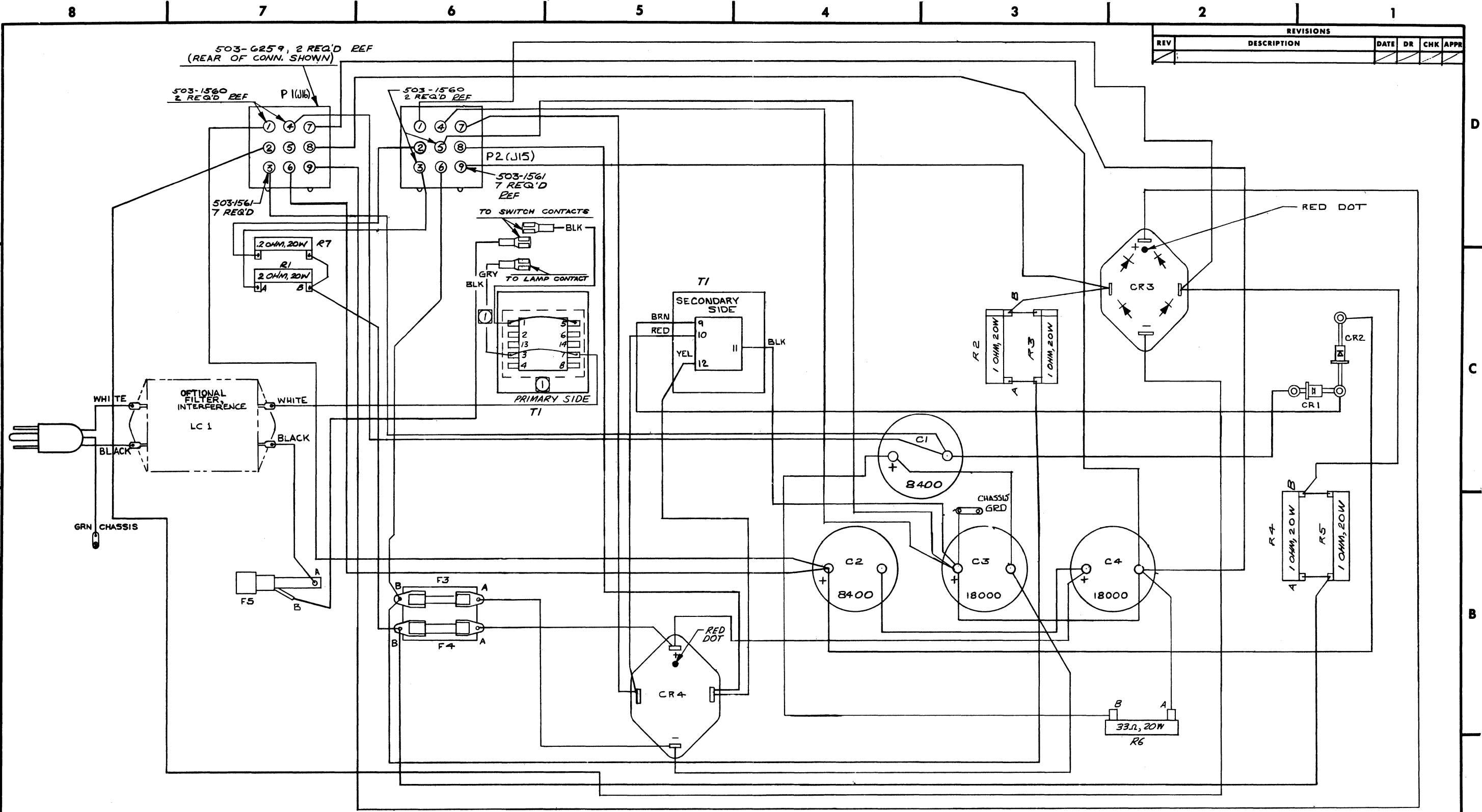
NOTE: THIS CHART APPLIES TO POWER SUPPLY ASSY 100990-01 REV L AND SUBSEQUENT

2. ALL RESISTORS ARE 20W, 5%
 ① FOR TRANSFORMER PRIMARY CONNECTIONS SEE TABLE I. (115V SHOWN)

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: .XX ± .010 .XXX ± .005 $\frac{X}{X} \pm \frac{1}{32}$ BREAK ALL SHARP CORNERS APPROX. .010		THE INFORMATION HEREON IS THE PROPERTY OF PERIPHERAL EQUIPMENT CORPORATION. NO REPRODUCTION OR UNAUTHORIZED USE SHALL BE MADE.		PEC PERIPHERAL EQUIPMENT CORPORATION TITLE: SCHEMATIC - POWER SUPPLY 6000 SIZE: D CODE IDENT. NO. DWG NO. 101132 REV D SCALE: NONE DO NOT SCALE DWG SHEET / OF /	
FINISH: NEXT ASSY: 100990 1 ST USED ON: 6000 APPLICATION:		SIGNATURES: DR: E. Stange, CHK: W. Kemp, ENGR: [Signature] DATE: 8-1-69, 1/27/71, 1/27/71		MATL:	

REVISIONS				
REV	DESCRIPTION	DATE	DR	CHK



WIRING DIAGRAM

① 115V CONNECTION SHOWN. FOR OTHER VOLTAGE CONNECTION, SEE 101132 PWR SUPPLY SCHEMATIC.
 NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		THE INFORMATION HEREON IS THE PROPERTY OF PERIPHERAL EQUIPMENT CORPORATION. NO REPRODUCTION OR UNAUTHORIZED USE SHALL BE MADE.	
TOLERANCES: XX ± .010 .XXX ± .005 X X ± 3/32	ANGULAR ± 1/2° ✓	SIGNATURES	
BREAK ALL SHARP CORNERS APPROX. 0.10		DR	DATE
FINISH:		ENGR	
MATERIAL:		ENGR	
100999-01 6000		TITLE	
NEXT ASSY 1 ST USED ON		POWER SUPPLY ASSY	
APPLICATION		SIZE	DWG NO.
		D	10099C
		SCALE	REV
		DO NOT SCALE DWG	L
		SHEET	