

Instruction Manual

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SECTION I

DESCRIPTION

INTRODUCTION The CartriFile[®] 40 cartridge-loaded digital magnetic tape unit is used with small digital computers, data terminals, and off-line data entry and readout stations. The unit contains a four-cartridge tape transport, all necessary read/write electronics, and a power supply. Tri-Data 1000 series single-tape cartridges are used as the recording medium. Each cartridge contains an endless-loop magnetic tape, with the photoreflexive load-point marker serving to indicate both the beginning and the end of the tape loop. The CartriFile 40 tape unit can be loaded with one, two, three, or four cartridges in any slot or combination of slots.

CartriFile 40 tape units are available with interface electronics for all widely used minicomputers or with standard interfacing for those who wish to build their own special interfaces. Details of the interface equipment supplied with this CartriFile 40 tape unit are presented in the separate INTERFACE section in the front of this manual.

EQUIPMENT DESCRIPTION The CartriFile 40 magnetic tape unit is supplied in a cabinet suitable for desk or table-top mounting. Four single-cartridges, an a-c power cable, and one copy of the CartriFile Instruction Manual are supplied with each unit. In addition, either the standard interface equipment or interfacing for a specific type of computer is furnished, as requested. Brackets for mounting the cabinet into a 19-inch equipment rack are also supplied.

The major assemblies of the CartriFile 40 tape unit are the tape transport, the electronics, the power supply, the front panel, and the cartridges. Descriptions of these assemblies are given below. Details of operation are given in Section III.

Tape Drive Assembly

The tape drive assembly contains the electromechanical components for driving the tape, the read/write heads, the load point sensors and buffers, the write driver amplifiers, the read amplifiers, and the sensors for detecting proper cartridge insertion and the write enabled status of the individual tapes. The tape drive assembly is mounted within the cabinet on a hinge so that it can be swung outward for servicing.

Tape drive occurs in a "forward only" direction and is accomplished by a constantly rotating capstan and a pinchroller actuator. The actuator engages a pinchroller (located within the cartridge), clamping the tape against the capstan. The tape is started, driven, and stopped by energizing and de-energizing the actuator for that particular tape. The four tapes are actuated independently.

The capstan drive motor operates from either 60-Hz or 50-Hz power; however, the pulley on the drive shaft is equipped with two drive belt grooves to accommodate differences in operating speeds. Units sold domestically are furnished with the drive belt positioned in the "60-Hz" groove; for 50-Hz operation, the pulley must be reversed and the belt engaged with the "50-Hz" groove.

The front of the transport serves as a mount for five lamps and a power switch. The upper and lower lamps light when the associated tape is in motion. The center lamp lights when power is supplied to the tape unit. The lamps illuminate plastic buttons in the front panel. The power switch is located below the cartridge slots; it is provided as a servicing aid and is normally left in the "on" position.

Electronics Assembly

The electronics assembly card rack contains six printed circuit boards and an extender board. The printed circuit boards contain the read and write timing and signal amplification circuits, data registers, and power regulation circuits. The boards can be removed from the front of the cabinet, and the extender board is provided to bring any of the boards forward for servicing while the unit is operating.

Input/output signals for the tape unit are run through a single cable from the card cage to connector J3, which is normally mounted on the rear panel. An alternate location for J3, toward the front of the cabinet, permits the installation of an interface circuit board within the cabinet.

[®]CartriFile is a registered trademark of Tri-Data Corporation.

Power Supply

The power supply provides the power requirements of the tape unit from an a-c line source and also includes a small fan for cooling the unit. The power supply is an integral part of the rear panel assembly, which is hinged to the cabinet frame and swings outward for access to power supply components.

The power supply operates at a line frequency of either 60 Hz or 50 Hz. The input voltage can be either 105-125 v ac or 210-250 v ac, depending upon the setting of a two-position slide switch mounted on the rear panel. The primary power input connector, fuseholder, and fuse are also located on the rear panel.

Connector J2 on the rear panel is provided for optional remote load-point search control. By grounding the appropriate line through J2, a tape can be brought to load point without a programmed instruction or other command through the controller.

SPECIFICATIONS

The specifications which follow include physical dimensions, environmental considerations, and various operating and timing characteristics of the CartriFile 40 tape unit. Specifications for the Tri-Data tape cartridges are also given. For specifications for the interface equipment supplied with this tape unit, refer to the separate INTERFACE section at the front of this manual.

Physical Characteristics

Specifications for CartriFile 40 dimensions, environmental conditions, power requirements, and connectors are given below.

DIMENSIONS AND WEIGHT

External dimensions, mounting dimensions, and clearances for the CartriFile 40 tape unit are shown in Figure 1-1. The tape unit weighs approximately 34 pounds.

ENVIRONMENT

The CartriFile 40 tape unit will operate in an ambient temperature range of +40°F to +110°F and at any relative humidity between 20% and 90% without condensation. The unit will also operate at any altitude between sea level and 10,000 feet.

INPUT POWER REQUIREMENTS

Maximum input power of 180 watts is required in any of four voltage frequency combinations. The CartriFile 40 tape unit will meet all specifications when the input power is within the ranges given in Table 1-1.

Front Panel

The front panel is attached to the CartriFile tape unit by a stud and catch on each end. To remove the panel, grasp the panel near the cartridge slot area and pull outward. The front panel contains no operating controls. Five plastic buttons to the right of the cartridge slots are illuminated by transport-mounted lamps to indicate "tape in motion" and "power-on".

Tape Cartridges

Each 1000 series cartridge contains a single endless-loop tape. A photoreflective Load Point marker on the tape determines the "beginning" and "end" of the tape. Write lockout is provided on the cartridge by a Protect/Enable switch. An integral slide cover encloses the tape completely when the cartridge is not in use. The front of each cartridge has a surface suitable for writing file identification information.

Table 1-1. Input Power

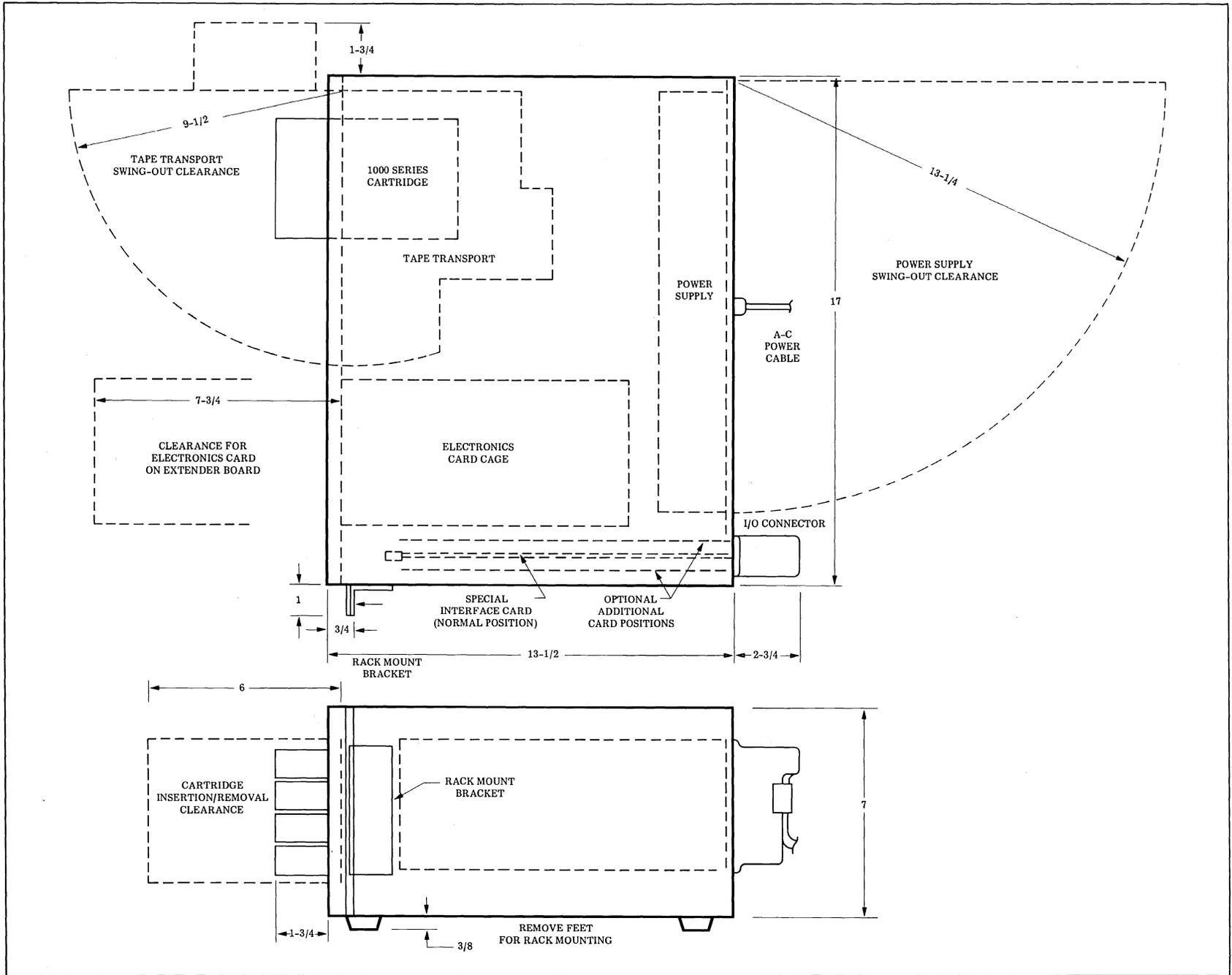
NOMINAL	VOLTAGE RANGE	FREQUENCY RANGE
115 vac, 60 Hz	105 vac to 125 vac	57 Hz to 63 Hz
115 vac, 50 Hz	105 vac to 125 vac	47 Hz to 53 Hz
230 vac, 60 Hz	210 vac to 250 vac	57 Hz to 63 Hz
230 vac, 50 Hz	210 vac to 250 vac	47 Hz to 53 Hz

INPUT/OUTPUT AND POWER CONNECTORS

Connector J3, for data and control inputs and outputs, is located at the left rear of the CartriFile 40 tape unit. Detailed information on this connector and the signals carried on the connector pins is presented in the separate INTERFACE section.

The power connector, J1, is recessed into the rear panel. A power cord which mates with J1 is supplied; its opposite end is fitted with a standard male U-ground plug.

Figure 1-1. Mounting Dimensions and Clearances



Operational Characteristics

The following paragraphs describe the operational characteristics of the CartriFile 40 tape unit: signal levels, tape motion, data transfer rate and storage capacity, and so forth.

INPUT/OUTPUT SIGNAL LEVELS

CartriFile 40 input and output circuitry uses Transistor-Transistor Logic (TTL), +2.5 to +5.0 v for High and -0.5 to +0.5 v for Low. Sink current requirements for a Low input will not exceed 2 ma. The outputs can supply 1 ma at minimum High voltage and can sink 10 ma at maximum Low voltage.

TAPE MOTION

The tape is driven at 10 inches per second in a "forward" direction in the three operating modes: Write Tape, Read Tape, and Load-Point Search. "Reverse" or "backspace" tape movement is not possible.

RECORDING TECHNIQUE

The CartriFile 40 tape unit employs a bit-serial phase-encoded, two-track recording technique with record-error detection.

RECORD FORMAT

Records of sequential data words are written on the tape, with the records separated by gaps. Each record may contain any number of words, as determined by the external control unit during writing.

The data words may contain 8, 12, or 16 bits. Either 8 or 12 bits-per-word formats may be program-selected by the external control unit or fixed by wiring the select input to ground at the interface. For 16 bpw, no ground connection is required.

DATA TRANSFER

The data words are transferred in and out bit-parallel. The data are written on the tapes bit-serial, with internal circuitry making the parallel-to-serial conversion during Writing and the serial-to-parallel conversion during Reading.

The using external control unit (e.g., digital computer) has wide latitude in servicing the data transfers during both Writing and Reading. During Writing, a Write Data Clock pulse output occurs at a fixed rate; the using control unit has the major portion of the period between each Data Clock to input the data word with a Write Data Transfer input pulse. During Reading, the data outputs may be sampled by the external control unit at any time

during the major portion of the period between Read Clock pulse outputs. Precise timing for the data transfers is given in Section III, OPERATION.

INTER-RECORD GAPS

In Writing each record, a Write Start delay of 16 msec and a Write Stop delay of 8 msec accommodate the start- and stop-tape motion transients and provide the time for writing a 0.16-inch (maximum length) inter-record gap. Internal circuitry times both delays and controls the tape motion and gap writing.

After reading each record, internal circuitry recognizes the inter-record gap remaining to accommodate the start transient prior to reading the next record. The Read Start and Read Stop delays are 9.5 msec and 4.75 msec, respectively.

BEGINNING-OF-TAPE AND END-OF-TAPE

A 3-inch long photoreflexive Load Point marker affixed to the continuous-loop tape marks both the beginning and the end of the tape. Each tape passes a photosensor before reaching the magnetic head; the 1.45-inch separation between the photosensor and head provides for the following beginning-of-tape timing and end-of-tape warning.

On writing the first record on a tape, a Write Start delay of 375 msec is initiated after the Load Point marker passes the photosensor to assure adequate beginning-of-tape gap. The resulting total Write Start or Read Start delay for the first record is therefore between 375 and 675 msec, depending upon the exact Load Point position of the tape when the Start Command input occurs.

An end-of-tape warning is provided during Writing when the leading edge of the marker passes under the photosensor and causes the Load Point status line for the tape to go True. When this occurs, 1.2 inches of the tape (up to 180 8-bit words) may be written before a Write Stop Command is mandatory.

DATA TRANSFER RATE

The bit rate is 18,000 bits per second, recording 900 bits to the inch (at 10 inches per second) on two tracks. The written tape format is bit-serial, and a Start bit is added to each half-word prior to writing it on the tape. The transfer rate during either writing or reading is therefore:

$$\text{Transfer Rate} = \frac{18,000}{B + 2} \text{ words per second,}$$

where B is the number of data bits in each word at the data input and data output (Table 1-2).

Table 1-2. Data Transfer Rates

Word Length	Peak Transfer Rate
8 bits	1800 words/second
12 bits	1286 words/second
16 bits	1000 words/second

DATA TRANSFER TIME PER RECORD

When writing records at the maximum rate, the elapsed time for each record is

$$\text{Time per record} = \frac{(B + 2)N}{18,000} + 0.025 \text{ second,}$$

where
 B = data bits per word
 N = record length in words, and
 0.025 = the sum of the Write Start and Write Stop delays,

with the exception that an additional 0.375- to 0.675-sec Write Start delay occurs at the beginning of each tape.

When reading records at the maximum rate, the elapsed time for each record is

$$\text{Time per record} = \frac{(B + 2)N}{18,000} + 0.020 \text{ second,}$$

where
 B = data bits per word (8, 12, or 16),
 N = record length in words, and
 0.020 = the sum of the Read Start and Read Stop delays,

with the exception that an additional 0.375- to 0.675-sec Read Start delay occurs at the beginning of each tape.

LOAD-POINT SEARCH TIME

Upon receipt of a Load-Point Search command input, the tape is advanced at 10 inches per second until the Load Point marker is reached. Load-Point Search time is directly proportional to the length of tape remaining on the tape loop at the time of the Load-Point Search command input.

$$\text{Load-Point Search Time} = \frac{L}{10} \text{ seconds,}$$

where L is the length of tape remaining (in inches). Average search time for a 150-foot file is 90 seconds.

DATA STORAGE CAPACITY

The data storage capacity on each tape varies with the bits-per-word and words-per-record format written and the length of the tape. The total storage available in the unit without reloading is the capacity of the four tapes with which it is loaded. The tape length required per record is

$$\text{Tape length per record} = \frac{(B + 2)N}{2 \times 900} + 0.16 \text{ inch,}$$

where
 B = data bits per word,
 N = words per record,
 900 = CartriFile recording density in bits per inch, and
 0.16 = inter-record gap (maximum).

The tape length required to store a number of records is the sum of the lengths required for each record plus 3 inches for the Load Point marker and initial record gap. For fixed record lengths, the capacity of a tape in records is

$$\text{Record capacity} = \frac{\text{Total inches tape} - 3 \text{ inches}}{\text{Inches Tape per Record}}$$

The capacity in words is the capacity in records times the words per record. For data in 1,000-character records, the capacity of a 150-foot tape is 300,000 8-bit words. System capacity for the same data is 1,200,000 8-bit words.

1000 Series Tape Cartridges

Tape Length	Model 1010: 10 feet
	Model 1025: 25 feet
	Model 1050: 50 feet
	Model 1150: 150 feet
Size	4 inches wide by 6 inches long by 7/8 inches thick.
File Protect	Self-locking switch with integral position indicator.
Tape	Endless loop of 1/4-inch wide computer-grade magnetic tape. One per cartridge.
Certification	Tape is tested and certified error-free.

SECTION II

INSTALLATION

GENERAL

The CartriFile 40 tape unit shipment consists of the tape unit itself, four 1000 Series single-tape cartridges, one Instruction Manual, an a-c power cord, and interface equipment. Brackets and hardware for rack mounting are also included. The interface equipment shipped depends on the type of interface ordered. Refer to the INTERFACE section for information on the equipment supplies and installation instructions.

Be certain that all parts have been unpacked before discarding the packing material.

INSTALLATION

The CartriFile 40 tape unit is designed for operation at sites that are not subject to shock, vibration, or wide ranges of ambient temperature. The CartriFile cabinet is suitable for placing on a desk or table top. Brackets for mounting the cabinet into a standard 19-inch rack are included. In either case, the unit should be mounted to provide access to the front and rear of the cabinet. Installation consists of placing the unit in its selected location and making the power and interface connections.

Table-Top Placement

If the CartriFile tape unit is to be positioned on a desk or table top, the only requirements are a level surface, a location close enough to the computer or controlling device to provide for safe installation of the connecting cables and the power cord, and availability of access to the front of the cabinet for cartridge insertion and removal. Access to the rear of the cabinet is necessary only for cable installation and for servicing. Four rubber feet are provided on the bottom of the cabinet to prevent marring the mounting surface.

Rack Mounting

The CartriFile 40 cabinet requires 7 inches of vertical space in a standard 19-inch equipment rack. In addition, the 10404-0 Rack Mount Adapter Assembly (two brackets and two covers, plus hardware) must be installed on the cabinet. Installation is as follows.

1. Two 1/4-20 socket drive set screws are located near the front of each side panel on the cabinet. Carefully remove enough paint to insert a 1/8-inch hex key and withdraw the set screws.
2. Note that there is a left-hand and a right-hand bracket. Install each one on its matching side panel using the 1/4-20 hardware provided.
3. Remove the four rubber feet from the bottom of the cabinet, then mount the cabinet in the equipment rack.

4. Install the rack-mount covers by engaging the lip with the bottom of the bracket. Lift up against the spring, push in at the top, then release. The spring will pull the cover down, engaging the pin at the top.

Power Connection

CAUTION

The CartriFile tape unit may be operated at 115 v nominal or at 230 v nominal. To avoid damaging the equipment, the line selector slide switch on the rear panel must be in the proper position before connecting power to the tape unit.

An a-c power switch is located behind the front panel below the cartridge slots on the transport. This switch is normally left in the "on" position so that power is applied when the power cable is connected.

Connect the female end of the a-c power cord to the recessed power receptacle, J1, on the rear panel. The male end of the power cord connects to any standard U-ground receptacle.

The CartriFile power supply will operate at a line frequency of 50 Hz to 60 Hz. The capstan drive motor will also operate at either frequency, but *pulley diameters must be changed* to accommodate the differences in rotational speed. The pulley on the motor shaft is provided with two grooves for the drive belt: units sold domestically are furnished with the belt positioned on the 60-Hz

(smaller diameter) pulley groove. The change from 60-Hz to 50-Hz operation is made as follows.

1. Remove the front panel by reaching through a cartridge slot, grasping the panel, and pulling outward. The front panel is held by two spring catches, one at the extreme left center and one at the extreme right center.
2. Remove the transport retaining screw (above the upper right-hand corner of the transport), and swing the transport outward on its hinge.
3. Disengage the drive belt from the groove in the small pulley, then withdraw it over the capstan flywheel.
4. Loosen the two set screws in the motor pulley with a 0.050-inch hex key. Remove the pulley from the motor shaft.
5. Reverse the pulley and place it back on the shaft. Align the large diameter (50-Hz) pulley groove with the groove in the capstan flywheel, then tighten the two set screws securely.
6. Install the drive belt first in the flywheel groove, then stretch it gently and engage it in the groove in the large pulley.
7. Swing the transport back into the cabinet, install the transport retaining screw, and snap the front panel onto the cabinet.

Grounding

On the CartriFile rear panel are two ground terminals, SIGNAL and CHASSIS. The tape unit is shipped with these terminals tied together. Depending on system grounding requirements, the jumper can be removed from these terminals; however, CartriFile SIGNAL and CHASSIS grounds *must* be connected together at some point in the system.

Remote Load-Point Search Control

Connector J2 on the CartriFile rear panel provides for optional remote control of the Load-Point Search operation. Supplying a ground through the mating plug (Switchcraft 12CL5M), switches tape 1 (pin 1), tape 2 (pin 2), tape 3 (pin 3), or tape 4 (pin 4) into the Load-Point Search mode. (Pin 5 is ground.) The mating plug may be ordered through Tri-Data as part no. 00021-015.

Interface Connections

Installation of the interface equipment supplied with the CartriFile 40 tape unit is presented in the separate INTERFACE section in the front of this manual. Interface equipment manufactured by Tri-Data Corporation can be used in the various CartriFile models: when referring to the INTERFACE section, note that the information presented covers the CartriFile 40 tape unit and the other CartriFile models which use the same interface equipment.

SECTION III OPERATION

INTRODUCTION The CartriFile 40 tape unit operates automatically under the control of a data processing system. Under Automatic control, the data processing or controlling system may command the CartriFile tape unit to Read, Write, or Load-Point Search its tapes. (Refer to Section I for limitations regarding such commands.) Manual operations are limited to inserting and removing the tape cartridges.

CONTROLS AND INDICATORS The CartriFile 40 front panel contains five plastic indicator buttons which are lighted from behind by lamps mounted on the tape transport. The upper and lower (white) indicators are lighted whenever the associated tape is "busy", i.e., in motion during a Read, Write, or Load-Point Search operation. The center (red) indicator is lighted whenever power is applied to the CartriFile tape unit.

An a-c power switch is located behind the front panel below the cartridge slots on the transport. This switch is primarily a service aid and is normally left in the "on" position. On the rear panel, provision is made for optional remote control of Load-Point Search operations through connector J2.

Application of Power

Connect the a-c power cable to a power outlet and check that the transport power switch, located below the cartridge slots, is in the "on" position. The center indicator on the front panel will light (red) when power is applied.

plastic switch lock can be inserted on the top of the slide switch to keep the switch from being accidentally moved.

Slide the cartridge into the cartridge slot until it seats. To remove the cartridge, simply pull outward. If the cartridge is not to be used again immediately, slide the cover door out and across the open end to exclude dust and other contaminants from the tape and pinchroller.

Cartridge Insertion and Removal

Before inserting a cartridge, move the cover door to its recessed position and set the Protect/Enable switch appropriately. When the cartridge switch indicates PROTECT, the tape is file-protected. Moving the switch in and to the right sets the switch in the ENABLE position, permitting data to be written on the tape. A

Remote Load-Point Search Control

Connector J2 on the CartriFile rear panel is provided for optional remote control of Load-Point Search, an operation normally initiated by command from the data handling system. Grounding the appropriate line (J2-1 for tape 1, J2-2 for tape 2, J2-3 for tape 3, J2-4 for tape 4) places the tape in the Load-Point Search mode.

AUTOMATIC OPERATIONS The automatic operations initiated by commands from the data processing system include the Write sequence and timing, the Read sequence and timing, and the Load-Point Search sequence. These operations and the bits-per-word format selection are described in the paragraphs which follow. The CartriFile 40 tape unit operates in either the Write mode or the Read mode for only one selected tape at a time. The Load-Point Search mode can be initiated for any tape at any time.

Write Sequence and Timing

Figure 3-1 shows the time relationships of input and output signals associated with writing a record on a tape. Only one tape can be processed at a time. With the Write Select Tape (1, 2, 3, or 4) input True, a Write Start input pulse commits the selected tape to write a record. The Write Mode and Busy (1, 2, 3, or 4) status lines go True at the initiation of the pulse. At the fall of the pulse,

the tape drive circuits are enabled and an internal Write Start delay is initiated.

A Write Clock output pulse occurs 16 msec after the fall of the Write Start input pulse (the delay is between 375 and 675 msec at the beginning of each tape), and subsequent Write Clock outputs occur at a fixed rate until a Write Stop input pulse is received.

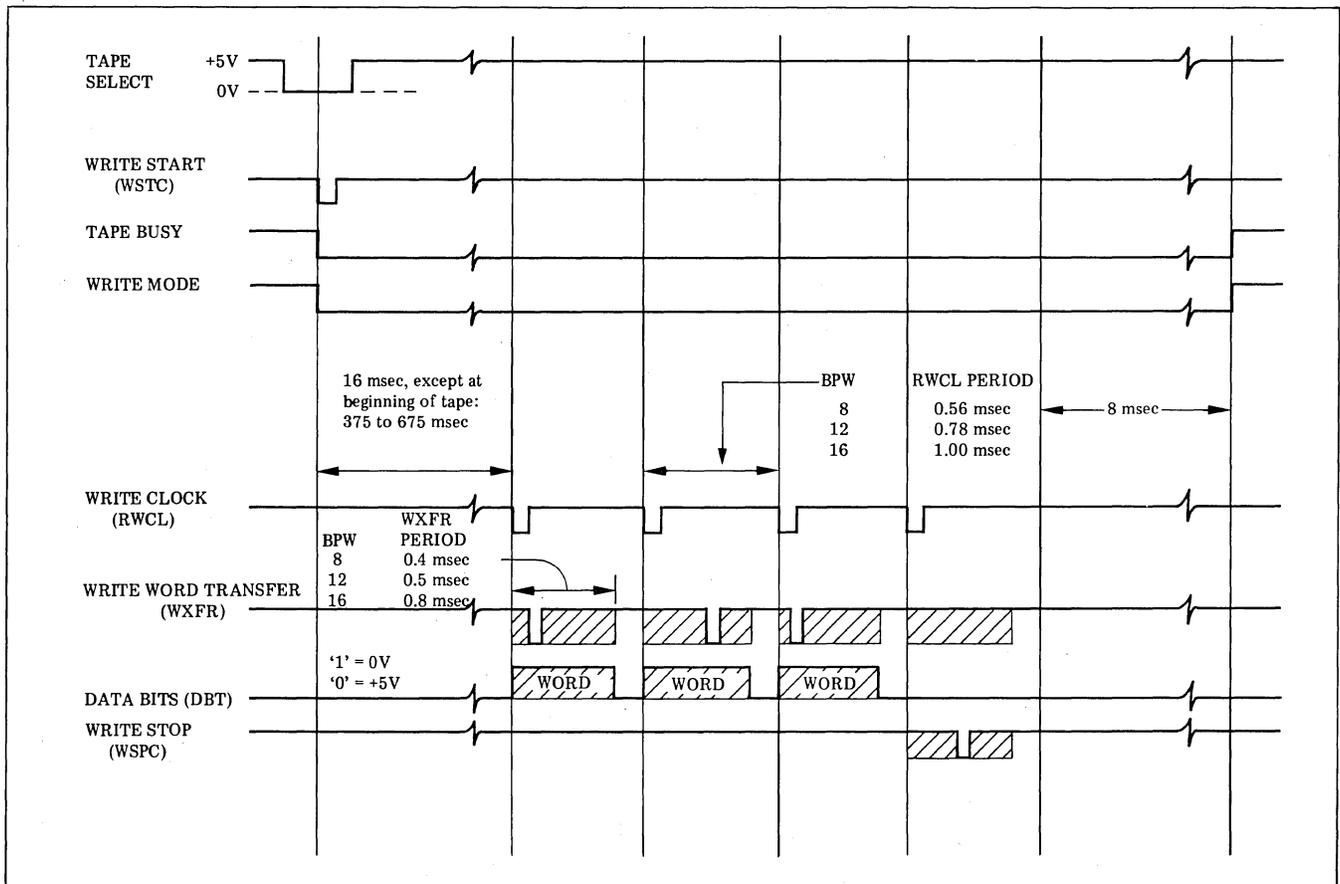


Figure 3-1. Write Timing Relationships

After each Write Clock output pulse, either a Write Word Transfer input pulse or a Write Stop input pulse *must occur* within a fixed time period (as listed in Table 3-1), or else the last previously transferred data word will be repeated on the tape. A Write Word Transfer input pulse will set the data input registers being used to a "1" or "0" state, determined by whether

the data bit inputs are ONE or ZERO at the time the Write Word Transfer pulse occurs. At the end of the fixed period, if a Write Stop input pulse has not been received, internal circuitry samples the input registers and transfers the data to a parallel-to-serial converter. As the data are written on the tape from the converter, the input register is ready to accept the next data word.

Table 3-1. Write Clock Timing

BITS-PER-WORD SELECTION	TIME BETWEEN WRITE CLOCK OUTPUTS	TIME SPAN FOR WRITE WORD TRANSFER OR WRITE STOP INPUT INSERTION FOLLOWING WRITE CLOCK OUTPUT
8 bits	0.56 msec	0.4 msec
12 bits	0.78 msec	0.6 msec
16 bits	1.00 msec	0.8 msec

A Write Stop input commits the tape that is writing to terminate the record and stop. Further Write Clock outputs are inhibited. At the time at which the next Write Clock would have occurred had the Write Stop input not occurred, the tape drive circuitry is de-energized and an internal 8-msec assurance time delay is initiated. At the end of this delay, the Write Mode and Busy status lines go False. An exception to this happens when a Load-Point Search input occurs while the record is being written: at the completion of the record, the Busy status line will remain True and a Load-Point Search operation will begin immediately. The Write Mode status will go False.

Note that the CartriFile 40 tape unit can be operated as a Write Only unit by removal of the Read Amplifier circuit board. Removing this board inhibits the Read Start command.

Read Sequence and Timing

Figure 3-2 shows the time relationships of the input and output signals associated with reading a record from the tape.

With the Read Select Tape (1, 2, 3, or 4) input True, a Read Start input pulse commits the tape to read a record. The Read Mode and Busy (1, 2, 3, or 4) status lines go True at the initiation of the pulse. At the fall of the pulse, the tape drive circuits are enabled and an internal Read Start delay is initiated.

The first data word is encountered and read from the tape approximately 16 msec after the fall of the Read Start input pulse (at the beginning of the tape, the delay will be between 375 and 675 msec). Subsequent Read Clock outputs occur as each data word is read from the

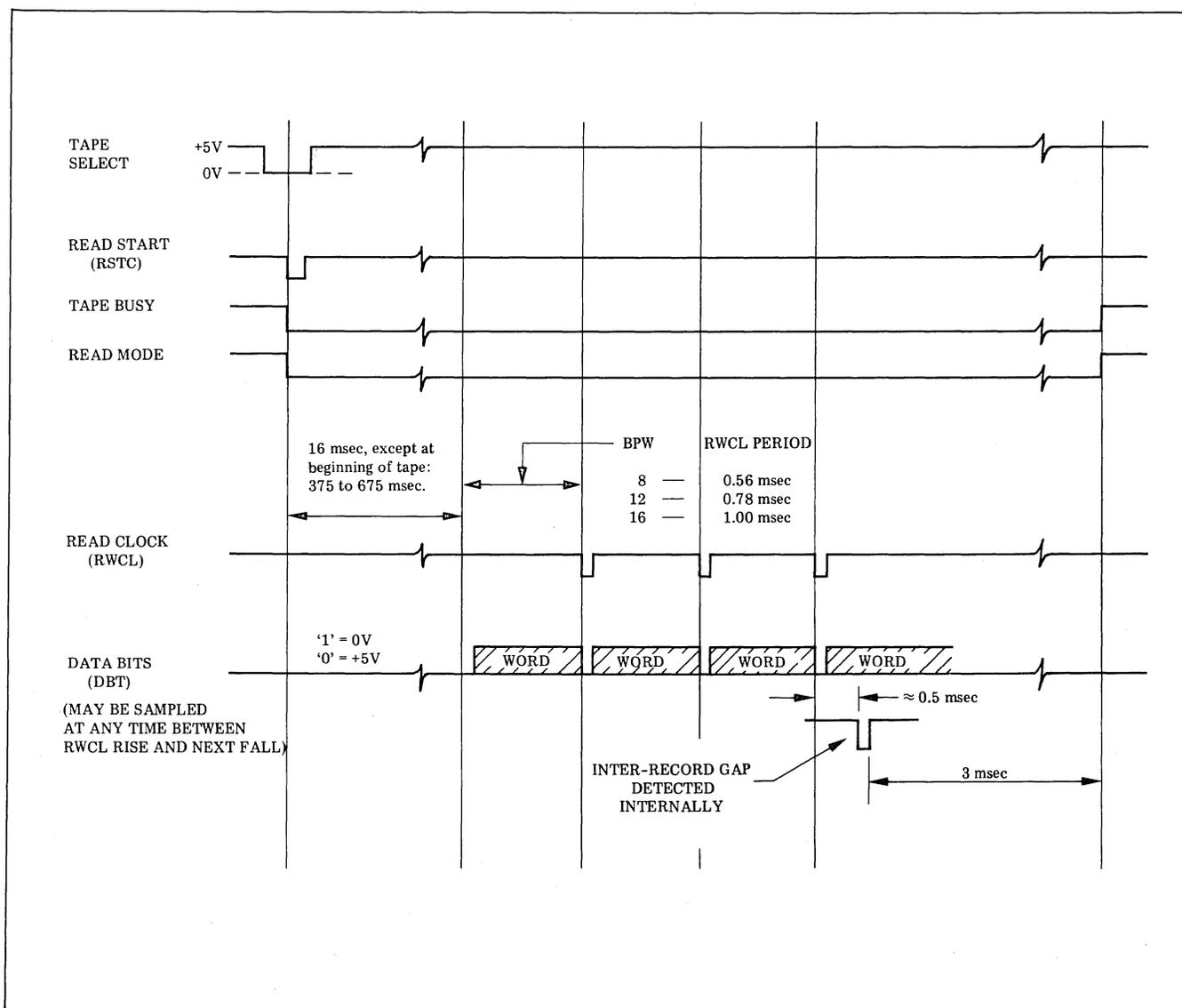


Figure 3-2. Read Timing Relationships

tape. The data bit outputs will be ONE or ZERO, representing the word read from the tape continuously from the time of the fall of the Read Clock output pulse until the time of the next Read Clock output pulse.

When the last word of the record has been read, internal circuitry recognizes the absence of data in the inter-record gap and de-energizes the tape drive. After a 4.75-msec delay, the Read Mode and Busy status lines go True. An exception to this happens when a Load-Point Search input occurs while the record is being read: at the completion of the record, the Busy status line will remain True and a Load-Point Search operation will begin immediately. The Read Mode status will go False.

If an error has been detected, the Record Error output goes True at the time of the Read Clock output and remains True until the Read Start Command for the next record occurs, at which time Record Error is reset to False.

Read Timing Variations

The 16-msec Read Start Delay and the times between Read Clock outputs (shown in Figure 3-2, in Table 3-2, and in Section I) are determined by times at which data are read from the tape; they are therefore varied by all conditions that change the tape length or the tape speed between writing and reading the data. The CartriFile has adequate margin to operate normally with the Read tape speed departing from the Write tape speed by as much as $\pm 20\%$.

Table 3-2. Read Clock Timing

BITS-PER-WORD SELECTION	NOMINAL TIME BETWEEN READ CLOCK OUTPUTS
8	0.56 msec
12	0.78 msec
16	1.00 msec

Load-Point Search and Status

A Load-Point Search input pulse normally causes one of three actions on the tape and its status outputs.

If the tape is at Load Point when the Load-Point Search input occurs, *no tape motion results*. It is recommended however, that a Load-Point Search command *always* be given to a newly loaded tape for the following reason: the output of a flip-flop in the Load Point circuitry

determines whether a normal (short) start delay or a Load Point (long) start delay will be initiated. The short delay is used during normal writing or reading. The output of this flip-flop may be set such that a normal (short) start delay will be actuated *even though a new cartridge tape which is already at Load Point has been inserted and the long start delay is required to clear the Load Point Marker*. A Load-Point Search command, however, will reset the flip-flop so that the long start delay will be actuated.

If the tape is *not* at Load Point and *not* being written or read when the Load Point Search input occurs, a Load Point Search sequence results. The Busy status output goes True, and the tape is advanced until it reaches its Load Point. At Load Point, the tape stops and the Busy status output goes False.

If the tape is being written or read when the Load Point Search input occurs, writing or reading will continue until the record is completed. Then the Load-Point Search sequence described above will occur.

The Load Point status output is True when the tape is at Load Point and False when it is not.

Bits-Per-Word Format Selection

The data input and output registers provide for up to 16 parallel data bits in each word. The internal circuitry is set by the Bits-Per-Word Select inputs to write and read 8-bit parallel data words using only the first 8 data bit inputs and outputs, or for 12-bit parallel words using the first 12, or for 16-bit parallel words using all 16. The word transfer rate for each bits-per-word format is a different constant since the data are written on the tapes bit-serially at a constant bit rate.

If the bits-per-word format to be used in a particular CartriFile installation is to be fixed, the Bits-Per-Word Select input may be pre-wired at the interface for the format used. If the bits-per-word format is selected under program control:

The Bits-Per-Word Select input must be held True during writing a record from the time of initiation of the Write Start pulse until the record is complete.

The Bits-Per-Word Select input must be held True during reading a record from the time of initiation of the Read Start pulse until the record has been completed, and the select input must be the same as that used in writing the record.

SECTION IV

THEORY OF OPERATION

GENERAL

The CartriFile 40 tape unit consists essentially of a tape transport mechanism for driving four magnetic tapes, tape motion control logic, Read/Write electronics, and power supplies. In this section, the recording technique and the tape transport are discussed first, followed by circuit descriptions for all of the circuit boards within the tape unit. Interface circuit boards are discussed in the separate INTERFACE section.

In general, the CartriFile 40 tape unit performs three basic operations: writing data, reading recorded data, and searching for the Load Point marker. In a Write operation, after tape motion is initiated, input data bits in parallel form are converted to serial form, phase-encoded, and recorded on the tape on two tracks. At the end of a record, tape motion is stopped by command. In a Read operation, tape motion is initiated, and flux transitions on the tape are detected. Timing is reconstructed and the data assembled bit by bit. There is also error detection. When a word is completely assembled in a register, it is made available for strobing out in parallel form. Detection of the inter-record gap automatically stops tape motion. When Load-Point searching, the selected tape is driven forward until a photoreflexive marker attached to the tape loop is sensed, generating a signal which stops tape motion.

RECORDING TECHNIQUE

The recording technique used in the CartriFile 40 tape unit is the phase-encoded, non-return-to-zero type, which is self-clocking. Figure 4-1 shows the recording and playback waveforms of a 16-bit data word. Data "ones" are recorded as positive transitions and "zeros" as negative transitions. Note that there is always a transition at data times, and a half-cell transition occurs only if the next data cell has the same data value. The half-cell transition is opposite to the next data cell value.

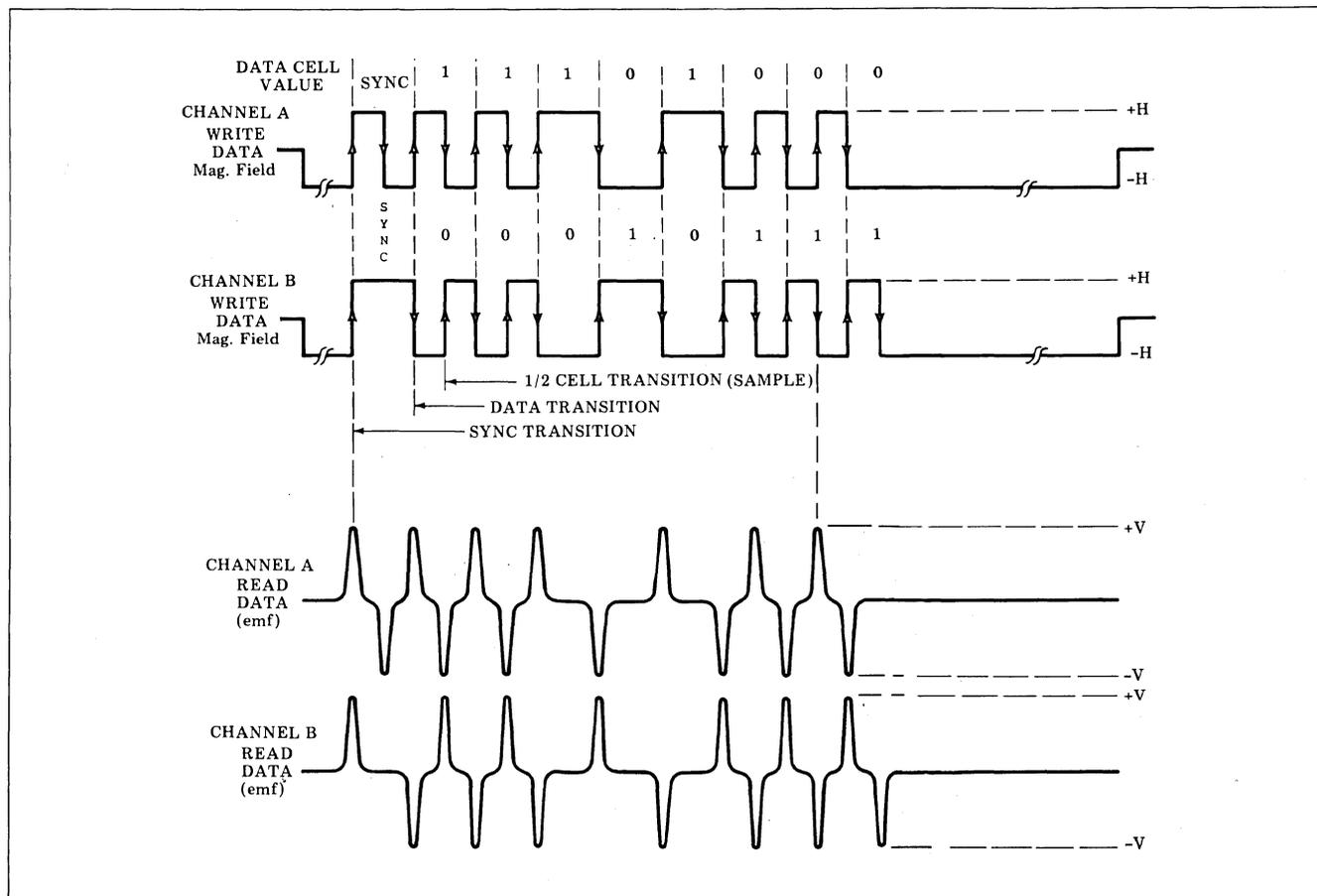


Figure 4-1. Write/Read Waveforms of 16-Bit Data Word 1010100110010101

Information is recorded on the tape in serial-bit form at 900 bits per inch on two tracks, designated channel A and channel B. The data word is broken into two half-words: the odd-numbered bits are recorded on channel A, the even-numbered bits on channel B. The channels are independent of each other, except at the start of each word when both tracks are made to record a "one". The detection of this first positive transition is used as a "start" bit for timing purposes during reading.

TAPE TRANSPORT

The Tape Transport consists of the capstan and drive motor, two pinchroller actuator assemblies, two actuator drivers, and Read/Write head assemblies, Write drivers, Read preamplifiers, and Load Point sensing circuits. The electronics associated with the Tape Transport are located on three circuit boards mounted to the transport frame. The pinchroller is part of the cartridge itself and is mechanically coupled to the pinchroller arm when the cartridge is inserted into the transport. A Protect/Enable switch for the tape and a cartridge-insert switch for each cartridge are used for interlocking and status indications.

When power is applied to the tape unit, an a-c motor continuously drives the capstan (Figure 4-2). Each cartridge contains a continuous-loop tape which passes in front of its pinchroller. The solenoid-actuated arm, engaged with the pinchroller, pulls the pinchroller against the capstan, forcing the tape against the capstan. While in contact with the capstan, the tape is driven at 10 inches per second. In this manner, the tape is pulled past a two-track magnetic head assembly. (The same head is used for both Read and Write functions.)

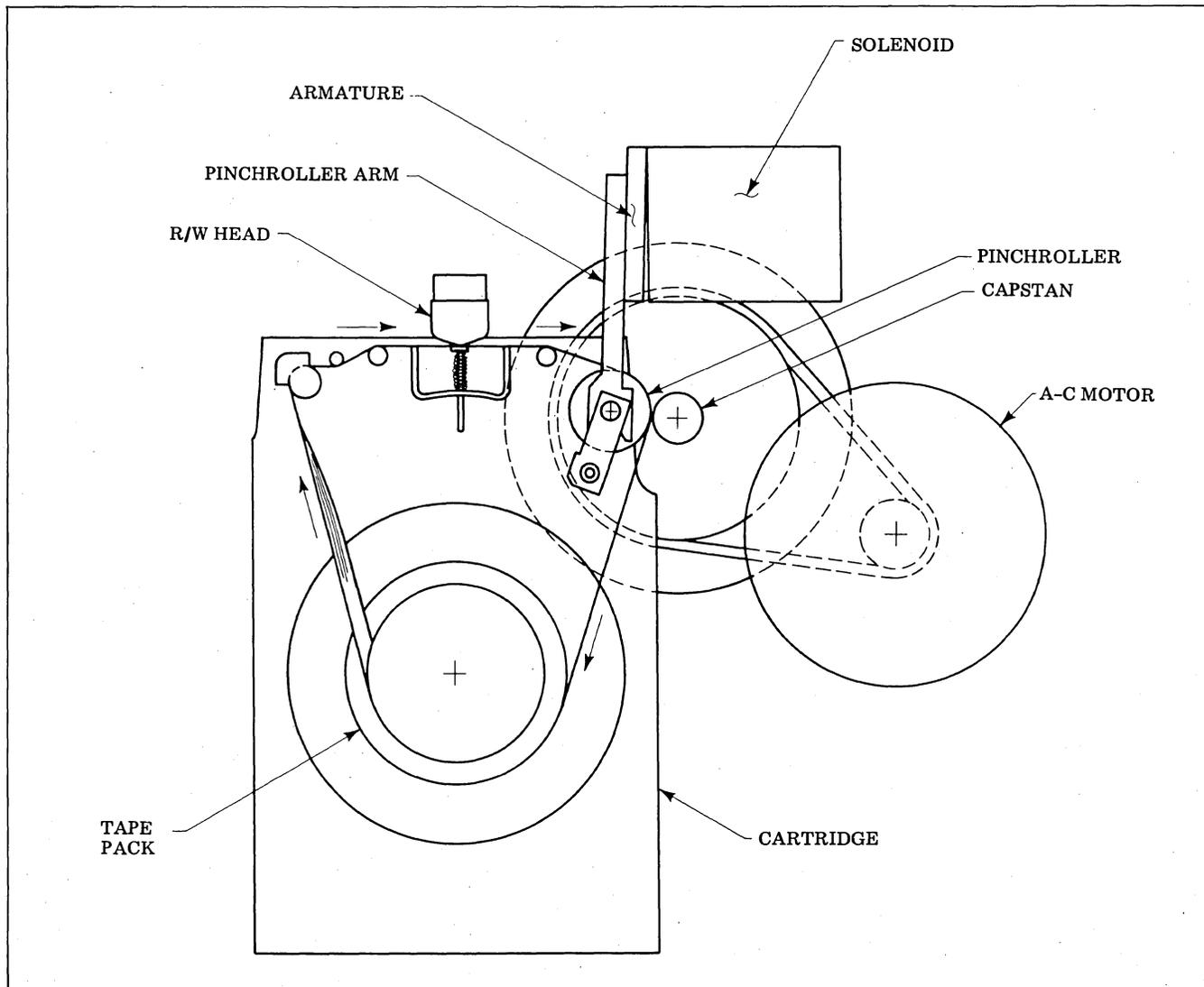


Figure 4-2. Tape Transport Mechanism

CIRCUIT OPERATION

The electronic operation of the CartriFile 40 tape unit is described below under four major divisions: Power Supplies, Motion Control, Write Electronics, and Read Electronics. The circuitry is contained primarily on six printed circuit boards in the card cage and two printed circuit boards mounted on the transport. The transport frame also mounts the photosense circuit board and the tape motion indicator lamps. The power supply chassis is located on the hinged rear panel. In tracing some of the functional operations, it is necessary to follow signal paths on several of the schematics; the schematics carry the assembly numbers of the circuit boards and are located in Section VI. The overall interconnection diagram is schematic 99005.

The logic circuits used throughout are TTL and DTL types. Logic operation is described in terms of Positive Logic, where a *high* is +2.5 to +5 volts and a *low* is -0.5 to +0.5 volts. CartriFile mnemonics for the signals are listed in Table 4-1. A bar over the mnemonic on a signal line indicates that the "true" level is low for that function. Integrated circuit gates are shown as NAND gates on the schematics. References to logic sections of an integrated circuit package are made by package number and output pin: for example, ML4-6 designates pin 6 of package ML4.

Table 4-1. CartriFile 40 Mnemonics

MNEMONIC	FUNCTION
BPW 8, 12	Bits per word select (8 or 12)
CISW (X)	Cartridge insert switch (tape X)
DBT (1-16)	Data bit (1 through 16)
FPSW (X)	File-protect switch (tape X)
FWD (X)	Forward drive (tape X)
HSLD (X)	Head (X) selected for write or read
LPA (X)	Load Point attained (tape X)
LPSC	Load-Point Search command
PSN (X)	Photosensor for tape (X)
RDCL	Read data clock
RESET	Resets certain circuits at power-on
RERR	Record error
RM	Read mode
RSLD (X)	Read selected (tape X)
RSTC	Read Start command
RWCL	Read or Write clock
TSLP	Tape selected is at Load Point
T(X)BY	Tape (X) busy
T(X)FP	Tape (X) file-protected
T(X)LP	Tape (X) at Load Point
T(X)OL	Tape (X) on line
T(X)SL	Tape (X) select
T(X)SM	Tape (X) in Search mode
WDCL	Write clock
WM	Write mode
WSLD (X)	Write selected (tape X)
WSPC	Write Stop command
WSTC	Write Start command
WXFR	Write word transfer

(X) indicates tape 1, 2, 3, or 4

Power Supplies

All the necessary power for the internal operation of the tape unit and, in some cases, power for external interface circuitry is supplied by two units, the Power Supply and the Regulator board.

POWER SUPPLY 10947-1

Incoming a-c power is applied to transformer T1 through a switch on the front of the transport. Switch S1 is used for changing the T1 primaries from parallel to series connection when the a-c input is 230 v ac instead of 115 v ac. Three of the four secondaries of T1 connect to full-wave rectifier-capacitor circuits to supply the +15 v, -15 v, and +5 v regulators. The +30 v unregulated supply is used for the pinchroller actuators and load-point lamp regulator. B1 is a fan (115 v) placed across one of the T1 primaries.

REGULATOR BOARD 10790-0

The Regulator board contains the circuitry for power regulation and Reset control and some circuits associated with the Write Clock and Load-Point Search functions.

With power off, the normally off contact of K1 grounds the Reset line. When power is applied initially, a 100-msec delay occurs before the Reset line is switched to "high". The delay results from C1 charging up to 10 volts (set by Zener diode CR3), at which point Q1, Q2 turns on and energizes K1.

ML18, ML19, and ML17 and associated components are series regulators for the +5 v, +15 v, and -15 v supplies, respectively. The regulators are current-limited by R23, R22, and R24, with the output voltages adjusted by potentiometers R20, R13, and R16. Q3 and Q4 are used to turn off the 15 v supplies rapidly to avoid Write transients when power is turned off. The falling of the +5 v supply turns off Q3, allowing Q4 to turn on (since the unregulated +20 v remains high for a longer period), thereby switching off the 15 v regulators through CR5 and CR6.

Motion Control

Motion Control includes all the circuits associated with the movement of the tape and the preparation for data transfer to or from the tape: tape start, drive, and stop operations; load-point search operations; write/read start and stop operations; and the handling of the various command and status signals. The circuits themselves are spread over several circuit boards in the card rack and on the transport assembly.

Tape Motion is initiated by any one of three commands: LPSC (Load-Point Search), WSTC (Write Start), or RSTC (Read Start). It is stopped by one of three signals: LPA (Load-Point attained following a Load-Point Search operation), WSPC (Write Stop command), or an internal Stop command derived from the detection of an inter-record gap during a Read operation.

LOAD-POINT SENSING

The Photosense Assembly (Figure 4-3) and the Photosense circuit (schematic 10972) detect the presence of the photoreflective Load Point marker on the tape as it approaches the magnetic head. There are five identical photo-transistor amplifier circuits, one for each tape and one (Q9, Q10) reference circuit used to control the lamp voltage.

Each tape sensor circuit works as follows, using Q7, Q8 as an example. When tape 1 is at Load Point, photo-transistor Q8 is illuminated, making it conduct more, thus raising the voltage at the base of Q7, an emitter-follower. When the tape is not at Load Point, Q8 conducts much less, making the output of Q7 go low.

Changes in temperature and lamp brightness will in turn vary the lamp voltage accordingly through the $\mu A723$ regulator located on the Actuator Driver board. R12 is used to manually adjust the lamp voltage. Each tape sensor circuit has its own potentiometer for adjusting the output at PSN.

PINCHROLLER ACTUATOR DRIVER

Four actuator solenoid driver circuits (one per tape) are located on the Actuator Driver Board (10974). The \overline{FWD} inputs are derived from the Motion Control boards.

The operation of the tape 1 driver circuit is as follows. When no drive is requested, the $\overline{FWD1}$ input is high, turning Q1 on, which keeps Q6 off. No current flows in the actuator coil and the BUSY lamp is off. When $\overline{FWD1}$ goes low (drive requested), Q1 turns off and the collector of Q1 is clamped at about 6 v by CR3 and CR4. Q6 is turned on, energizing the solenoid and turning the BUSY lamp on.

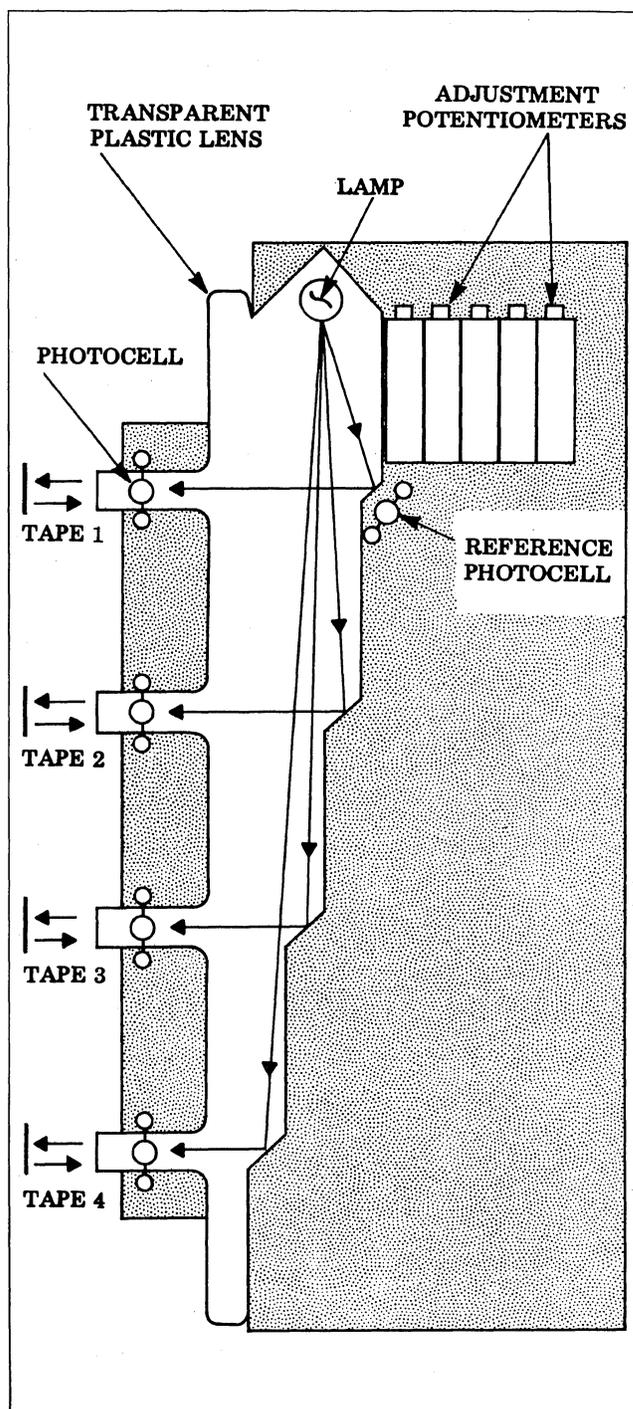


Figure 4-3. Photosense Assembly

LOAD-POINT SEARCH OPERATION

Each tape has a load-point sensor, PSN, the output of which is fed to Transport board 2 (schematic 10968). When the load-point marker on tape 1 is opposite its sensor, PSN1 is high and the LPA1 output of ML9-5

is also high. ML9 acts as a time delay (R36, C8) and a Schmitt circuit. When the marker moves away from the sensor, LPA1 goes low. PSN2 and LPA2 for tape 2 operate in the same way, using ML4.

LPA1 connects to the Regulator board (schematic 10790). The LPA1 signal is inverted by ML2-8 to provide the $\overline{T1LP}$ (tape 1 at load point) status indication. Assume that tape 1 is not at load point and that an LPSC (Load-Point Search command) for tape 1 is given. $\overline{LPSC1}$ goes low, setting flip-flop ML4-8. This causes ML7-8 ($\overline{T1SM}$, tape 1 in Search mode) to go low, making the $\overline{FWD1}$ and $\overline{T1BY}$ (tape 1 busy) lines go low on the Motion Control 1 board (schematic 10788). Tape 1 is driven until the load-point marker is sensed, making LPA1 high.

If tape 1 is then selected for a Read or Write operation, HSLD1 (magnetic head 1 selected) goes high, causing ML7-12 to go low, which makes ML5-6 (TSLP, tape selected is at load point) high. TSLP is used by the Motion Control board to generate a long start delay which allows the load point marker to pass the head before the first record is read or written. As tape 1 moves off load point, LPA1 goes low, making ML2-6 high. ML2-11, R6, R7, and C2 generate a negative-going pulse at ML7-5, which resets flip-flop ML4-8 so that TSLP will be low (for the generation of normal start delays for subsequent records on tape 1).

When the leading portion of the load-point marker is sensed again, additional data can still be written (or read) on the small length of tape remaining between the head and the sensor. If this is done, however, an LPSC *must* be given to set flip-flop ML4-8. The additional LPSC will not cause the tape to move, but assures that the next time the tape is started, the appropriate "long" start delay will be generated to allow the marker to clear the head before writing or reading.

LPA2, LPA3, and LPA4 signals are processed in a similar manner.

WRITE/READ START OPERATIONS

The start of tape motion for a Write or Read operation is controlled by the Motion Control 1 board (schematic 10788). Of particular importance is the control of Start delays: these differ in duration and depend not only on whether a Write or a Read operation is being initiated, but also on whether the tape is at Load Point or not when the operation starts. A *normal* Start delay occurs when the tape is *not* starting from Load Point and, in combination with the Stop delays, provides the inter-record gap on the tape. A *long* Start delay, however, is required when the tape starts at Load Point to allow time for the 3-inch-long Load Point marker to move past the magnetic head. The various time delays are listed in Table 4-2.

Table 4-2. Time Delay Adjustments

DELAY	WRITE	READ
Start (long)	375 msec	185 msec
Start (normal)	16 msec	9.5 msec
Stop	8 msec	4.75 msec

In following a Write Start operation, assume that when the \overline{WSTC} (Write Start command) is received, these conditions exist: tape 1 is selected but not already in a Read, Write, or Search mode; the tape is at Load Point; the cartridge Protect/Enable switch is set at Enable; and the cartridge is inserted in the upper slot. Under these conditions, ML16-8 goes low, setting flip-flop ML15-11 and making the \overline{WM} (Write Mode) line high (through ML22-8). The \overline{WSTC} pulse, through ML23-8, also sets the following flip-flops: ML11-6 (through ML24-8), ML12-11 (through ML7-3), and ML9-9. As a result, the $\overline{FWD1}$ lines goes low (through ML10-11 and ML10-8), causing tape 1 to be driven.

When the load point marker moves away from the Photosense assembly, photosense signal TSLP goes low, causing ML12-3 to go high, ML22-12 to go low, and Q1 to turn off. C2 then begins to charge through R9. After about 375 msec, C2 reaches +5 v, ML3 triggers, and the negative-going signal at ML8-12 resets flip-flops ML11-6 and ML12-11. Q1 turns on again through ML22-12, discharging C2, causing ML3-9 to go low, thus causing a positive pulse at ML8-2. At the trailing edge of the pulse, ML9-12 is set high (Timing Enable), turning on the sawtooth generator located on the Regulator board. The output of the sawtooth generator is fed out as a pulse train with a pulse repetition rate of 12 kHz which is used as the Write Clock. In this manner, the writing of the first record on the tape is initiated.

The Read Start operation (schematic 10788) is similar to the Write Start operation. It is initiated by the RSTC (Read Start) command; however, the long start delay is 185 msec when the tape starts from Load Point. The shorter delay is caused by lowering the trigger level of the sawtooth generator to 2.7 v by ML7-6 and R6. ML14-4 inhibits the RSTC pulse if the Read Amplifier Board is removed from the tape unit.

The normal start delays for Write and Read operations are generated whenever the tape is started from other than the Load Point position. These shorter delays are obtained by switching R7 (Write) or R8 (Read) in shunt with R9 to provide a faster charging rate for C2. Since the tape is not at Load Point, latch ML12-11 is not set by Start pulses, keeping ML12-3 high for Write or Read operations.

WRITE/READ STOP OPERATIONS

The stopping of tape motion during a Write or a Read operation is also controlled by the Motion Control 1 board (schematic 10788). Stop time delays are listed in Table 4-2. "Normal" start/stop time delays produce the inter-record gaps on the tape.

With the tape unit in the Write mode, the WSPC (Write Stop) command sets latch ML25-6. At the end of the Write Clock cycle, a Write Clock pulse at pin 10 generates the Write Stop Trigger through gates ML21-4 and ML6-3, setting latch ML11-6 and resetting flip-flop ML9-9 through ML6-6 and ML8-6. The FWD line goes high, stopping tape drive. Latch ML11-6 turns on the delay generators; but since ML8-4 is low, the trigger level is 2.7 v, giving a Stop time delay of 8 msec.

At the end of the delay, the pulse at ML8-2 generates the Mode Gate Reset pulse through ML6-11 and ML6-8, resetting the WSLD flip-flops. ML9-9 resets the Timing Enable Gate flip-flop ML9-12, which stops the Write Clock.

The Read Stop operation occurs in a similar manner. The Read Stop pulse coming in on pin 34 stops the tape

drive and initiates a 4.75-msec time delay. At the end of the delay, the RSLD flip-flops are reset and the Timing Enable Gate flip-flop ML9-12 is also reset.

For control of tapes 3 and 4, the WSLD and RSLD flip-flops and the FWD and HSLD gates are located on Motion Control 2 board (10968), with the start/stop signals derived from Motion Control 1 board.

Write Electronics

The Write Electronics consists of Write timing, data storage, shift register, phase encoder, and head driver circuits. Figure 4-4 is a block diagram of the Write operation, and Figure 4-5 is a timing chart showing Write timing signals for one record. The circuitry is located on the Timing & Data board and on the Transport board.

TIMING & DATA BOARD 10786-0

The Timing & Data board (schematic 10786-0) contains the data registers, binary counter, multiplexers, and timing circuits. The Write Drivers are located on Transport Board 1 and are described later.

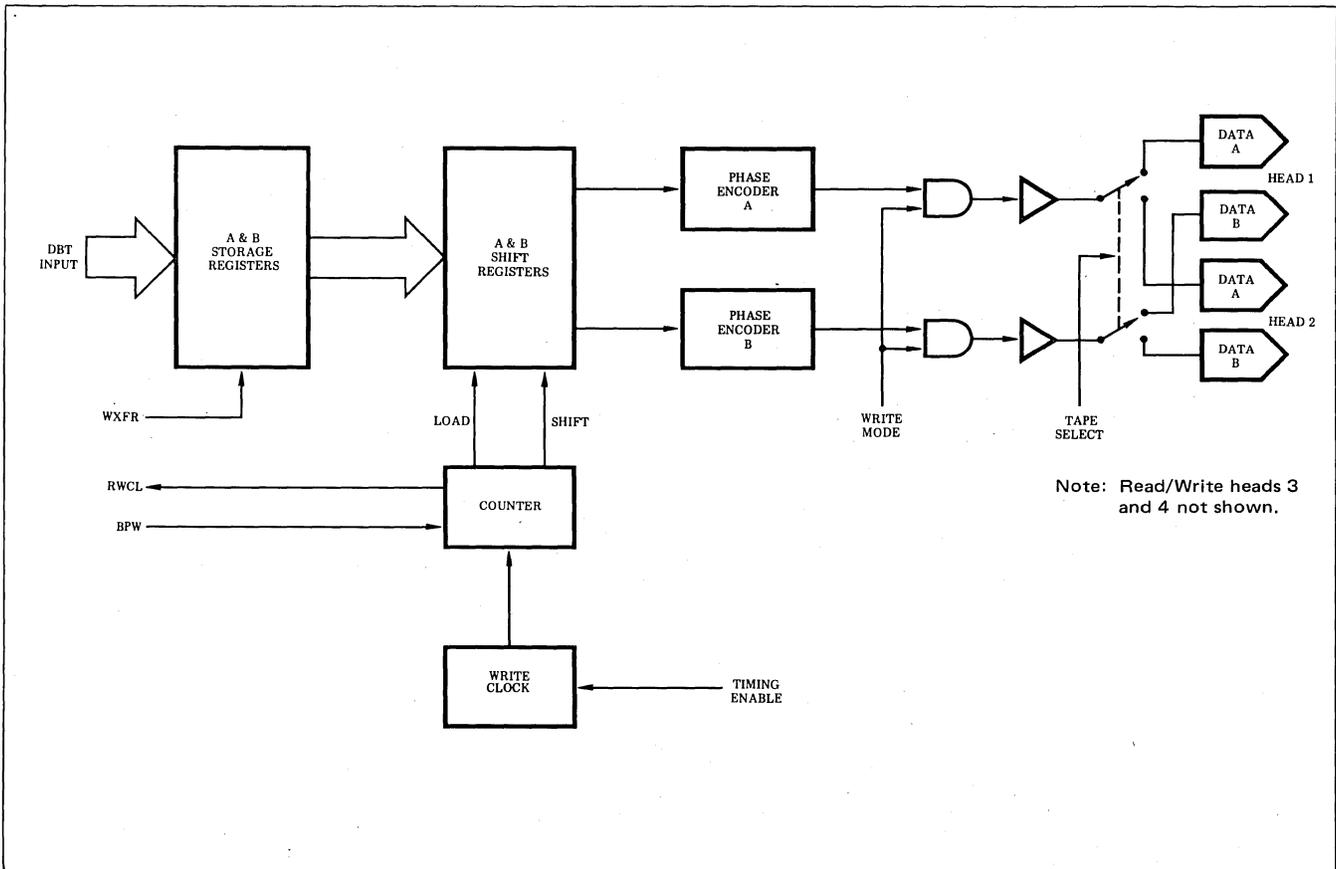


Figure 4-4. Write Operation Block Diagram

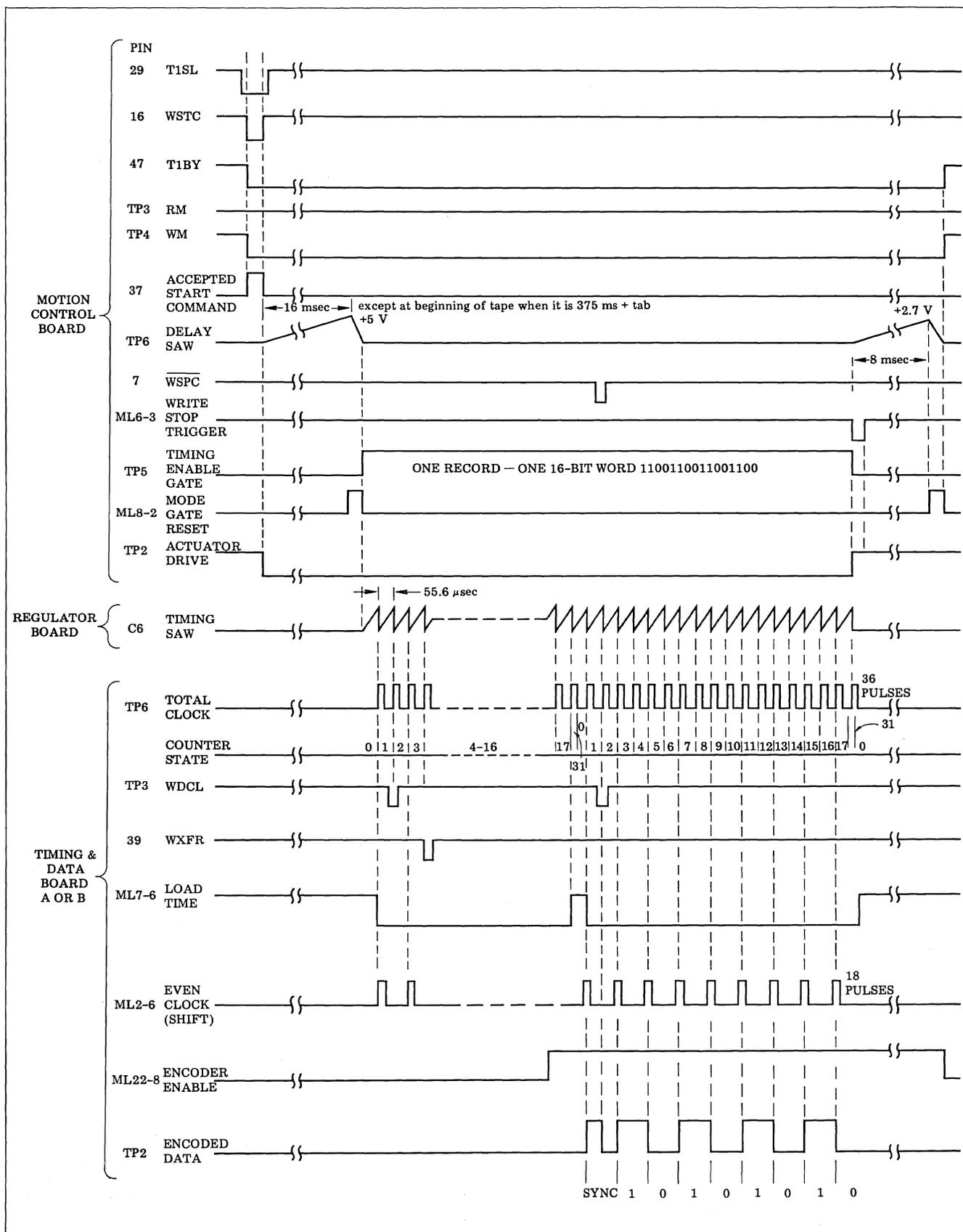


Figure 4-5. Write Timing Diagram

Assume that a WSTC (Write Start) command has been received and that, after the appropriate Start delay, the Timing Enable gate (Motion Control 1 Board) has started the sawtooth generator so that Write Clock pulses are appearing at pin 13 of the Timing & Data board. Also, the bits-per-word selection is BPW16, i.e., pins 11 and 12 are high.

The Write Clock pulses generate Total Clock pulses through ML6-12 to drive the counter (ML17, ML18, ML19) and to transfer data into the shift register (ML3, ML8, ML13). The shift action is gated at ML1-8 by the 1 state of the counter so that shift pulses occur only for even states of the count.

The five-stage binary counter has a modulus of 18 for BPW16, 14 for BPW12, and 10 for BPW8. For BPW16, the output at ML1-6 is maintained high; when the counter reaches state 17, ML1-6 goes low and the leading edge of the 18th clock pulse sets the 2, 4, 8, and 16 counter states to 1 through ML11-6, making the counter state 31. The trailing edge of the 18th clock pulse changes the counter state to 0. For BPW12 (or BPW8), a similar action is involved with ML12-6 (or ML6-8) at counter state 13 (or 9). Also, at the start of each record, the counter is reset by a pulse from ML16-8, originating as the Accepted Start command.

The counter states are decoded to produce the following timing pulses: WCAL by gating counter state 1 with the Write Clock pulse at ML23-6; Write Clock \cdot 31, by gating counter state 31 with the Write Clock pulse at ML16-3; and Load time, by counter state 0 at ML23-8. At the start of a record, the counter cycles once before allowing the Write cycle to begin. The Encoder Enable latch ML24-3 is set at the end of this first cycle.

The data bits (DBT) are clocked into the quad-latch storage registers ML10 and ML9 on receipt of the \overline{WXFR} (transfer) pulse, which is gated out through ML23-6. During the Write operation, Tri-Level gates ML5 and ML15 are kept off since ML2-12 is kept low.

The Load pulse (ML24-8) then transfers the data into the shift register (ML3, ML8, ML13); and the Shift pulse (ML1-8) transfers the data sequentially into the phase encoder (ML21-6, ML17-15) to produce the serial phase-encoded data for the magnetic head. The output of the shift register (ML3-10) is fed to the J and K inputs of flip-flop ML17-15, which is conditioned by the odd/even state of the counter at ML20-6. At Data time, the Write Clock pulse at an even counter state sets the J-K to the data value at ML3-10. (The trailing edge of this pulse shifts the data in the shift register.) At half-cell times, the Write Clock pulse for odd counter states sets the J-K to the opposite of the data value at ML3-10, which now has the next data value. At Sync times, the bit value at ML3-10 is always 1, so the Write Clock pulse sets the J-K to the 1 state.

Input data bits are loaded into the shift register at the trailing edge of the Load pulse. Both the Q and \overline{Q} outputs of ML17-15 are used for switching the Write Driver amplifiers (located on the Transport board).

WRITE DRIVERS

The Write Drivers are located on the Transport board (schematic 10976). Each channel has its own driver circuit. A head select circuit switches Head 1, 2, 3, or 4 into that circuit, depending on the state of the HSLD signals, which are derived from the tape select and Read/Write start command logic of the Motion Control boards. With HSLD 2, 3, or 4 high, Head 2, 3, or 4 is selected. If HSLD 2, 3, and 4 are low, Head 1 is selected.

With HSLD 2 high, head 2 is selected as follows. ML3-12, ML1-8, and ML3-10 are low, keeping Q9, Q11, and Q15 off. ML3-8 goes high, turning Q13 on, which turns Q5 and Q6 on, switching in Head 2 channel A and B coils. Since both Write channels operate in the same way, only channel A is described.

Phase encoded data are fed in as DATA A (pin 16) and $\overline{DATA A}$ (pin 18). If DATA A is high and $\overline{DATA A}$ is low, ML6-8 switches on, turning Q10 on, which drives current left to right through head coil A and to ground through R25 and CR17. ML6-5 is switched off, keeping Q26 off. For the opposite case (DATA A low and $\overline{DATA A}$ high), ML6-5 switches on, turning Q16 on, driving current right to left through the head coil A and to ground through R31 and CR21. ML6-8 is switched off, keeping Q10 off.

Read Electronics

The Read Electronics contains the Read Amplifier, peak detector, clock, error detection, shift register, and data storage circuits. Figure 4-6 is a block diagram of the Read operation; Figure 4-7 is a timing chart indicating Read timing signals for one record. The circuitry is located on three boards: Read Amplifier, Timing & Data, and Transport 1.

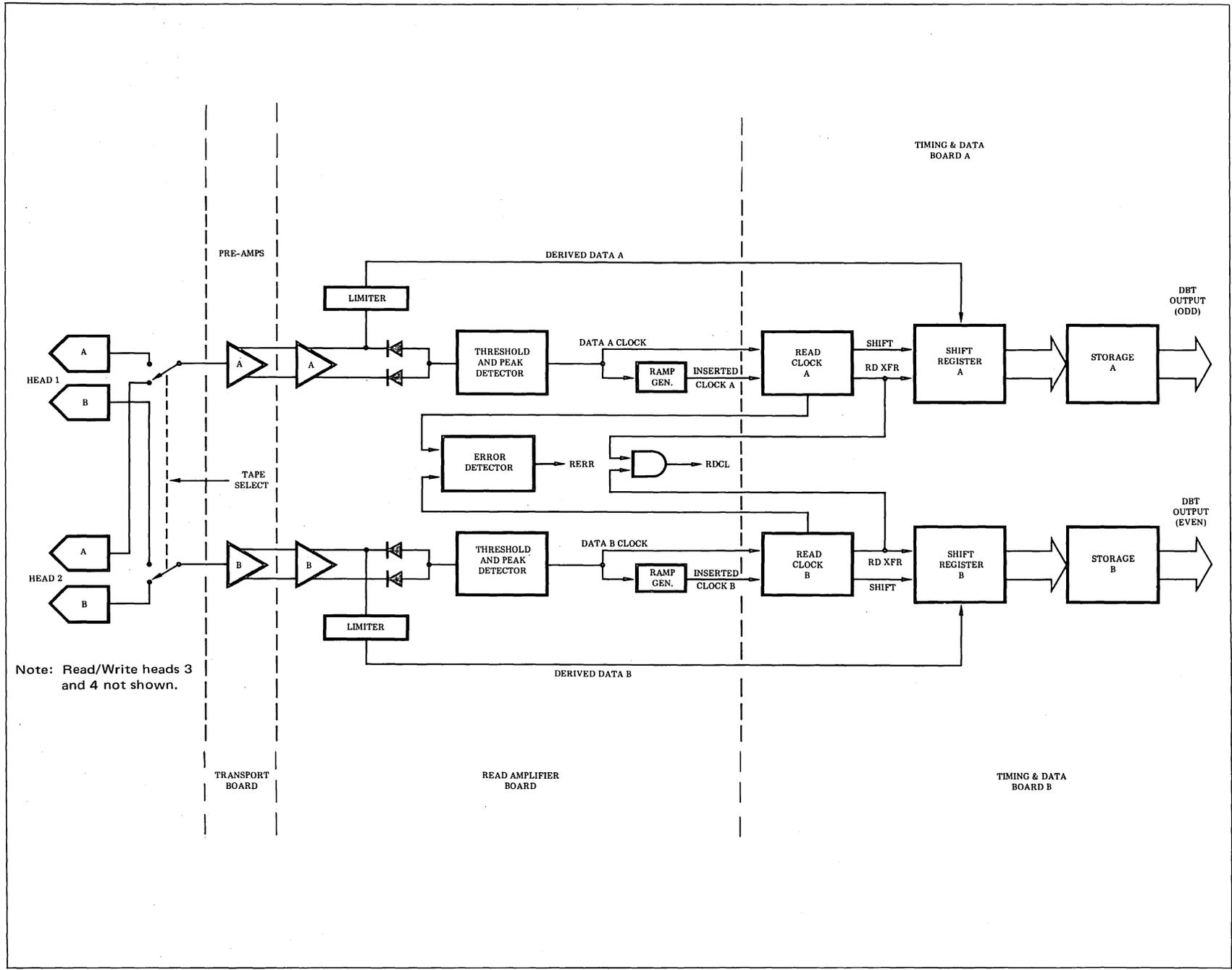
READ PREAMPLIFIERS

The Read preamplifiers are located on the Transport board 1 (schematic 10976). ML5 (channel A) and ML4 (channel B) are differential preamplifiers which sense the data signals from the magnetic heads. The outputs, Preamp, and \overline{Preamp} , are transferred to the Read Amplifier board for further processing.

READ AMPLIFIER BOARD 10746-1

The Read Amplifier board (schematic 10746-1) operates with data signals from the Read Preamplifiers (Transport 1 board) and in conjunction with the Timing & Data board. Read channels A and B operate in the same way; only channel A is described below.

Figure 4-6. Read Operation Block Diagram



Note: Read/Write heads 3 and 4 not shown.

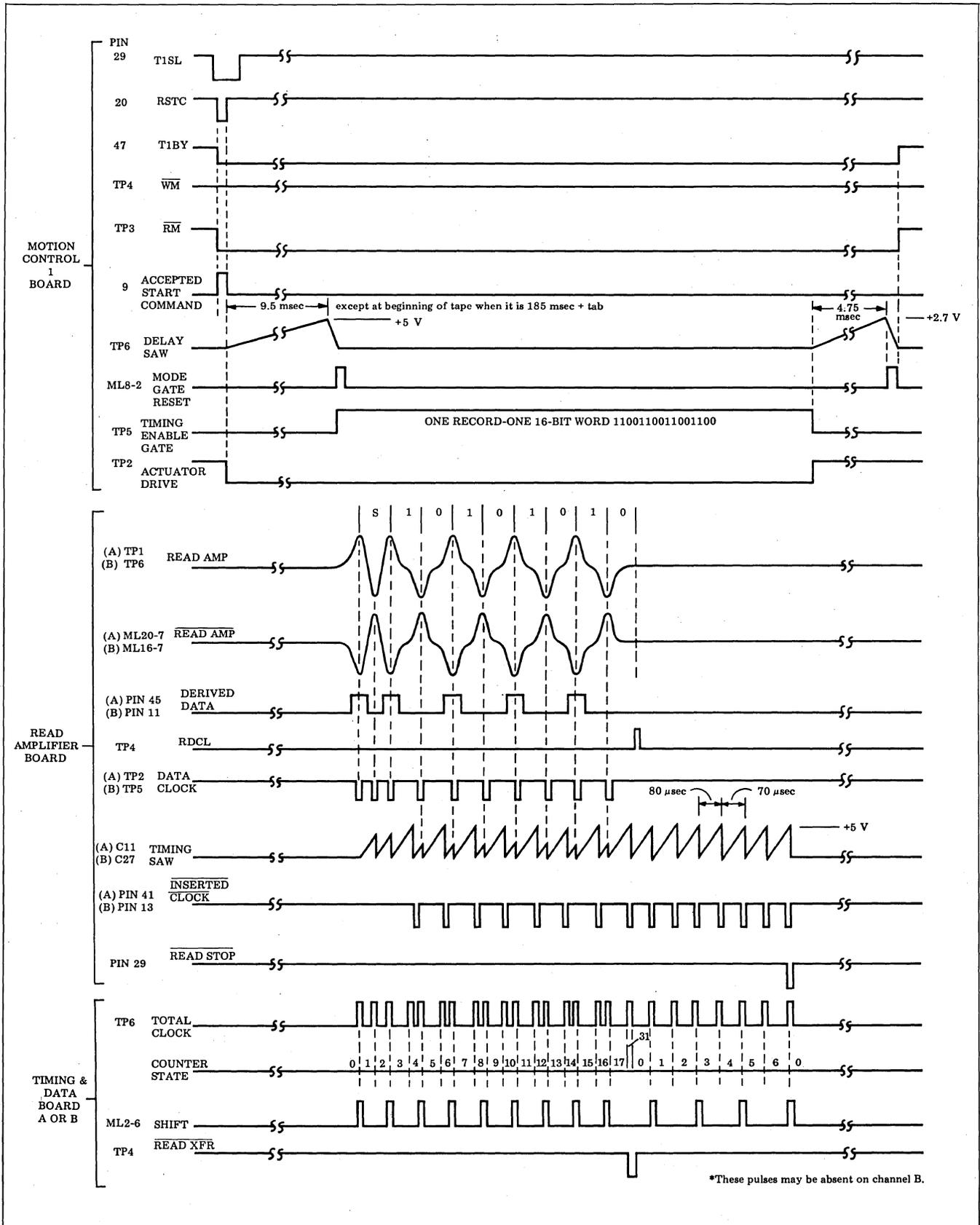


Figure 4-7. Read Timing Diagram

The preamplified data signals are applied to the Read Amplifier board at pins 49 and 47 and are amplified further by a combination of two amplifiers (ML20). The outputs of ML20 are the Read Amp and Read Amp signals, which are identical except that Read Amp is 180° out of phase with Read Amp. The ML20-7 output is fed to a limiting circuit consisting of R18, CR5, Q1, and R19 to produce the Derived Data output at pin 45 (high for a 1 data transition and low for a 0 data transition).

The negative-going portions of the ML20 outputs are fed through CR1 and CR2 to a 1.5-v threshold circuit, R9 and R10. Data signals exceeding 2 v are transferred to the peak detector circuit (ML19). This circuit is essentially a differentiator followed by a limiter, with the output clamped to +3.5 v and -0.7 v. The RC circuit consisting of C10, R16, and R17 together with ML15-6 produces a positive pulse when the output of ML19 goes negative, corresponding to a peak of the Read waveform. This pulse is ANDed at ML8-8 with the Read Enable signal from ML10-11 to produce the Data Clock signal at pin 43.

Data-derived clock pulses are used to synchronize a sawtooth generator to the timing information from the tape. The first data-derived clock pulse sets ML9-6, a latch which turns on the sawtooth generator (Q2, R20, R21, C11, ML14). The timing sawtooth generates the Inserted Clock pulses when there are no half-cell transitions on the tape.

Comparator ML14 triggers at about +5 v, and a positive pulse appears at ML10-6 to drive a three-stage binary counter (ML5 and ML4-12). The decoded output of the counter is gated with the input pulse to produce the Read Stop pulse at pin 29 when the counter state is 6. This occurs when no more clock pulses are derived from the tape. In effect, the inter-record gap produces the Read Stop signal. The counter is reset to 0 by the data-derived Read Clock.

Error detection is conditional on the counter state being out of synchronization with the data-derived Read Clock. If the counter is in an even state (pin 31 high) at the time of an Inserted Clock pulse, J-K flip-flop ML4-9 is set to 1; at the end of the data word, the Read Transfer (RDXFR) pulse at pin 39 transfers this error signal through ML3-8 to ML10-8 to provide the Record Error

(RERR) status signal (pin 37). The flip-flops are reset at the start of the next record by the Accepted Start Command pulse at pin 23.

The RDCL (Read Data Clock) pulses are generated on the Read Amplifier board by J-K flip-flops ML2-12 and ML3-12. The Read Transfer B (RDXFR B) pulse sets ML2-12 to 1; RDXFR A sets ML3-12 to 1. When both flip-flops are set to 1, ML7-3 goes low and causes the flip-flops to reset, after a short delay, through ML9-8 and ML7-6. The RDCL pulse exits at pin 25 for use in the system. The Read operation is affected next by the Timing & Data board.

TIMING & DATA BOARD 10786-0

The Data and Inserted Clocks (pins 7 and 22) are combined on the Timing & Data board (schematic 10786-0) at OR gates ML6-12 and ML1-3 to produce the Total Clock and Read Clock signals. The Total Clock drives the five-stage binary counter (described under Write Electronics, Timing & Data board). Shift pulses for shift registers ML3, ML8, and ML13 are generated by gating the Total Clock with even counter states at ML1-8.

The serially derived data (pin 15) from the Read Amplifier board are fed into the shift register at ML8-1 (for 16-bit words), at ML13-1 (12-bit words), or ML3-1 (8-bit words). The gating action is controlled by the AND/OR logic of ML21-8 and ML11. The data bits are sequentially shifted in the register by the shift pulses which occur at data times.

After the derived bits are completely assembled in the shift register, they are transferred to the quad-latch storage registers ML4 and ML14. The Read Mode signal (pin 17) is high, enabling Read data to exit through the Tri-Level gates ML5 and ML15 to the DBT lines. At the counter state 31 (the end of a cycle), a Read Clock pulse at ML22-3 generates the Read Transfer (RDXFR) pulse, which in turn generates the Transfer-to-Storage pulse at ML16-6: the data bits transfer into the storage register and are then available in parallel as DBT outputs.

Interface Electronics

Operation of the interface circuitry is presented in the separate INTERFACE section.

SECTION V

MAINTENANCE

INTRODUCTION CartriFile tape units were designed and built with care to provide long, trouble-free usage; they have demonstrated remarkable reliability under varying conditions of service. To keep the CartriFile tape unit operating efficiently, a program of periodic servicing is recommended.

This section is divided into five parts to help service the CartriFile tape unit with a minimum of effort: Daily Maintenance, Yearly Maintenance, 3-Year Maintenance, Magnetic Head Maintenance, and Troubleshooting. As their headings imply, Daily, Yearly, and 3-Year Maintenance contain those procedures which are to be performed at regular intervals. Magnetic head maintenance is handled separately: the head assembly should be trouble-free for at least 2000 hours of operating time; however, procedures for checking and aligning the heads and for checking head wear are included. Troubleshooting information is presented in table form, listing possible fault conditions and what to investigate should a malfunction occur.

Table 5-1 is a check list keyed to the maintenance intervals, including the tools and test equipment required. The maintenance time intervals are based on an operating time (tape in motion) of about 8 to 16 hours per week. If usage is significantly higher, shorten the time intervals between servicing accordingly. When servicing the tape unit, perform all of the procedures listed for that time interval and follow the sequence in which the procedures are given.

Table 5-1. Maintenance Schedule

INTERVAL	RECOMMENDED MAINTENANCE	TOOLS AND EQUIPMENT REQUIRED
Daily	Clean head and capstan	Cotton swab, Freon solvent or alcohol
Yearly	Lubricate capstan motor Replace drive belt, indicator lamps, photosense lamp Check and adjust actuator Check and adjust electronics Check head alignment	Shell #33 infusion oil Component Parts Kit 10691 0.012-inch and 0.005-inch feeler gauges, 3/16-inch open-end wrench, 0.062-inch Allen wrench, oscilloscope, scratch cartridge Oscilloscope, scratch cartridge, CartriFile Exerciser or on-line system access Oscilloscope, Tri-Data Standard Alignment Tape 10720-3, 0.050-inch Allen wrench
3 years	Replace capstan motor Replace capstan assembly Replace cooling fan Perform complete Yearly Maintenance procedures Check for head wear	Soldering iron, 0.050-inch and 9/64-inch Allen wrenches, Motor Replacement Kit 10692 7/16-inch open-end wrench. Capstan/Flywheel Assembly 10043-3 Soldering iron, screwdriver, Fan Assembly (Tri-Data 00097-005)
5 years	Factory reconditioning: replace head assemblies, actuator assemblies, cartridge detent assembly, capstan motor, capstan bearings, capstan, sensing switches, and power relay. Provide complete checkout and alignment.	

DAILY MAINTENANCE

Every day, before using the CartriFile tape unit, the head and capstan should be cleaned to remove loose oxide, dust, or other contaminants. Use cotton swabs and Freon solvent (Miller-Stephenson Chemical Co., MS-180 Freon TF Degreaser) or denatured alcohol. Occasional cleaning of the photosense lens is also recommended.

1. Remove the cartridges. Grasp the front panel, and pull it outward to remove it.
2. Moisten a cotton swab with solvent. Reach through the cartridge slot and clean the visible surfaces of the head.

3. Apply power to the tape unit. While the capstan rotates, hold a cotton swab moistened with solvent against it. Lightly scrub the capstan from top to bottom.
4. Snap the front panel in place.

YEARLY MAINTENANCE

The "yearly" maintenance procedures given below should be performed when the CartriFile tape unit has accumulated somewhere between 400 and 800 hours of operating time (tape in motion). The procedures should be followed in the order given: this sequence provides an orderly and thorough checkout in a minimum amount of time. Replacement parts for three Yearly Maintenance procedures are included in the Component Parts Kit 10691.

Begin the maintenance procedures by removing the cartridges and front panel. Clean the head and capstan, then perform all of the procedures given below.

After completing the yearly maintenance procedures, refer to MAGNETIC HEAD MAINTENANCE and check the alignment of the head assembly.

Capstan Motor Lubrication

1. Remove the transport retaining screw under the lower right-hand end of the transport and swing the transport out of the cabinet.
2. At the bottom of the motor, directly across from the mounting flange is an oil hole. Directly above this, at the top end of the motor is a second oil hole. Squirt a small quantity of oil into each hole. Wipe off any excess around the outside of the holes.

Drive Belt Replacement

1. Remove the old drive belt, disengaging it first from the groove in the small pulley.
2. Install a new drive belt (Tri-Data part no. 00007-002). Place it in the groove around the large pulley, then stretch it gently and engage the groove in the small pulley.

Lamp Replacement

1. Remove power from the tape unit.
2. Remove the Busy Lamp board mounting screws and swing board on harness for rear access.
3. Swing the spring clips aside and replace the four busy lamps (two upper and two lower) with type 328 (Tri-Data part no. 00041-004), and power indicator lamp with type 327 (Tri-Data part no. 00041-009). Install the red boot on the power indicator lamp.
4. Return the spring clips to their original position.

5. Return the Busy Lamp board to its original position and secure with the mounting screws.
6. Swing the transport out. The Photosense board is on the right rear of the transport. Unsolder the photosense lamp, and replace it with type 2162 (Tri-Data part no. 00041-007).
7. Solder new lamp in place, and trim excess leads.
8. Swing the transport into place and secure with the retaining screw.

Actuator Adjustment

1. Swing the transport out. With the actuator de-energized, check the gap (see Figure 5-1) with shim stock or 0.012-inch feeler gauge. Adjust backstop screw to obtain this setting (3/16 wrench).

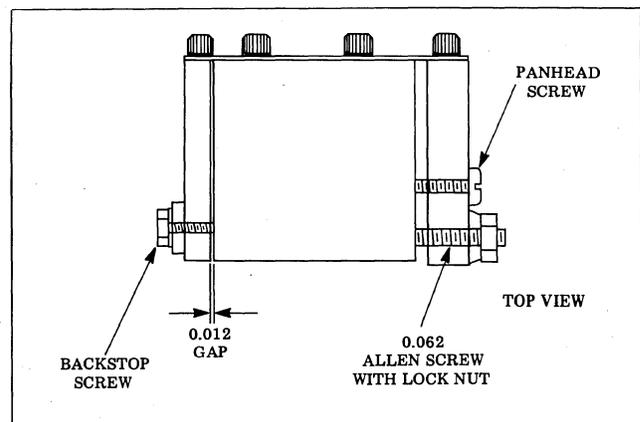


Figure 5-1. Actuator Adjustment Points

2. Place a 0.005-inch shim in the gap for tape 1.
3. Place a cartridge of the shortest length available that has been written continuously from Load Point to Load Point.
4. Read Start the tape and check TP6 of the Read Amplifier board for data coming off tape. The signal should be approximately 19 v pk-pk and on the verge of dropping out (see Figure 5-2).

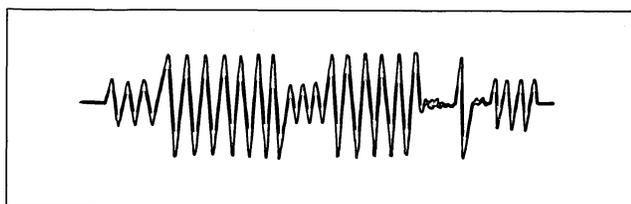


Figure 5-2. Read Amplifier TP6

5. To obtain these results, loosen lock nut on Allen screw, and adjust the Allen screw in conjunction with

the panhead screw, keeping in mind that the panhead must end up a tight fit against the housing.

6. Stop reading and remove the 0.005-inch shim. Read Start again. The data should be a constant-amplitude signal.

Electronics Checkout and Adjustment

The location of all circuit boards, connectors, and terminal boards are shown in Figure 5-3. All of the boards within the card file plus the Transport board contain test points, adjustment points, or both. If desired, timing and waveform diagrams for each circuit board may be consulted during the checkout procedures; these diagrams are Figures 5-9 through 5-16, which are arranged in numerical sequence by circuit board number.

All of the electronic checkout procedures assume access to the on-line system. Electronics adjustments may, however, be performed without on-line access through the use of the Tri-Data CartriFile Exerciser, Model 4092.

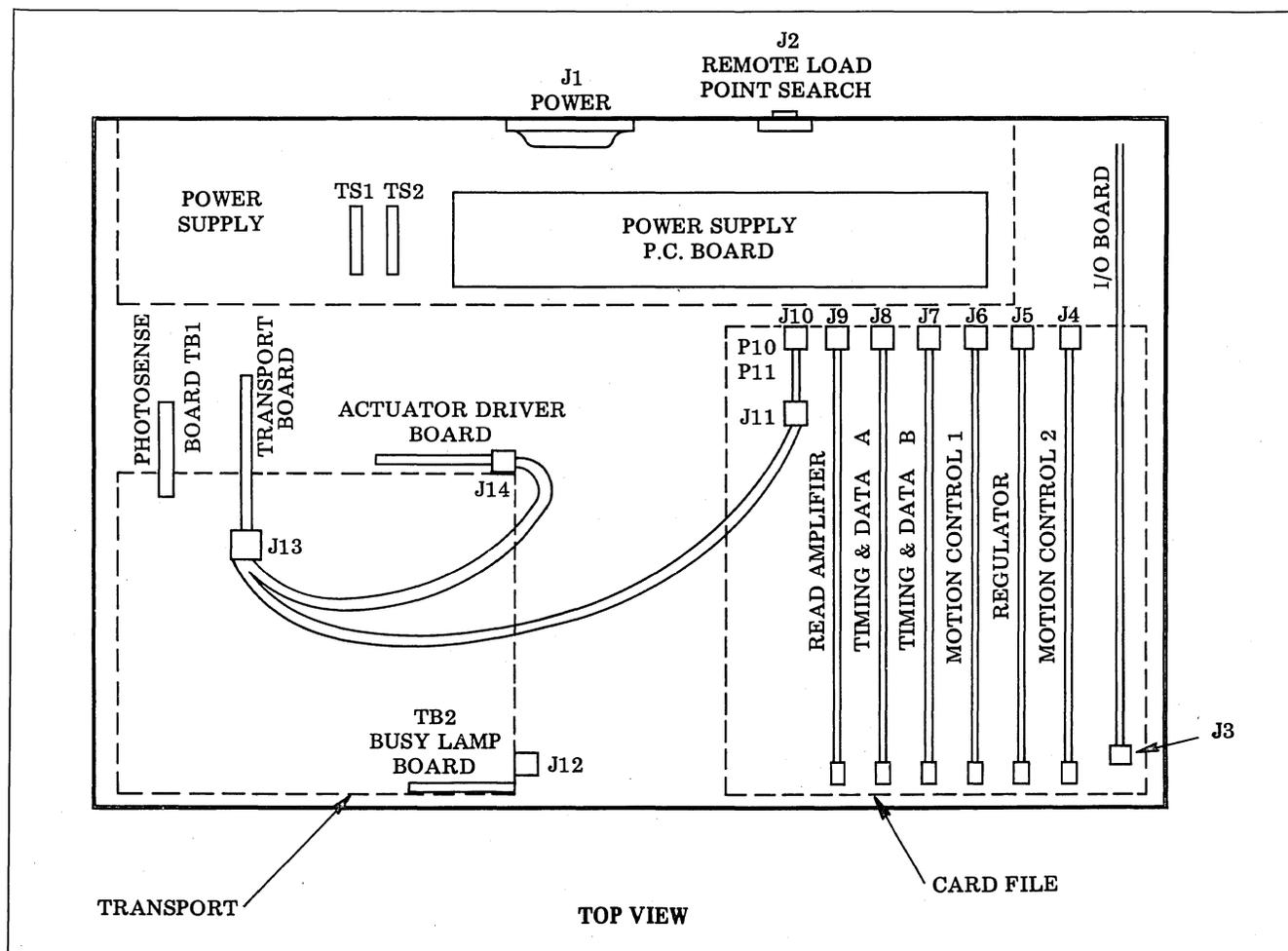


Figure 5-3. Location of Electronics Assemblies, Connectors, and Terminals

CAUTION

Avoid shorting out IC's and other circuit components. NEVER remove or install a printed circuit board while power is applied to the tape unit.

NOTE

If difficulty is encountered in adjusting the electronics (i.e., certain voltages given in the procedures cannot be obtained), the problem may be caused by a faulty component on a circuit board. Isolate the faulty component and replace it using normal circuit board repair procedures.

REGULATOR BOARD 10790-0

Measurements must be made with a d-c VTVM capable of $\pm 1\%$ accuracy and while the tape unit is in operation. All measurements are referenced to ground at TP6.

1. Measure the voltage at TP3. If the reading is not $+15 \pm 0.5$ v, adjust R13.
2. Measure the voltage at TP4. If the reading is not $+5 \pm 0.2$ v, adjust R20.
3. Measure the voltage at TP5. If the reading is not -15 ± 0.5 v, adjust R16.
4. Set the oscilloscope time base to $10 \mu\text{sec}/\text{cm}$ and the vertical display to 2 v/division. Set the triggering mode to INT DC POS.
5. Using a scratch cartridge, write long records on the tape.
6. Observe the waveform at TP6 of the Timing & Data board 10786. The sawtooth timing from the start of one pulse to the start of the next pulse should be $55.6 \pm 2.5 \mu\text{sec}$. Adjust potentiometer R27 to the correct timing.

READ AMPLIFIER BOARD 10746-1

1. Turn the tape unit power off. Place the Read Amplifier board on the extender board for access to terminals in this procedure, then apply power to the tape unit.
2. Set the oscilloscope time base to $20 \mu\text{sec}/\text{cm}$ and the vertical display to 2 v/division. Set the triggering mode to INT DC NEG.
3. Ground terminal A (use TP6 on the Regulator board).

4. On the Timing & Data board for channel A, observe the waveform at TP1. The waveform should be a series of negative pulses with the time interval between pulses alternating between $80 \pm 2 \mu\text{sec}$ and about $70 \mu\text{sec}$. Adjust the longer time interval to $80 \pm 2 \mu\text{sec}$ with potentiometer R21 on the Read Amplifier board. (The $70 \mu\text{sec}$ interval is not critical.)

5. Repeat step 4 for TP1 on the Timing & Data board for channel B, grounding terminal B and adjusting potentiometer R48 on the Read Amplifier board.

6. Remove the ground jumper.

7. Insert a scratch cartridge and write short records with a 00110011... sequence.

8. Set the oscilloscope time base to 0.1 msec/cm and the vertical display to 5 v/division. Set the triggering mode to INT DC POS.

9. Read the tape and observe TP6 on the Read Amplifier board. The data signal should be 19 ± 3 v pk-pk. Adjust R3 to obtain the correct reading.

10. Repeat step 9, observing TP5 and using R29 for adjustment.

11. Turn off the tape unit power and install the Read Amplifier board in the card file.

PHOTOSENSE BOARD 10972-0

1. Set the oscilloscope time base to 1 msec/cm, and the vertical display to 1 v/division. Set the triggering mode to auto, free run.

2. Insert scratch cartridges and bring all tapes to Load Point.

3. Set the voltage at TP5 on the Actuator Driver board to 9 or 9.5 v using R12 on the Photosense board.

4. Set R13 through R16 on the Photosense board to maximum and determine which channel has the least gain (TP2 through TP5). This channel will be adjusted first.

5. Set the weak channel's potentiometer to mid-position. Adjust R12 such that this channel switches from 4 v at Load Point to less than 1 v off Load Point. After obtaining the proper R12 setting, do not adjust it further.

6. Adjust the remaining three channels, using each channel's potentiometer only. The associated test point voltage for each channel should be greater than 3.5 v on-tab and less than 1 v off-tab.

7. After adjusting all channels, check that the voltage at TP5 on the Actuator Driver board is not higher than about 12 v.

8. If the TP5 voltage exceeds 12 v, check the regulator circuit, photo-transistors, and photosense lamp for a faulty components.

3-YEAR MAINTENANCE

When the CartriFile tape unit has accumulated 1200 to 2400 hours of operating time (the approximate average range of usage in three years), the capstan motor, capstan, and cooling fan should be replaced. Procedures for the replacement of these items are given below. Parts required are the Motor Replacement Kit 10692, Capstan/Flywheel Assembly 10043-3, and a Fan Assembly (Tri-Data part no. 00097-002).

Perform the replacement procedures below first, then perform the YEARLY MAINTENANCE procedures in their entirety. After completing the yearly procedures, refer to MAGNETIC HEAD MAINTENANCE and check the head assembly for wear.

Capstan Motor Replacement

1. Remove the cartridges, front panel, and a-c power cord.
2. Remove the transport retaining screw, and swing the transport out of the cabinet.
3. Remove the drive belt, disengaging it first from the groove in the motor pulley.
4. Using a 0.050-inch hex key, loosen the two set screws in the motor pulley. Remove the pulley.
5. Trace the two leads from the motor and locate the point at which they connect to a plastic connector. Disconnect the connector.
6. Using a 9/64-inch hex key, remove the four socket-head cap screws with lockwashers which pass through the transport side and secure the motor.
7. Remove and discard the motor.
8. Mount the new drive motor using the hardware removed in step 6. Connect the plastic connectors.
9. Install the pulley removed in step 4 on the motor shaft. Note that this pulley has two grooves: the larger diameter is for 50-Hz operation, the smaller for 60-Hz operation. The pulley must be placed on the shaft so that the desired groove is closest to the motor. Align the appropriate pulley groove with the groove in the capstan flywheel. Tighten the setscrews securely.

Capstan Assembly Replacement

This procedure assumes that the capstan motor has just been replaced and continues with the drive belt not yet installed.

1. Grasp the flywheel and hold it firmly. Using a 7/16-inch end wrench, loosen the self-locking nut on the top of the capstan shaft.

2. Remove the nut and the washer beneath it. Withdraw the capstan/flywheel from the bottom of the transport.
3. Place the old spacer on the shaft of a new 10043-3 capstan/flywheel. Slide the spacer all the way down the shaft until it seats against the flywheel.
4. Insert the capstan/flywheel shaft into the bearing at the bottom of the transport. Slide it upwards, guiding it through the upper bearing. Care should be taken that no damage occurs to the plastic-coated surface of the shaft.
5. Place the old washer on the top of the shaft.
6. Install the self-locking nut on the top of the shaft.
7. Insert a 0.002-inch shim between the upper bearing and the washer. Grasp the flywheel below the transport and tighten the self-locking nut at the top until the shim is just held snugly. Remove the shim and tighten the nut one-eighth additional turn.
8. Install a new drive belt (Tri-Data part no. 00007-003). Place it in the groove around the flywheel, then stretch it gently and engage the groove in the small pulley.
9. Swing transport into place and fasten.

Cooling Fan Replacement

The following steps assume that the tape unit is in normal operating position and viewed from the rear.

NOTE

Certain systems include interface cables and components which project outward from the rear panel, preventing it from pivoting on its hinge. The interfering components must be removed before proceeding with the steps below. Refer to the separate INTERFACE section of this manual for interface installation instructions.

1. Unplug the power cord from the rear panel.
2. Remove the two No. 6 panhead screws, lockwashers, and flat washers at the left-hand edge of the rear panel. The rear panel may now be pivoted out.
3. Locate the black plastic protective cover with the CAUTION note. Withdraw the two No. 4 panhead screws, lockwashers, and flat washers. Remove the cover.
4. Two terminal strips are now exposed, as shown in Figure 5-4. The terminal strip on the left is TS2, the other is TS1. Terminals are numbered 1 through 4 consecutively, with terminal 1 nearest the rear panel.
5. Carefully holding wires away from the area, unsolder each of the leads connecting the fan to the terminal strips.
6. Using a screwdriver, remove the four screws which secure the fan and guard. Discard the fan.
7. Install a new cooling fan (Tri-Data part no. 00097-005).
8. Dress the leads of the new fan to the terminal strips: brown to TS2-1, blue to TS2-2, and yellow to TS1-4.
9. Solder the leads to the terminal strips.
10. Install the black plastic cover using the hardware removed in step 3.

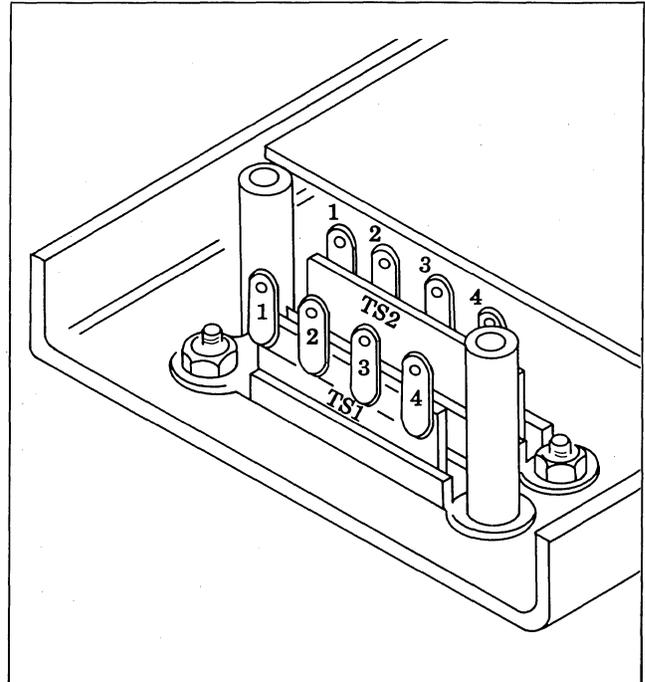


Figure 5-4. Power Supply Terminals

11. Swing the rear panel in and secure in place with the hardware removed in step 2.
12. Install any interface components removed. Connect the power cord.

MAGNETIC HEAD MAINTENANCE

The CartriFile 40 tape unit contains four read/write magnetic heads mounted as an assembly, with the heads capable of separate vertical and azimuth adjustment. The alignment of the heads can be checked once a year following the electronics checkout and adjustment procedures. The heads should also be checked for wear at about three years, in case replacement is required at that time.

Head Alignment

Correct head alignment is crucial to the reliable interchange of cartridges between tape units. Vertical alignment ensures that the active track on the head will be properly registered with the track location on the tape. Azimuth alignment produces minimum skew between the data tracks.

Normally, there should be no need for realignment during the life of the head assembly. The adjustments are sealed at the factory, and further adjustments *should not be attempted* unless there is a definite indication of misalignment.

A dual-trace oscilloscope is required to check for proper alignment of the head. However, if a misalignment is indicated by the check, it will be necessary to use the

Tri-Data Standard Alignment Tape (part no. 10720-3) to isolate the misalignment to one tape unit (where several are in use) and to realign the head.

1. Connect the A and B oscilloscope channels to TP6 and TP5 of the Read Amplifier board. Sync the oscilloscope from TP5 of the Motion Control 1 board. Set the gain to 5 v/division (0.5 v/division for a 10:1 probe), horizontal sweep time to 5 msec/division, and EXT sync. The start period and data block will be displayed.

2. Observe channel A while reading a tape written in blocks of the bit pattern 101100110011. Raise the gain to 1 v/division and center the trace so that the start period is centered vertically. Vertical misalignment will be indicated by a signal in excess of 0.5 v pk-pk during

the start period preceding the data block. This signal may not be continuously present, so observe the display for at least 15 seconds.

3. Repeat step 2 for channel B.
4. If these tests indicate vertical misalignment, the error may be caused either by the tape unit on which the tape was written or by the tape unit reading the tape. The Standard Alignment Tape must then be used to isolate the faulty tape unit. If, when using this tape, the signal preceding the data block exceeds 0.5 v pk-pk the vertical alignment is definitely faulty.
5. To check azimuth alignment, use the same oscilloscope connections and settings as for the vertical alignment check, except that the display should be set to "chopped" and the polarity of one channel should be inverted. Observe the simultaneous display of both channels.
6. If the amplitude of both channels is not the same, reduce the amplitude of the larger signal with the oscilloscope gain control until both channel amplitudes are approximately equal.
7. Set the display to A-B. At the test points of the Read Amplifier board, the data from the two tape channels will be of the same polarity, except for the

first bit. If the two signals are of the same amplitude and waveshape and are exactly in phase, the data portion of each word will cancel and the out-of-phase portion will add, producing a presentation similar to Figure 5-5a. Adjust both oscilloscope channel voltages to obtain maximum cancellation of data. (Perfect cancellation will not occur because of minor variations in amplitude, waveshape, and head azimuth alignment.

8. If the alignment is poor, a presentation similar to Figure 5-5b will appear. If the "grass" between the pulses reaches the level of the negative pulses, an error will occur; if the "grass" exceeds about one-third of this level, a potential azimuth alignment problem exists and should be corrected. Again, to be sure that the tape unit under test is the one actually causing the error, this test must be performed using the Standard Alignment Tape.

NOTE

If the tests above indicate misalignment, returning the CartriFile tape unit to the factory for realignment is recommended. The realignment can be attempted by following the procedure below; however, the adjustments interact and several cycles of "test and adjust" may be required before proper alignment is obtained.

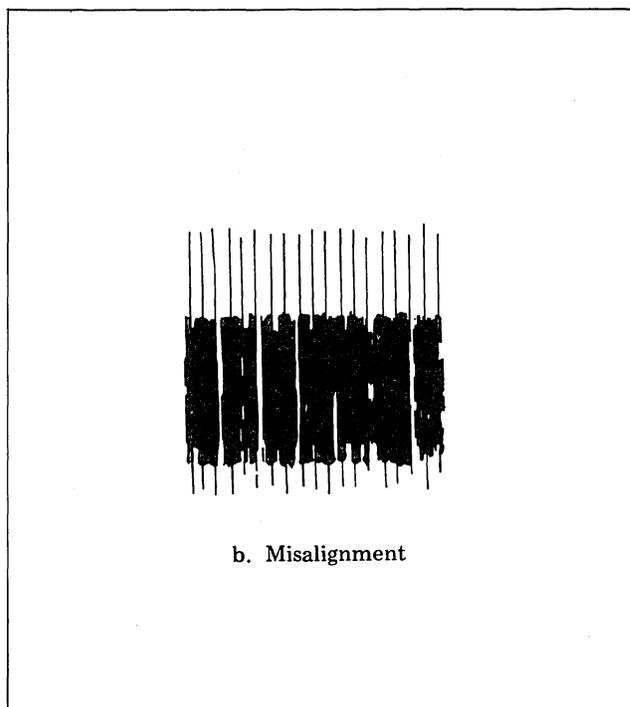
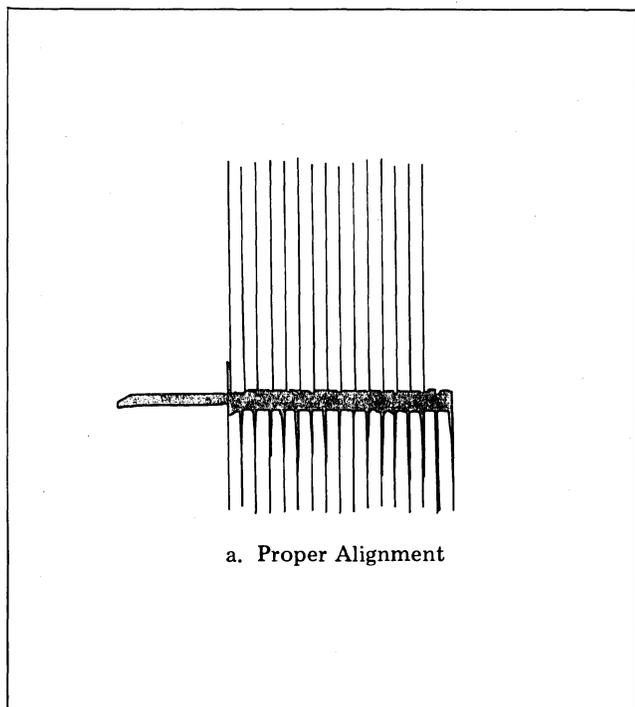


Figure 5-5. Head Alignment Checkout Waveforms

9. Insert the Standard Alignment Tape into the tape unit. Set the oscilloscope time base to 2 msec/cm, vertical display to 5 v/division, and triggering mode to EXT DC POS. Trigger from TP6 of the Motion Control 1 board. Connect the channel A probe to TP5 and the channel B probe to TP5 of the Read Amplifier board. Generate a Read Start Command.

10. For azimuth alignment, set the display mode to A-B and adjust both oscilloscope channel voltages to obtain maximum cancellation of data. The cancelled data should be 25% (or less) of the negative pulses (Figure 5-6.)

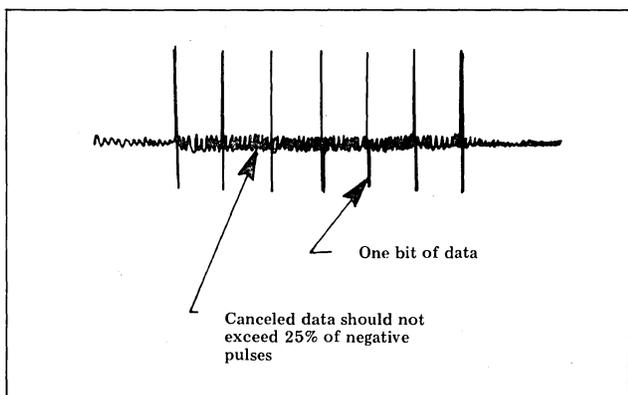


Figure 5-6. Azimuth Alignment

11. If adjustment is required, turn the *azimuth* adjustment screw (Figure 5-8) *very slightly* to obtain maximum cancellation.

12. For vertical alignment, set the oscilloscope to "chopped" and 1 v/division on channels A and B. Check the inter-record gap for noise (Figure 5-7). Less than 0.5 v pk-pk is desirable.

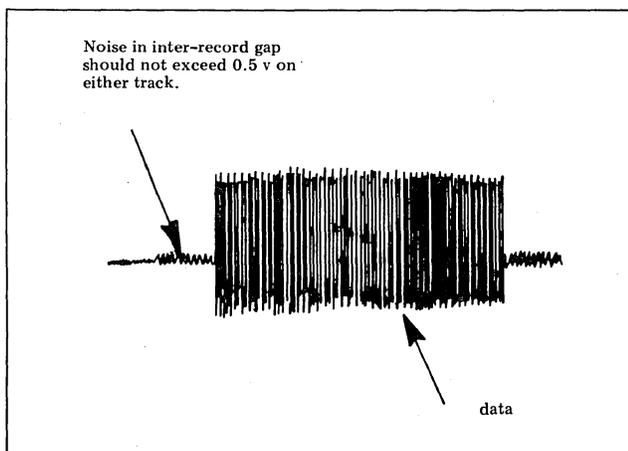


Figure 5-7. Vertical Alignment

13. If adjustment is required, turn the *vertical* adjustment screw (Figure 5-8) *very slightly* to reduce the noise to the minimum value on both channels.

NOTE

Do NOT tamper with the reference screw (Figure 5-8); it is a reference point set at the factory. If moved, field realignment of the head becomes very difficult.

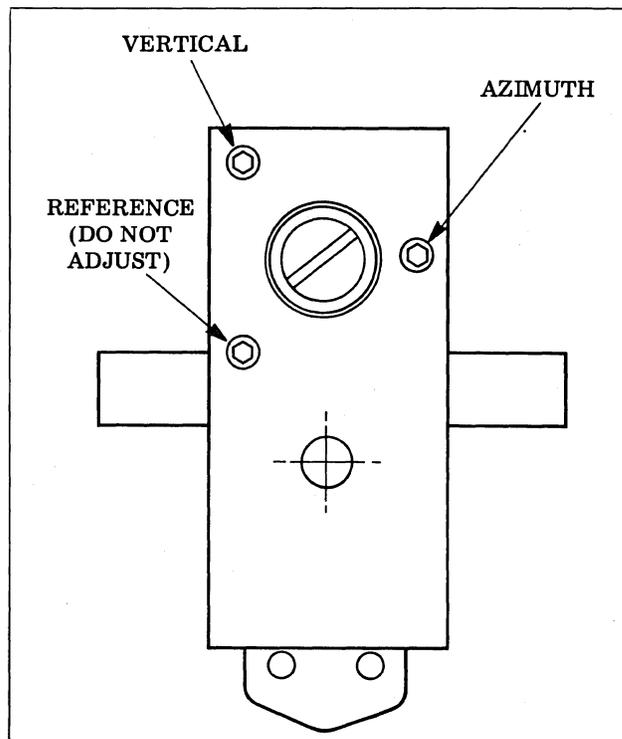


Figure 5-8. Head Adjustment Screws

14. Recheck alignments (steps 10 through 13): azimuth and vertical adjustments interact, and correct overall alignment may not be achieved on the first try.

Head Wear

The amount of wear on the magnetic head is highly dependent upon the actual usage of the CartriFile tape unit. "Average" life for a head is about 2000 hours, roughly 2-1/2 to 3 years under "normal" usage. However, a number of conditions can significantly alter head life. New tapes, for example, are more abrasive than used tapes and will wear down the head more quickly. Daily usage over a span of 2 to 3 years may also vary widely. As a result, it is recommended that head wear be checked at the third yearly maintenance period. It may or may not be necessary to replace the head assembly at this time.

The following are indications of head wear:

1. The tip of a magnetic head (where it contacts the tape) becomes flattened as it wears. However, because of diminishing gap reluctance, a head is most efficient

just before it wears out completely. A visual inspection may indicate a worn head.

2. Insufficient gain when reading a tape and difficulty adjusting Read amplifiers on the Read Amplifier board may be caused by a worn head.

3. Inability to read back a tape just written by that head (assuming that the head is properly aligned) is an important indication of head wear. A good test is to write on a previously recorded tape, then read it back: a badly worn head will be indicated by information remaining in the inter-record gaps.

Head Replacement

If head wear is apparent, the head should be replaced with a new unit (10994-X). Specify whether the head is above or below mounting plate and the color of the dot.

1. Remove Transport board assembly.
2. Remove Photosense assembly mounting screws and swing assembly out on harness.

3. Remove harness mounting screws, as required.
4. Remove transport board connector mounting screws and swing connector out to gain access to head connections.
5. Unsolder leads of head to be removed.
6. Using an 11/32-inch hex wrench, remove tension spring retaining nut, washer, and spring.
7. Remove head assembly from transport.
8. Install new head assembly by reversing steps 3 through 7. Make sure that the head alignment screws rest in dimples in the mounting boss when tightening the tension spring.
9. Using a 0.050-inch Allen wrench and a 0.076-inch drill gauge, set clearance between head mounting plate and mounting boss.
10. Install Photosense assembly and Transport board assembly.

TROUBLESHOOTING Table 5-2 contains information that will be useful in determining the nature of certain CartriFile tape unit problems, particularly operator or minor hardware problems. If the tape unit continues to exhibit abnormal operation, load the diagnostic program into the computer and note the unit's operating characteristics and indications. Analysis of the diagnostic program printout should indicate the nature of the fault conditions.

Table 5-2. Problem Analysis

PROBLEM	PROBABLE SOLUTION
1. Cannot apply power to the CartriFile.	A. Check a-c line cord and fuse. B. Check POWER lamp filament and Power switch. C. Check J10 and J11 connectors to tape transport.
2. Does not go into On-line with cartridge inserted.	A. Check position of "cartridge inserted" sensing switch assembly. Try moving cartridge back and forth. B. Check J10 and J11 connectors to tape transport.
3. Tape Busy lamp always on and tape in motion.	A. Check seating and position of the interface board. B. Check seating of P3 connector to transport. C. Check for 0 v level at $\overline{\text{FWD}}$ terminals on Actuator Driver board. Signal originates on Motion Control boards.

Table 5-2. Problem Analysis (Continued)

PROBLEM	PROBABLE SOLUTION
4. No apparent tape action.	<ul style="list-style-type: none"> A. Check Busy lamp filament. B. Check capstan drive belt. C. Check the actuator to be sure it is being energized. D. Check for 0 v level at $\overline{\text{FWD}}$ terminal on Actuator Driver board.
5. Tape wrap around capstan.	<ul style="list-style-type: none"> A. Clean capstan daily with Freon or alcohol to remove tape lubricant build-up. B. Check capstan for damage (gouged or rutted): the surface that contacts tape should be smooth and clean.
6. Tape creases or gouges.	<ul style="list-style-type: none"> A. A loop may form at the face of the cartridge: move loop into cartridge by running finger over pinchroller before inserting into tape unit or closing the cartridge cover.
7. Tape motion does not stop within 3 minutes after a Load-Point Search command.	<ul style="list-style-type: none"> A. Check for capstan rotation B. Check Photosense lamp filament. C. Check Photosense adjustment.
8. Cannot write on a particular tape.	<ul style="list-style-type: none"> A. Check that the cartridge file-protect lever has actuated the microswitch in the transport. B. Attempt to isolate the problem by trying to write on the other tapes.
9. Read errors.	<ul style="list-style-type: none"> A. Check cleanliness of tape guides, head, and capstan. B. Check tape for damage; change cartridges. C. Change capstan drive belt. D. Check head alignment.

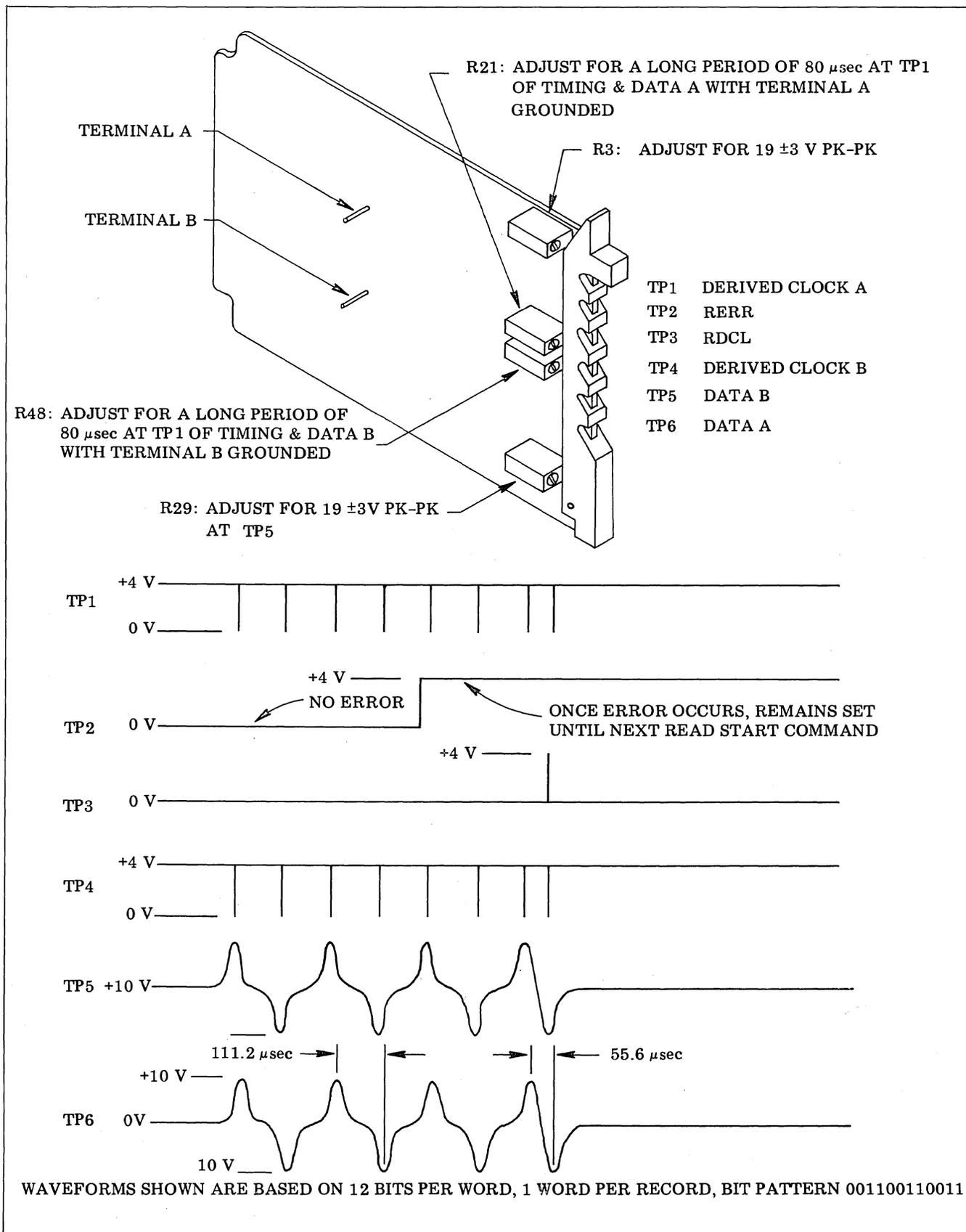
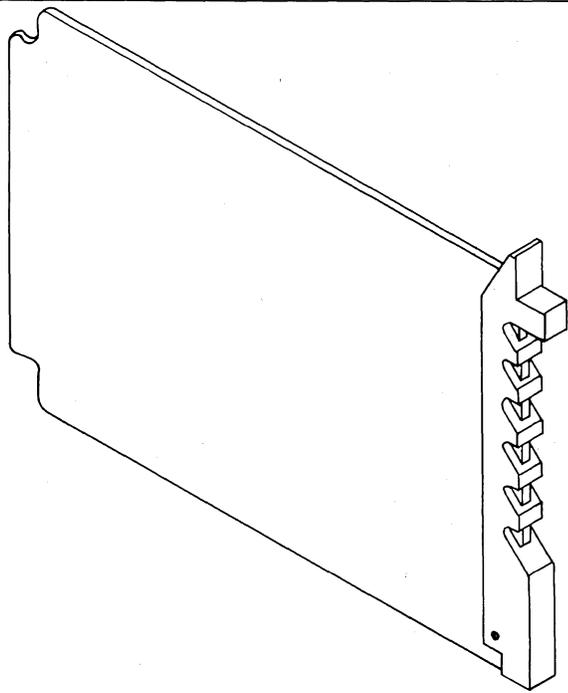
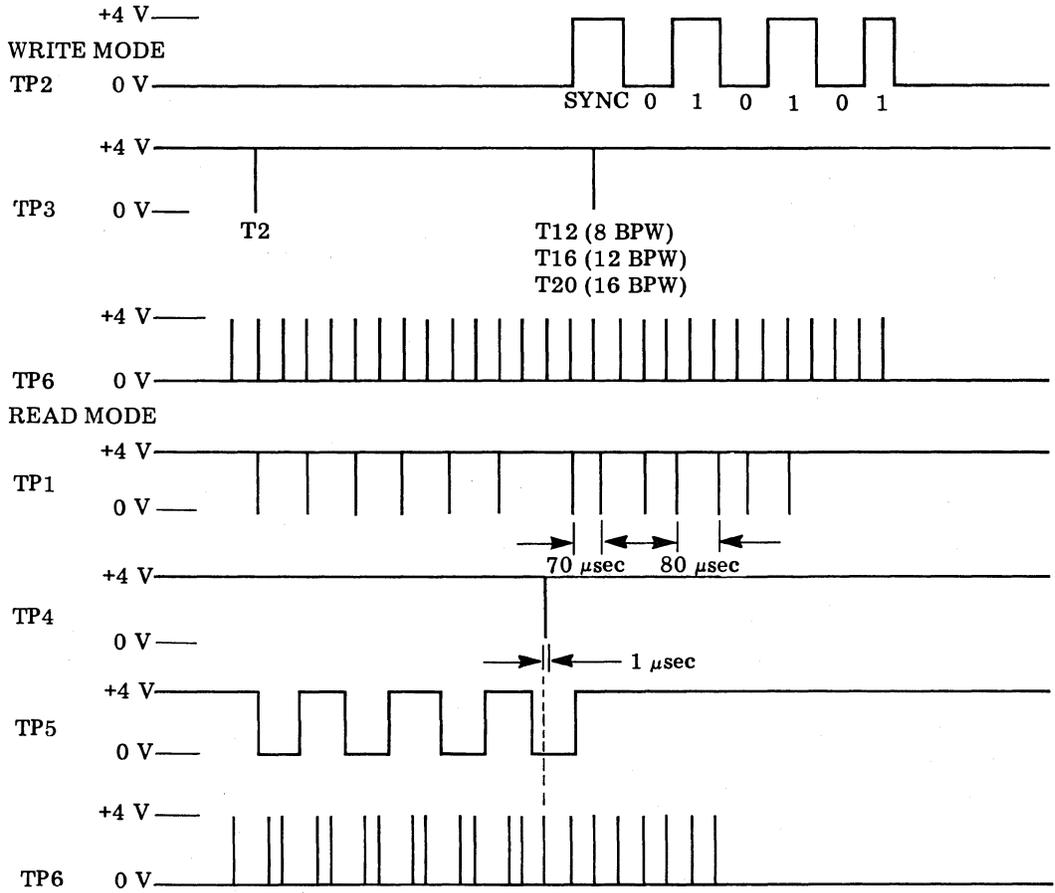


Figure 5-9. Read Amplifier Board 10746-1



- TP1 INSERTED CLOCK (READ ONLY)
- TP2 ENCODED DATA (WRITE ONLY)
- TP3 \overline{WCAL} (WRITE ONLY)
- TP4 \overline{RDXFR} (READ ONLY)
- TP5 DERIVED DATA (READ ONLY)
- TP6 TOTAL CLOCK



WAVEFORMS SHOWN ARE BASED ON 12 BITS PER WORD, 1 WORD PER RECORD, BIT PATTERN 001100110011

Figure 5-10. Timing & Data Board 10786-0

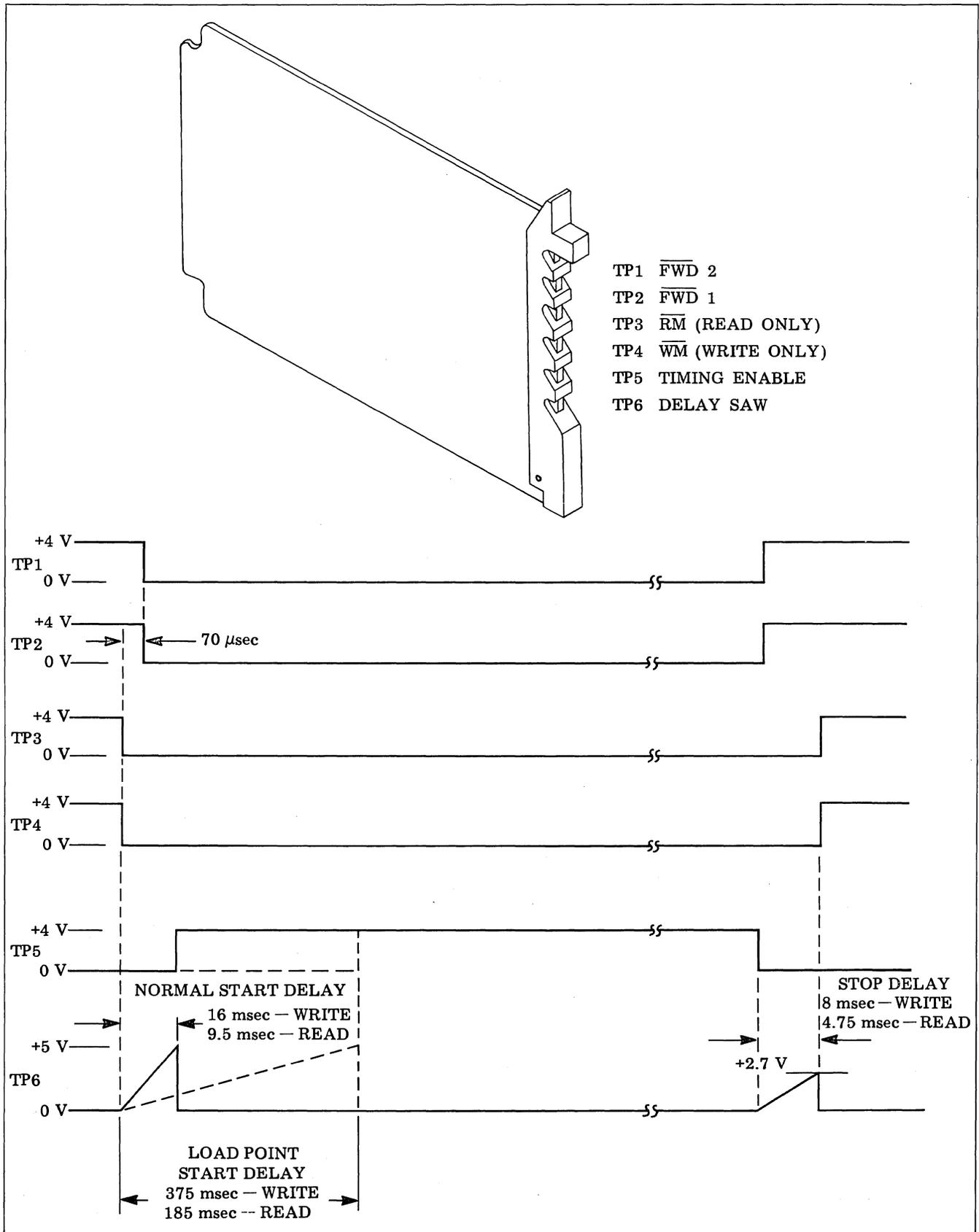


Figure 5-11. Motion Control 1 Board Assembly 10788-0

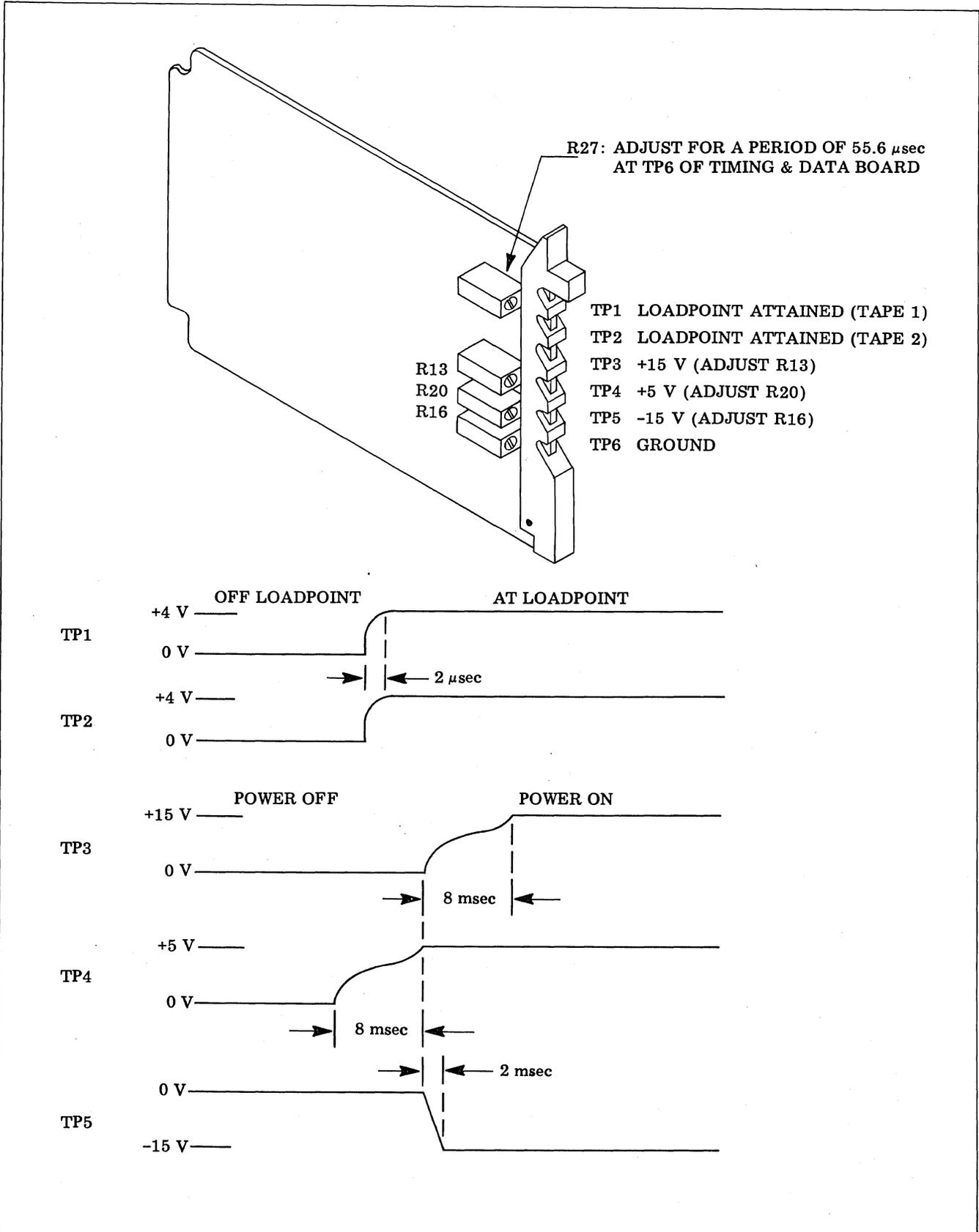
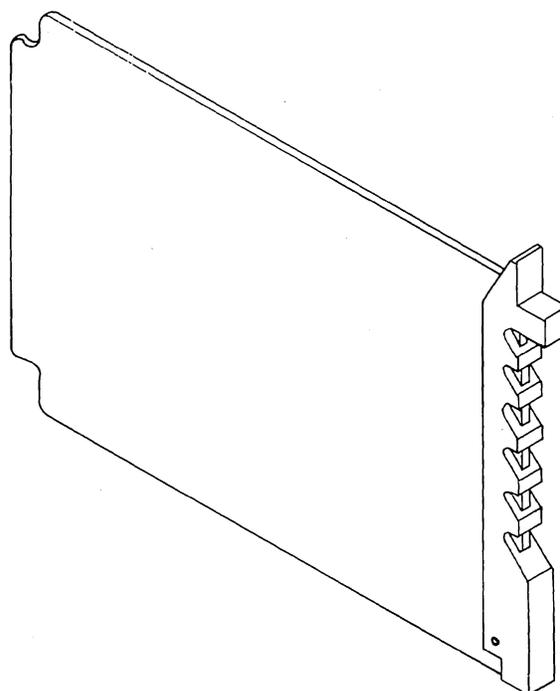


Figure 5-12. Regulator Board 10790-0



- TP2 LPA 4
- TP3 $\overline{\text{FWD3}}$
- TP4 $\overline{\text{FWD4}}$
- TP5 LPA3

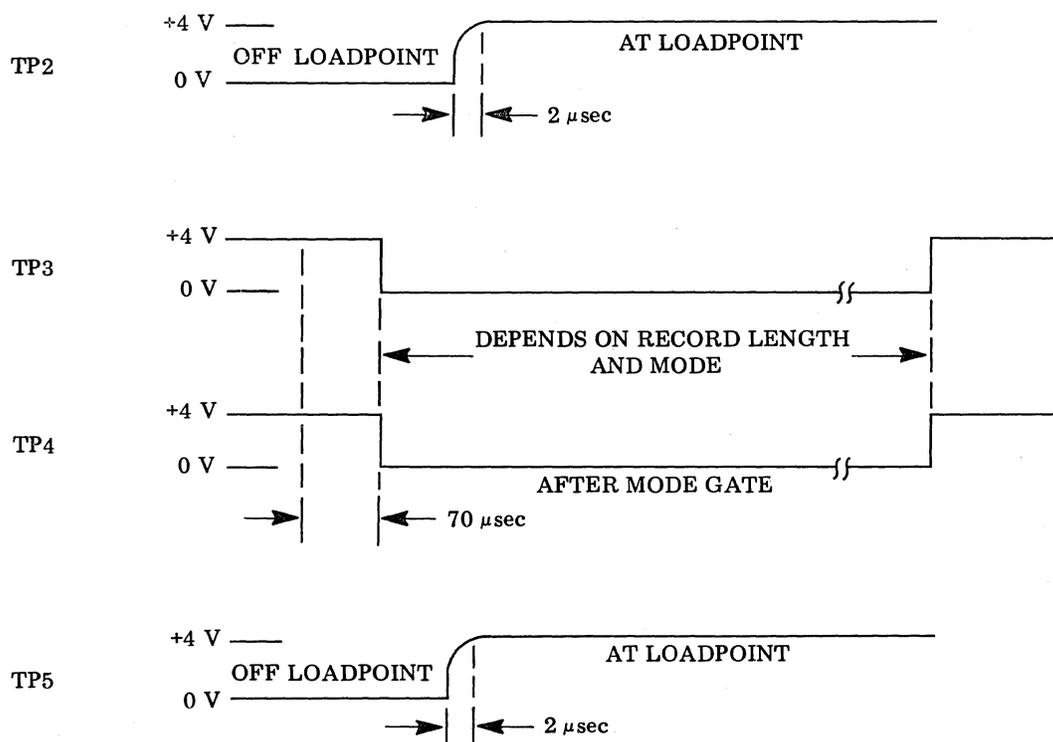
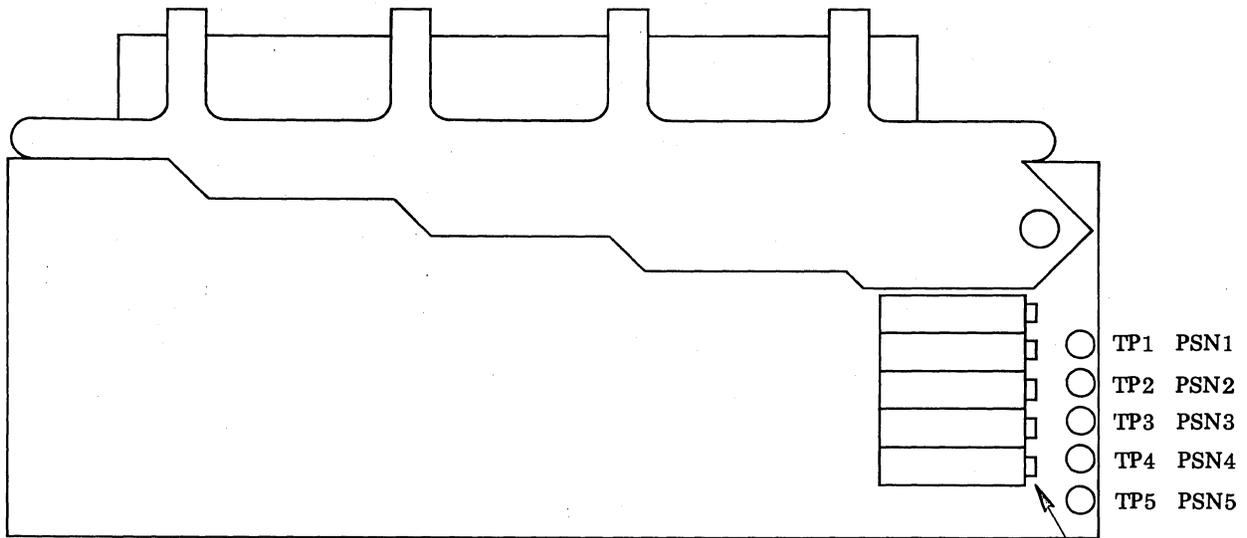


Figure 5-13. Motion Control 2 Board 10968-0



R12: ADJUST TO OBTAIN
9-9.5 V AT TP5 ON THE
ACTUATOR DRIVER BOARD

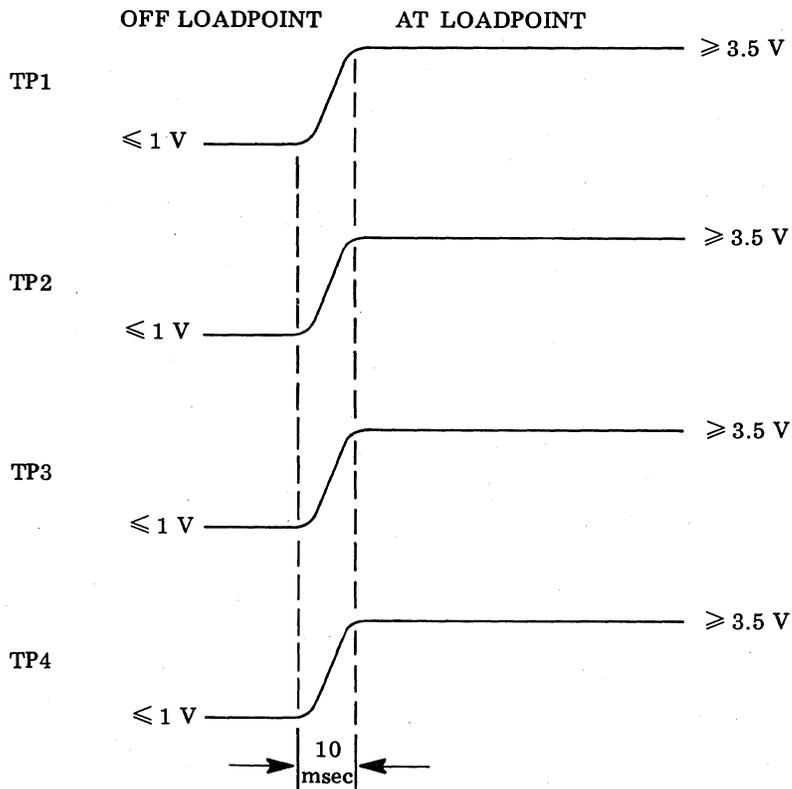


Figure 5-14. Photosense & Lamp Board 10972-0

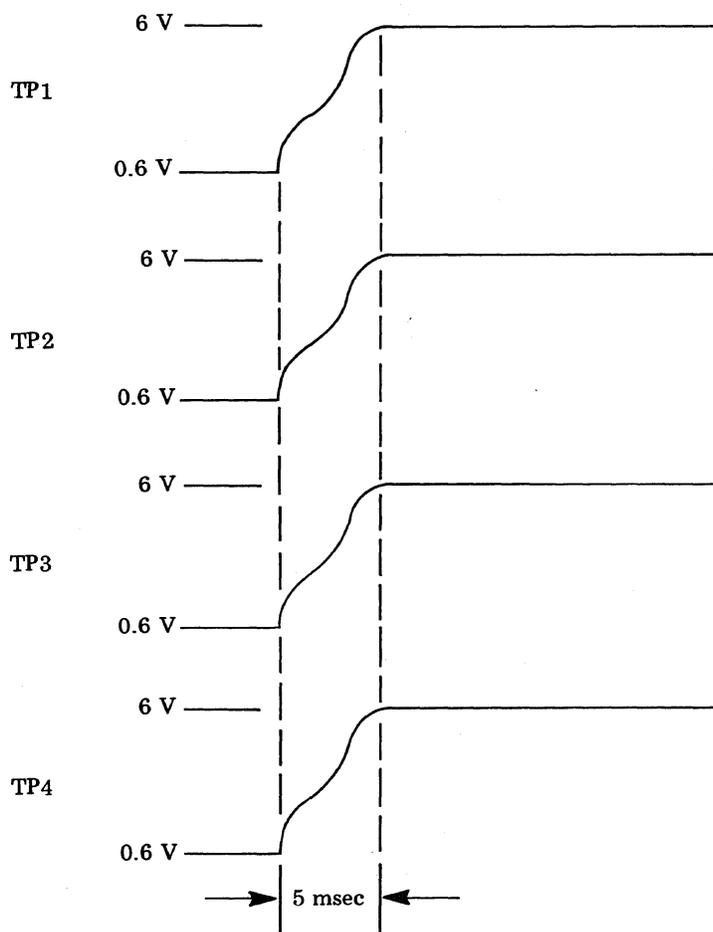
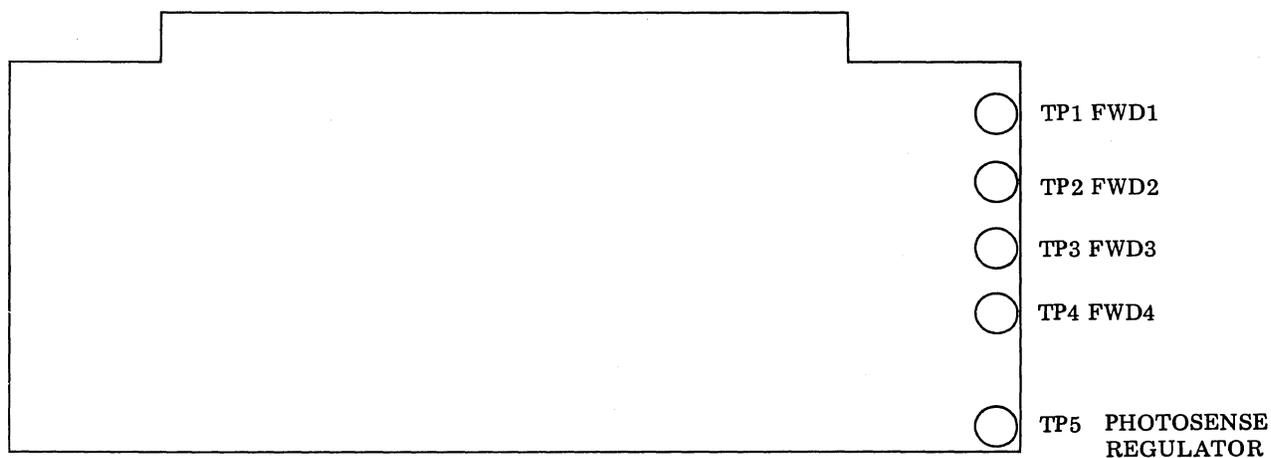


Figure 5-15. Actuator Driver Board 10974-0

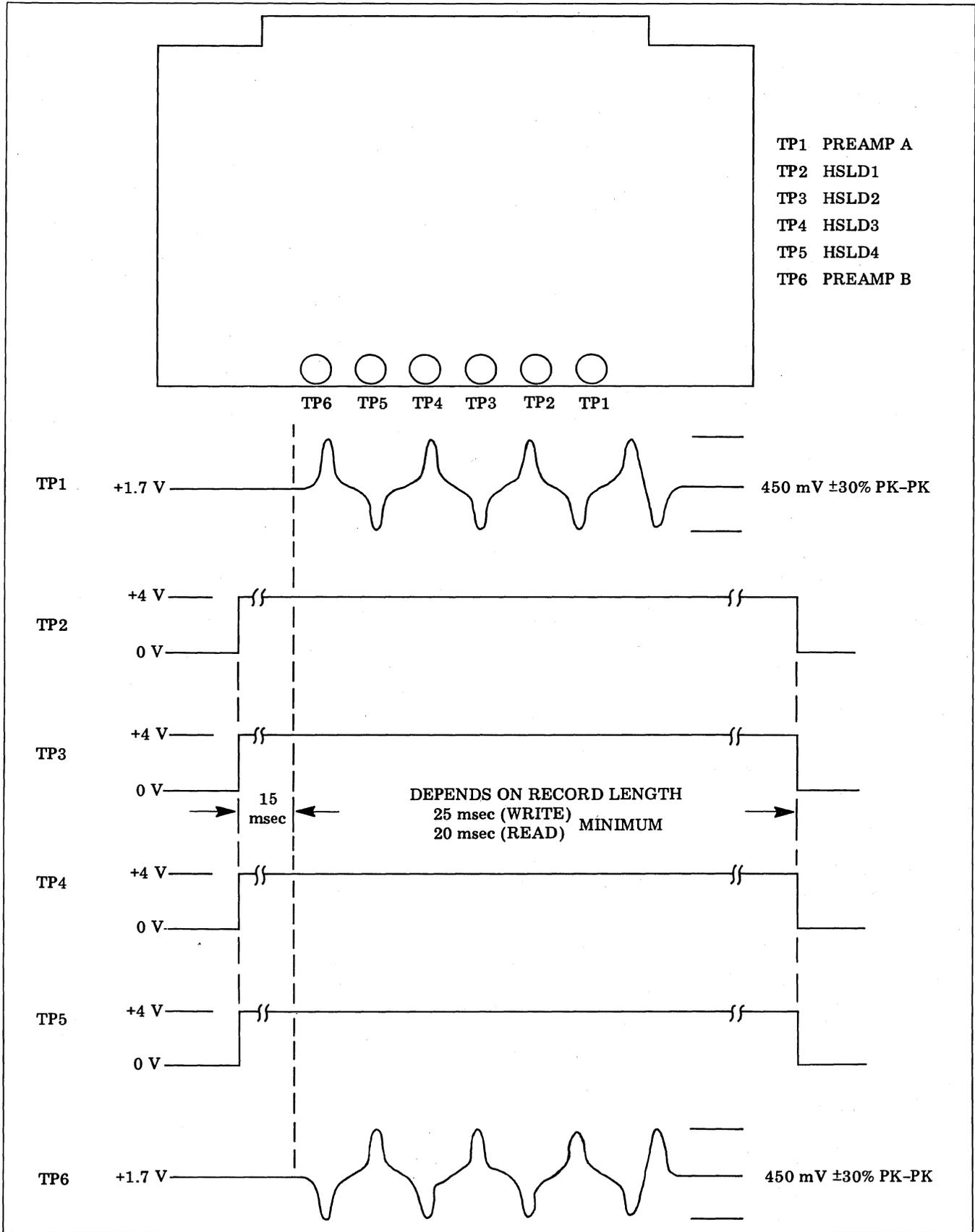
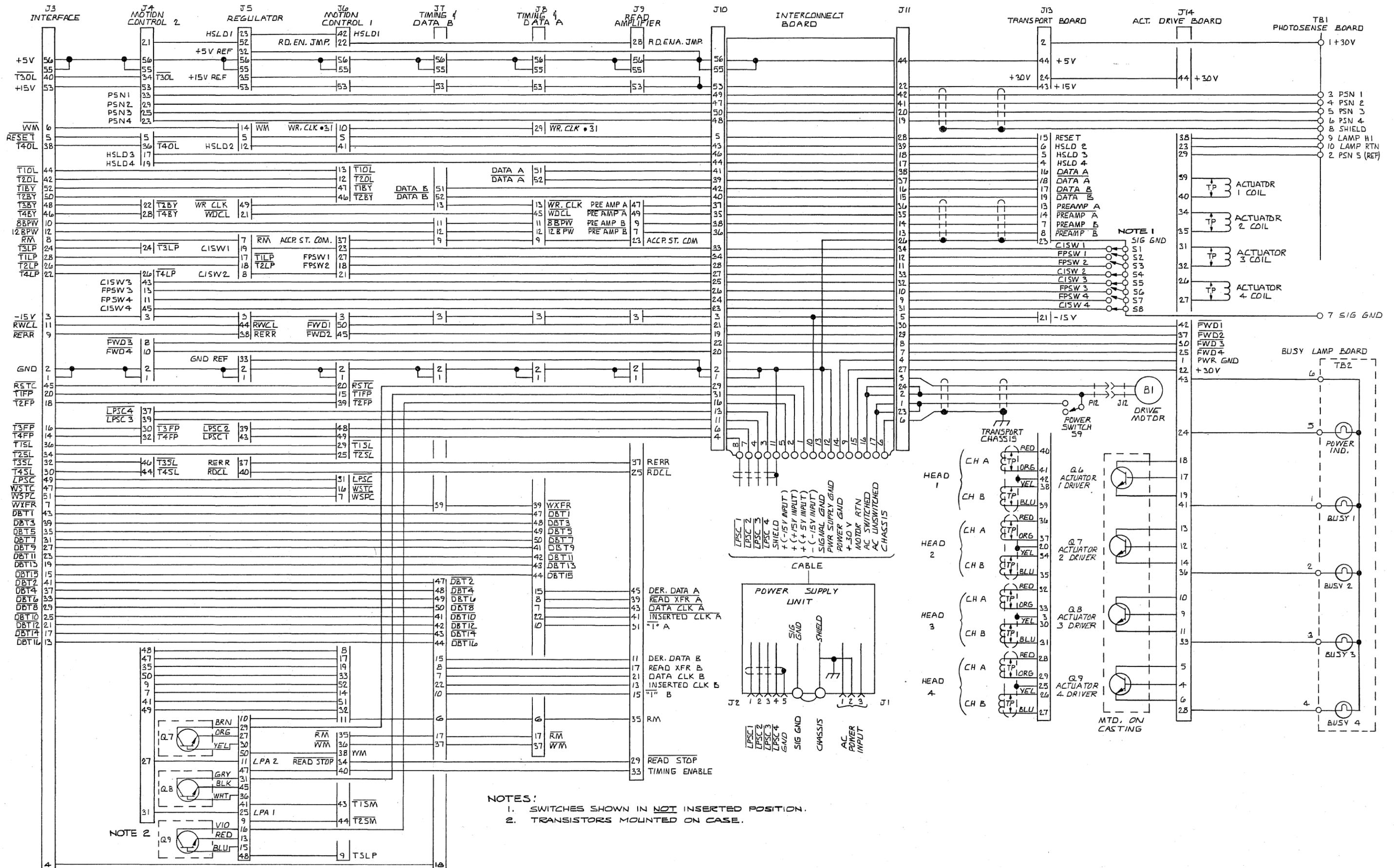


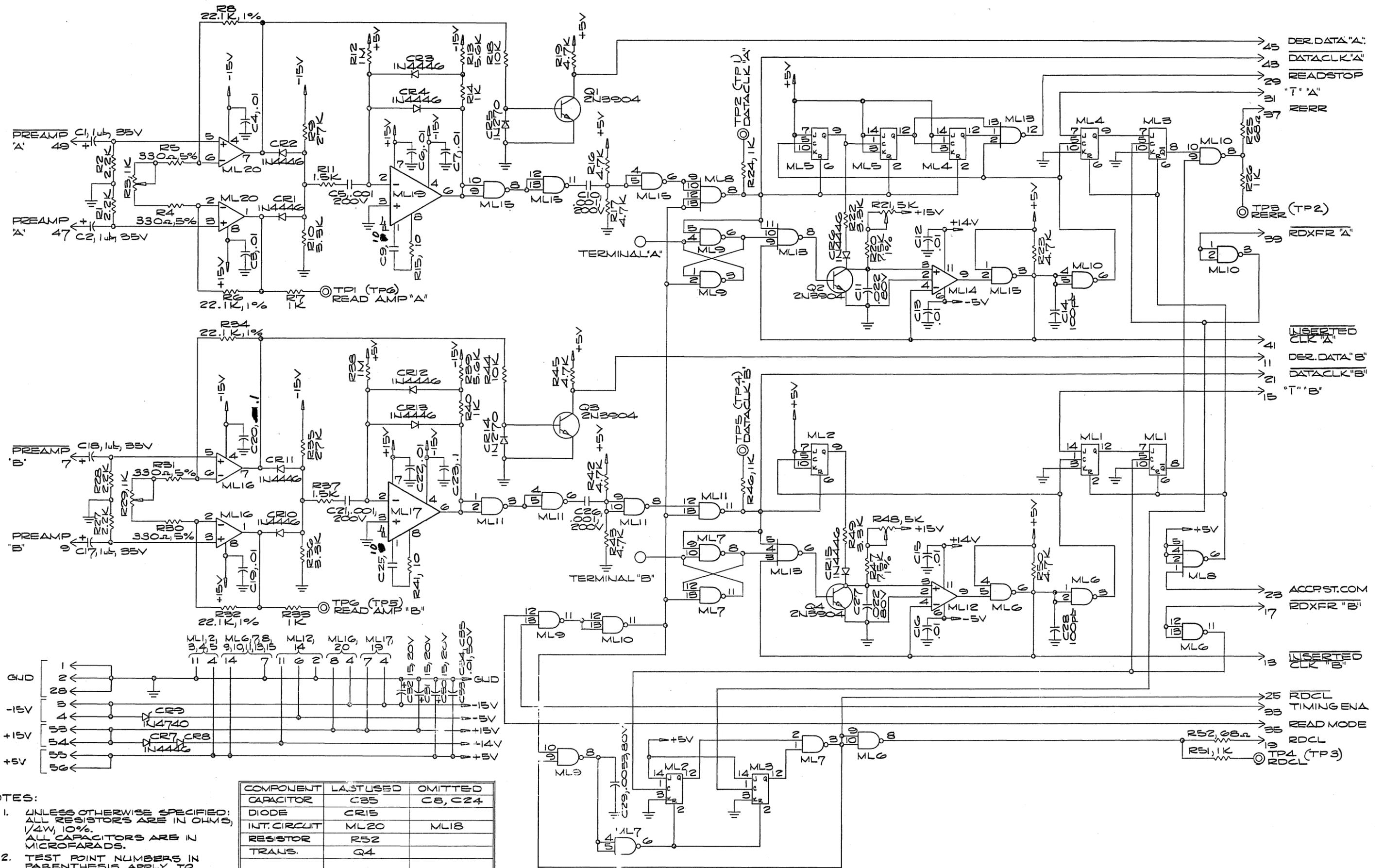
Figure 5-16. Transport Board 10976-0





11050-0,-1 CARTRIFILE 40 ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
1	10746-1	Amplifier Board Assy. (see separate list)	1	
2	10786-0	Timing & Data Board Assy. (see separate list)	2	
3	10788-0	Motion Control 1 Board Assy. (see separate list)	1	
4	10790-0	Regulator Board Assy. (see separate list)	1	
5	10947-1	Power Supply Assy. (see separate list)	1	
6	10962-0	Extender Board Assy. (see separate list)	1	
7	10968-0	Motion Control 2 Board Assy. (see separate list)	1	
9	10990-0	Tape Transport Assy. (see separate list)	1	
11	11048-0	Front Panel Assembly (see separate list)	1	
12	11049-0	Cabinet Assembly (see separate list)	1	
13	11049-1	Cabinet Assembly (see separate list)	1	
17	00048-003	Nut, hex, #6	A/R	
19	00062-027	Screw, pan hd, #6-32 x 3/8	A/R	
20	00062-029	Screw, pan hd, #6-32 x 1/2	A/R	
24	00077-002	Washer, ext. tooth lock, #6	A/R	
25	00078-003	Washer, plain, #6	A/R	
27	00109-001	Cord, power	1	



NOTES:

- UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS,
1/4W, 10%.
ALL CAPACITORS ARE IN
MICROFARADS.
- TEST POINT NUMBERS IN
PARENTHESIS APPLY TO
-1 VERSION ONLY.

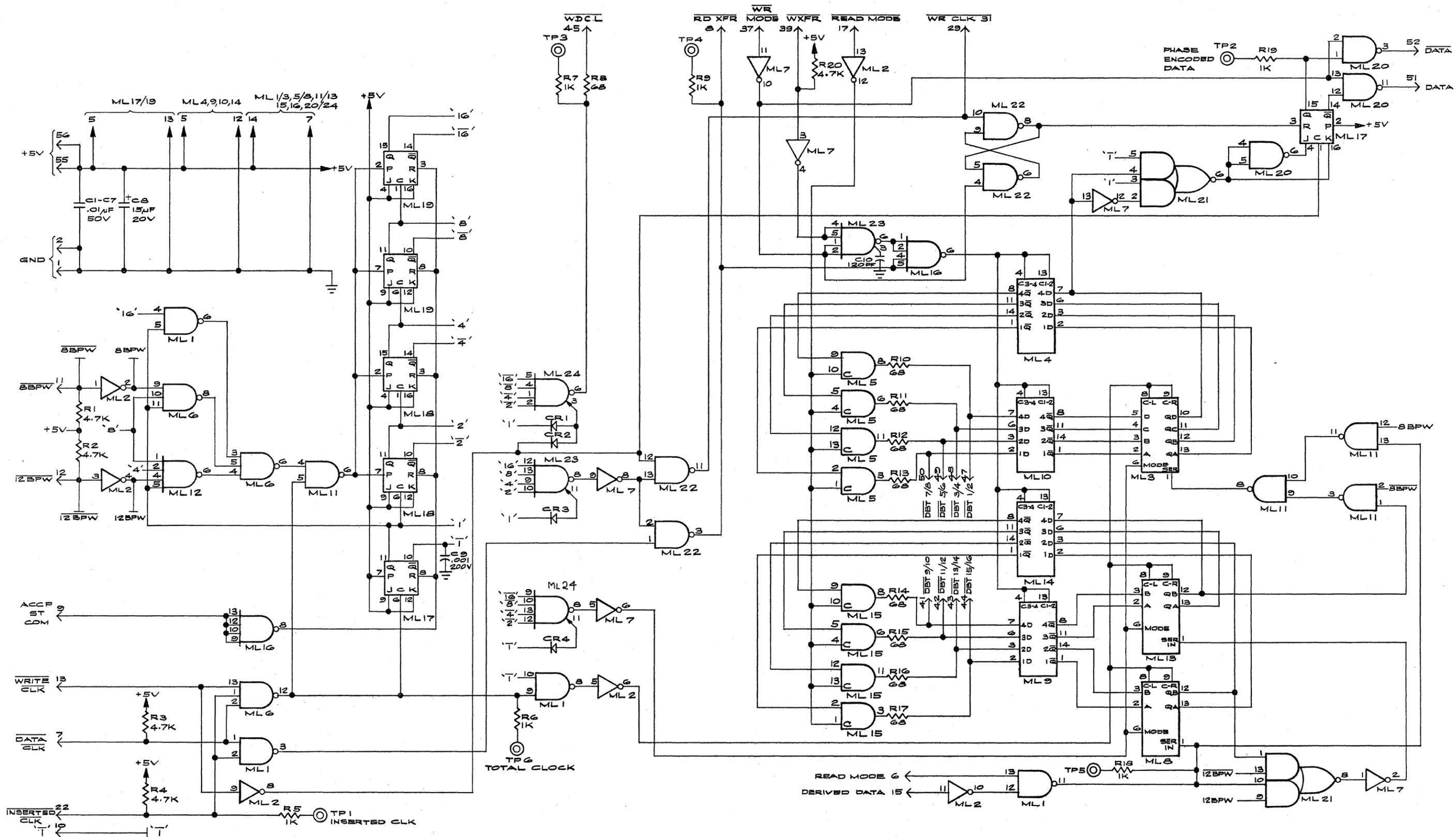
COMPONENT	LAST USED	OMITTED
CAPACITOR	C35	C8, C24
DIODE	CR15	
INT. CIRCUIT	ML20	ML18
RESISTOR	R52	
TRANS.	Q4	

10746-0,-1 READ AMPLIFIER BOARD ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
	10746-0	READ AMPLIFIER BOARD ASSY. (Model 1124)		
	10746-1	READ AMPLIFIER BOARD ASSY. (CartriFile 20/40)		
1	10745-0	. Circuit Board	1	
3	10181-7	. Test Point Handle, marked -0:	1	
4	10182-2	. Test Point Handle, marked -1:	1	
5	00011-001	. Cap., fxd, cer, .01uf, 50V C3,4,6,7,12,13,15,16,19, 20 ,22,33/35	13	
6	00011-004	. Cap., fxd, cer, 100pf, 500V C14,28	2	
7	00011-022	. Cap., fxd, cer, .luf, 25V C23, ²⁰	1	
9	00013-002	. Cap., fxd, mica, 10pf, 500V C9,25	2	
11	00014-005	. Cap., fxd, Mylar, .001uf, 200V C5,10,21,26	4	
12	00014-011	. Cap., fxd, Mylar, .0033uf, 80V C29	1	
13	00014-021	. Cap., fxd, Mylar, .022uf, 80V C11,27	2	
14	00015-013	. Cap., fxd, Tant., luf, 35V C1,2,17,18	4	
15	00015-027	. Cap., fxd, Tant., 15uf, 20V C30/32	3	
17	00024-001	. Diode, Ge, 1N270 CR5,14	2	
18	00025-001	. Diode, Si, 1N4446 CR1/4,6/8,10/13,15	12	
19	00026-001	. Diode, Zener, 1N4740 CR9	1	
21	00033-001	. Integrated Circuit, 710C ML12,14	2	
22	00033-011	. Integrated Circuit, 748C ML17,19	2	
23	00033-010	. Integrated Circuit, N5558V ML16,20	2	
25	00045-001	. Integrated Circuit, 7400N ML6,10,11,15	4	
26	00045-003	. Integrated Circuit, 7473N ML1/5	5	
27	00045-005	. Integrated Circuit, 7440N ML8	1	
28	00045-014	. Integrated Circuit, 849 ML7,9	2	
29	00045-015	. Integrated Circuit, 863 ML13	1	
30	00057-001	. Res., fxd, comp., 10 ohm, 1/4W, 10% R15,41	2	
31	00057-011	. Res., fxd, comp., 68 ohm, 1/4W, 10% R25,52		
32	00057-025	. Res., fxd, comp., 1K, 1/4W, 10% R7,14,24,26,33,40,46,51	8	
33	00057-027	. Res., fxd, comp., 1.5K, 1/4W, 10% R11,37	2	
34	00057-029	. Res., fxd, comp., 2.2K, 1/4W, 10% R1,2,27,28	4	
35	00057-031	. Res., fxd, comp., 3.3K, 1/4W, 10% R10,22,36,49	4	
36	00057-033	. Res., fxd, comp., 4.7K, 1/4W, 10% R16,17,19,23,42,43,45,50	8	
37	00057-034	. Res., fxd, comp., 5.6K, 1/4W, 10% R13,39	2	

10746-0,-1 READ AMPLIFIER BOARD ASSEMBLY (continued)

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
38	00057-037	. Res., fxd, comp., 10K, 1/4W, 10%	R18,44	2
39	00057-042	. Res., fxd, comp., 27K, 1/4W, 10%	R9,35	2
40	00057-061	. Res., fxd, comp., 1M, 1/4W, 10%	R12,38	2
42	00060-002	. Res., Var, film, 5K	R21,48	2
43	00060-004	. Res., Var, film, 1K	R3,29	2
45	00075-001	. Transistor, NPN, 2N3904	Q1/4	4
47	00085-019	. Res., fxd, comp., 330 ohm, 1/4W, 5%	R4,5,30,31	4
49	00086-056	. Res., fxd, film, 7.5K, 1/8W, 1%	R20,47	2
50	00086-075	. Res., fxd, film, 22.1K, 1/8W, 1%	R6,8,32,34	4
52	00087-003	. Roll pin, 3/32 x 7/16	-0:	1
53	00087-001	. Roll pin, 3/32 x 1/4	-1:	1
54	00098-006	. Terminal		2



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
 ALL RESISTORS ARE IN OHMS, 1/4W, ±10%.
 ALL CAPACITORS ARE IN MICROFARADS.
 —|— = SILICON DIODE.

COMPONENT	LAST USED	OMITTED
CAPACITOR	C10	
DIODE	CR4	
INTEG. CIRCUIT	ML24	
RESISTOR	R20	
TEST POINT	TP6	

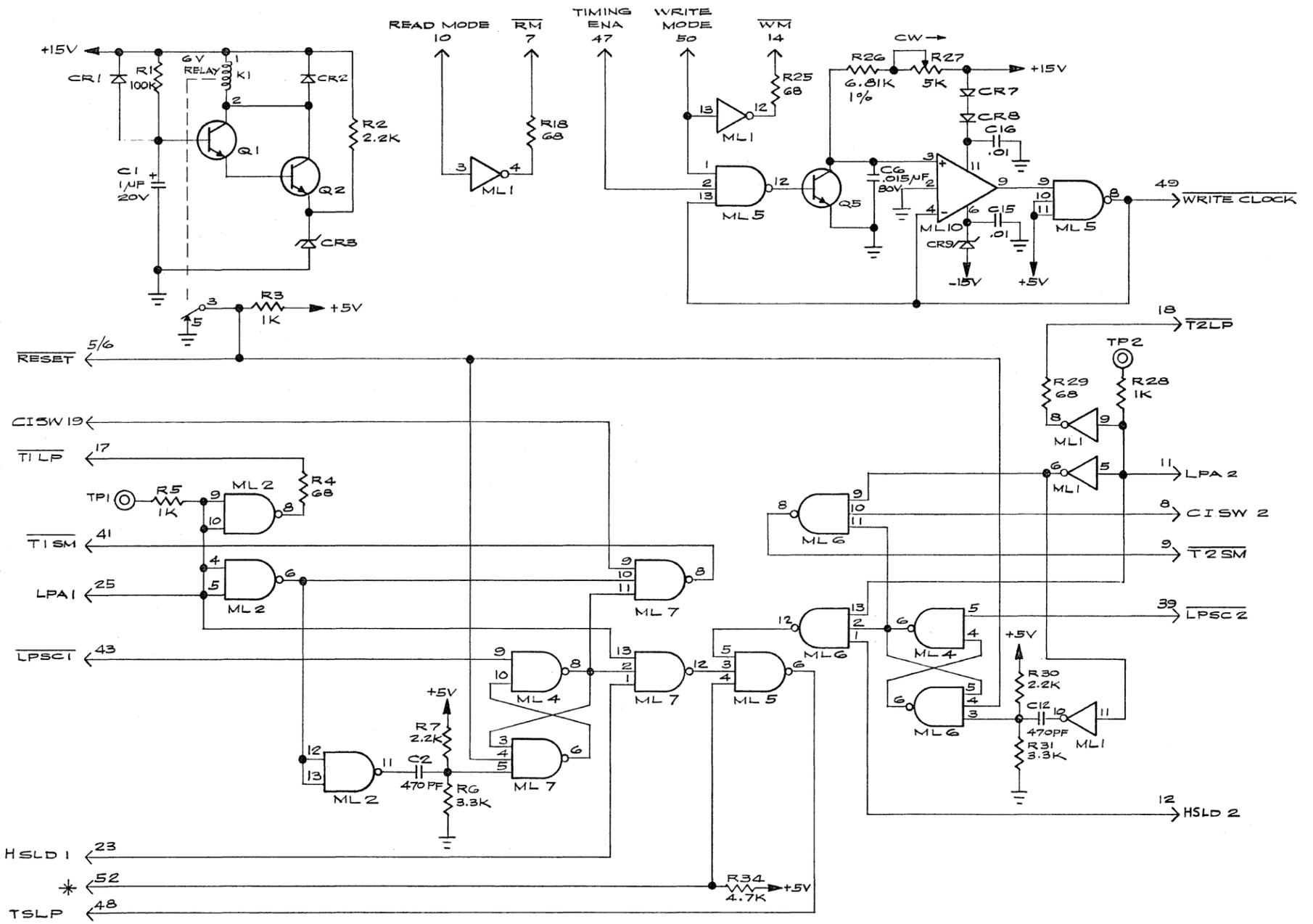


10786-0 TIMING & DATA A/B BOARD ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
1	10182-0	Test Point Handle, marked	1	
3	10785-0	Circuit Board	1	
5	00011-001	Cap., fxd, cer, .01uf	C1/7 7	
7	00013-014	Cap., fxd, mica, 120pf	C10 1	
9	00014-005	Cap., fxd, Mylar, .001uf	C9 1	
11	00015-027	Cap., fxd, tant., 15uf	C8 1	
13	00026-001	Diode, Si, 1N4446	CR1/4 4	
15	00045-001	Integrated Circuit, 7400N	ML1,11,20,22 4	
16	00045-002	Integrated Circuit, 7420N	ML12 1	
17	00045-004	Integrated Circuit, 7476N	ML17/19 3	
18	00045-005	Integrated Circuit, 7440N	ML16 1	
19	00045-007	Integrated Circuit, 7475N	ML4,9,10,14 4	
20	00045-009	Integrated Circuit, 7451N	ML21 1	
21	00045-011	Integrated Circuit, 7410N	ML6 1	
22	00045-013	Integrated Circuit, 7404N	ML2,7 2	
23	00045-024	Integrated Circuit, 830	ML23,24 2	
24	00045-026	Integrated Circuit, 7495N	ML3,8,13 3	
25	00045-046	Integrated Circuit, 8094	ML5,15 2	
28	00057-011	Res., fxd, comp., 68 ohm, 1/4W, 10%	R8,10/17 9	
29	00057-025	Res., fxd, comp., 1K, 1/4W, 10%	R5/7,9,18,19 6	
30	00057-033	Res., fxd, comp., 4.7K, 1/4W, 10%	R1/4,20 5	
32	00087-001	Roll pin, 3/32 x 1/4	1	

10788-0 MOTION CONTROL 1 BOARD ASSEMBLY

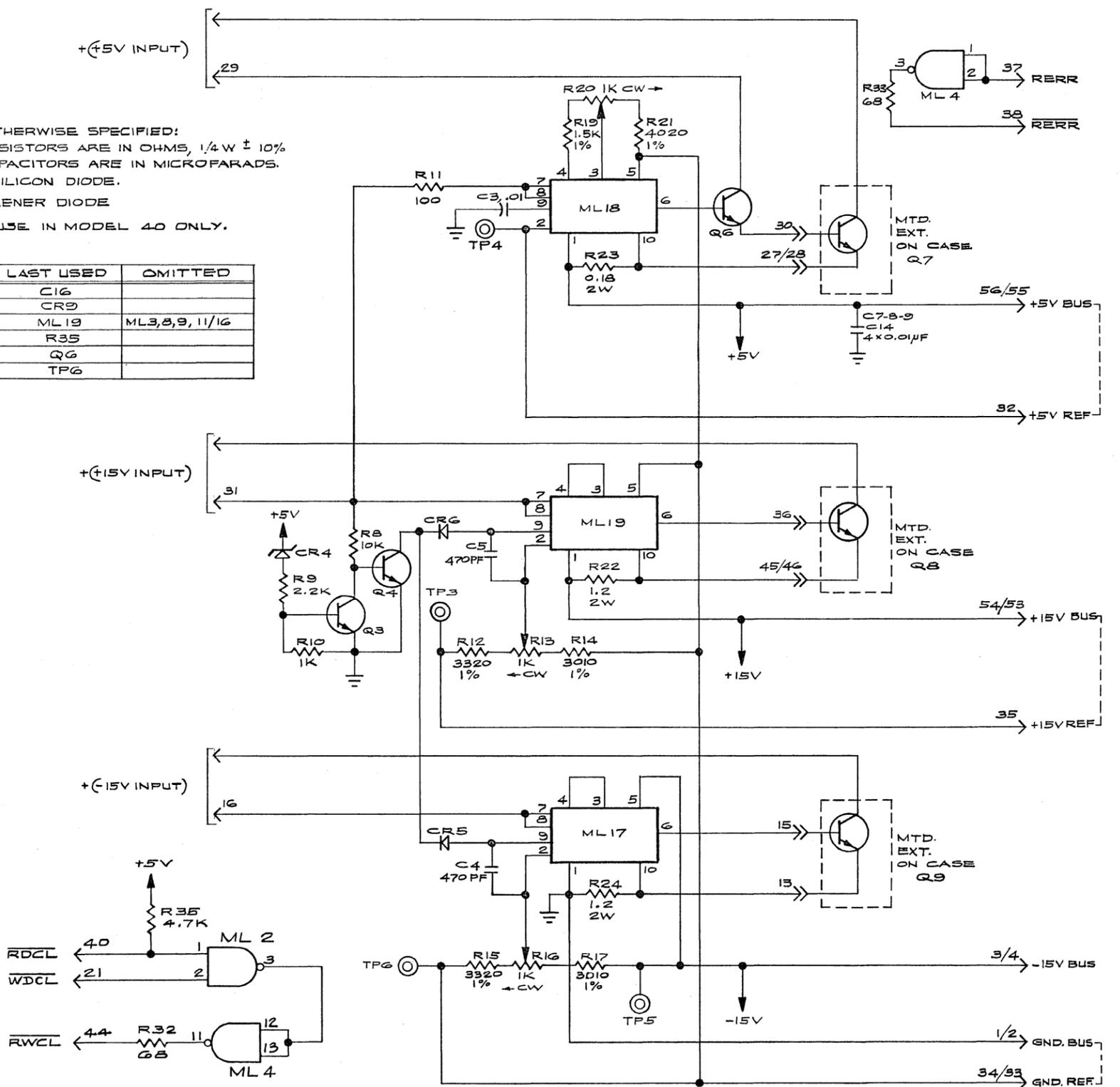
ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
2	10182-1	Test Point Handle, marked	1	
4	10787-0	Circuit Board	1	
6	00011-001	Cap., fxd, cer, .01uf	C6,9,10,13	4
7	00011-003	Cap., fxd, cer, 470pf	C5	1
8	00013-014	Cap., fxd, mica, 120pf	C7,8,11,12	4
9	00147-001	Cap., fxd, tant., 3.3uf	C2	1
10	00015-027	Cap., fxd, tant., 15uf	C1,3,4	3
12	00024-001	Diode, Ge, 1N270	CR1,7/11	6
13	00025-001	Diode, Si, 1N4446	CR3/6,12	5
14	00026-003	Diode, Zener, 1N4740A	CR2	1
16	00033-001	Integrated Circuit, 710C	ML3	1
17	00045-001	Integrated Circuit, 7400N	ML6,7,10,12,15,20,24,25	8
18	00045-002	Integrated Circuit, 7420N	ML11,16	2
19	00045-003	Integrated Circuit, 7473N	ML9	1
20	00045-011	Integrated Circuit, 7410N	ML18,19	2
21	00045-013	Integrated Circuit, 7404N	ML14,17,21	3
22	00045-015	Integrated Circuit, 863	ML22	1
23	00045-024	Integrated Circuit, 830	ML13,23	2
24	00045-025	Integrated Circuit, 7405N	ML8	1
29	00057-011	Res., fxd, comp., 68 ohm, 10%, 1/4W	R1,14,15,28,29,31	6
30	00057-025	Res., fxd, comp., 1K, 10%, 1/4W	R3,4,32/34,36,37	7
31	00057-029	Res., fxd, comp., 2.2K, 10%, 1/4W	R10,11	2
32	00057-031	Res., fxd, comp., 3.3K, 10%, 1/4W	R12	1
33	00057-033	Res., fxd, comp., 4.7K, 10%, 1/4W	R2,13,16/27,30,35	16
35	00075-001	Transistor, Si, NPN, 2N3904	Q1	1
37	00086-039	Res., fxd, film, 1.96K, 1%, 1/8W	R5	1
38	00086-041	Res., fxd, film, 2.37K, 1%, 1/8W	R6	1
39	00086-055	Res., fxd, film, 6.81K, 1%, 1/8W	R8	1
40	00086-061	Res., fxd, film, 12.1K, 1%, 1/8W	R7	1
41	00086-111	Res., fxd, film, 267K, 1%, 1/8W	R9	1
43	00087-001	Roll Pin, 3/32 x 1/4		1



NOTES:

- UNLESS OTHERWISE SPECIFIED:
 ALL RESISTORS ARE IN OHMS, 1/4W ± 10%
 ALL CAPACITORS ARE IN MICROFARADS.
 —|— = SILICON DIODE.
 —|— = ZENER DIODE
- * = FOR USE IN MODEL 40 ONLY.

COMPONENT	LAST USED	OMITTED
CAPACITOR	C16	
DIODE	CR9	
INTEG. CIRCUIT	ML19	ML3,8,9,11/16
RESISTOR	R35	
TRANSISTOR	Q6	
TEST POINT	TP6	





10790-0 REGULATOR BOARD

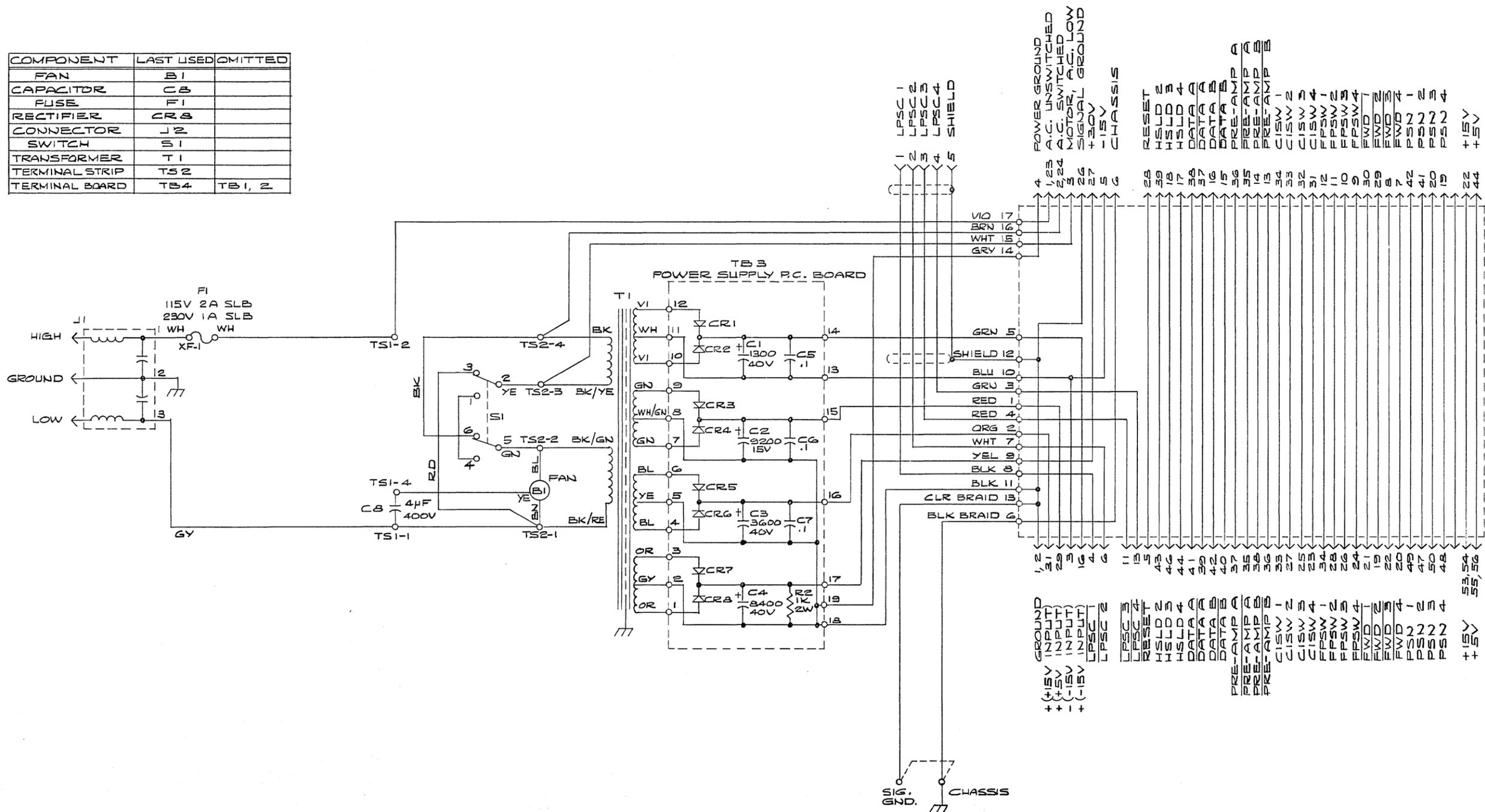
ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
1	10181-9	Test Point Handle, marked	1	
2	10789-0	Circuit Board	1	
4	00011-001	Cap., cer. disc, 0.01uf	C7/9,14/16	6
5	00011-003	Cap., cer. disc, 470pf	C2,4,5,12	4
6	00014-017	Cap., Mylar, 0.01uf	C3	1
7	00014-019	Cap., Mylar, 0.015uf	C6	1
8	00015-013	Cap., tant. polarized, 1.0uf	C1	1
12	00025-001	Diode, Si, 1N4446	CR1,2,5/8	6
13	00026-003	Diode, Zener, 10V, 1N4740A	CR9	1
14	00026-006	Diode, Zener, 3.6V, 1N4729A	CR4	1
15	00026-007	Diode, Zener, 8.2V, 1N4738A	CR3	1
18	00033-001	Integrated Circuit, 710C	ML10	1
19	00033-003	Integrated Circuit, 723C	ML17/19	3
21	00045-001	Integrated Circuit, TTL, 7400	ML2,4	2
22	00045-013	Integrated Circuit, TTL, 7404	ML1	1
23	00045-015	Integrated Circuit, DTL, 863	ML5/7	3
25	00056-005	Relay, reed, 1 form C	K1	1
26	00057-011	Res., fxd comp., 1/4W, 10%, 68 ohm	R4,18,25,29,32,33	6
27	00057-013	Res., fxd comp., 1/4W, 10%, 100 ohm	R11	1
28	00057-025	Res., fxd comp., 1/4W, 10%, 1K	R3,5,10,28	4
29	00057-029	Res., fxd comp., 1/4W, 10%, 2.2K	R2,7,9,30	4
30	00057-031	Res., fxd comp., 1/4W, 10%, 3.3K	R6,31	2
32	00057-033	Res., fxd comp., 1/4W, 10%, 4.7K	R34,35	2
33	00057-037	Res., fxd comp., 1/4W, 10%, 10K	R8	1
34	00057-049	Res., fxd comp., 1/4W, 10%, 100K	R1	1
36	00059-005	Res., WW, 5%, 2W, 1.2 ohm	R22,24	2
37	00059-014	Res., WW, 5%, 2W, 0.18 ohm	R23	1
38	00060-002	Res., var., 5K	R27	1
39	00060-004	Res., var., 1K	R13,16,20	3
41	00075-001	Transistor, Si, 2N3904	Q1/5	5
42	00075-005	Transistor, Si, 2N5298	Q6	1
44	00086-035	Res., prec., 1/8W, 1%, 1.5K	R19	1
45	00086-044	Res., prec., 1/8W, 1%, 3010 ohm	R14,17	2
46	00086-045	Res., prec., 1/8W, 1%, 3320 ohm	R12,15	2
47	00086-047	Res., prec., 1/8W, 1%, 4020 ohm	R21	1
48	00086-055	Res., prec., 1/8W, 1%, 6.8kK	R26	1
51	00087-001	Roll Pin, 3/32 x 1/4		1



10940-0,-1,-2 TRANSISTOR ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
	10940-0	TRANSISTOR ASSEMBLY		
	10940-1	TRANSISTOR ASSEMBLY		
	10940-2	TRANSISTOR ASSEMBLY		
2	00075-005	. Transistor, Si, NPN, 2N5298	1	
4	00099-020	. Tubing, shrink, 1/4", (1" long)	1	
5	00099-120	. Tubing, shrink, 3/32", (4-1/2" long)	1	
7	00100-000	. Wire, stranded, 24 GA, blk., (8" long)	-1:	1
8	00100-010	. Wire, stranded, 24 GA, brn., (6" long)	-0:	1
9	00100-020	. Wire, stranded, 24 GA, red, (10" long)	-2:	1
10	00100-030	. Wire, stranded, 24 GA, org., (6" long)	-0:	1
11	00100-040	. Wire, stranded, 24 GA, yel., (6" long)	-0:	1
12	00100-060	. Wire, stranded, 24 GA, blu., (10" long)	-2:	1
13	00100-070	. Wire, stranded, 24 GA, vio., (10" long)	-2:	1
14	00100-080	. Wire, stranded, 24 GA, gry., (8" long)	-1:	1
15	00100-090	. Wire, stranded, 24 GA, wht., (8" long)	-1:	1
17	00157-001	. Terminal, wire, crimp	3	

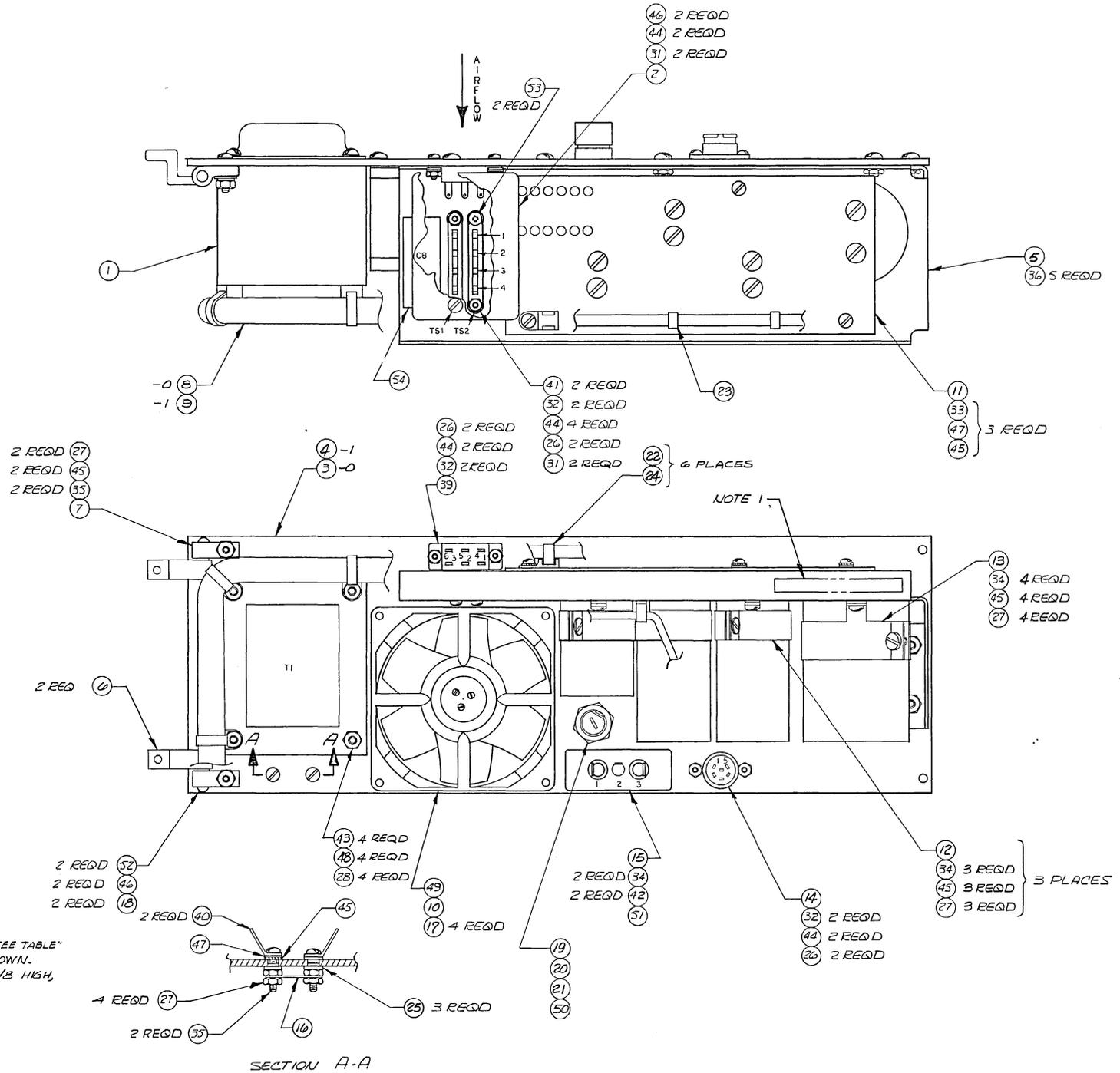
COMPONENT	LAST USED	OMITTED
FAN	B1	
CAPACITOR	CB	
FUSE	F1	
RECTIFIER	CR8	
CONNECTOR	J2	
SWITCH	S1	
TRANSFORMER	T1	
TERMINAL STRIP	TS2	
TERMINAL BOARD	TB4	TB1, 2



NOTES:

- UNLESS OTHERWISE SPECIFIED:
RESISTORS IN OHMS.
CAPACITORS IN MICROFARADS.
—▷— = SILICON DIODE
SWITCH CONTACTS SHOWN IN 115V CONDITION.

INTERCONNECT
P.C. BOARD
10969-0
TB-4



NOTES:
 1. MARK PART NO. "SEE TABLE"
 APPROX WHERE SHOWN.
 NUMBERS TO BE 1/8 HIGH,
 COLOR BLACK.

SECTION A-A



10947-0,-1 POWER SUPPLY ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
	10947-0	POWER SUPPLY ASSEMBLY (Model 20)		
	10947-1	POWER SUPPLY ASSEMBLY (Model 40)		
1	10019-2	. Transformer, power	1	
2	10034-1	. Board, insulation	1	
3	10901-0	. Rear Panel	-0: 1	
4	10901-1	. Rear Panel	-1: 1	
5	10902-0	. Chassis, power supply	1	
6	10909-0	. Hinge, chassis	2	
7	10910-0	. Hinge, power supply	2	
8	10936-0	. Power Supply Cable	-0: 1	
9	10936-1	. Power Supply Cable	-1: 1	
10	10953-0	. Guard, fan	1	
11	10959-0	. Power Supply Board Assy. (See Separate List)	1	
12	00019-001	. Clamp, capacitor, 1 - 3/8 inch	3	
13	00019-002	. Clamp, capacitor, 2 inch	1	
14	00022-019	. Connector, 5 pin, audio	1	
15	00023-009	. AC Connector, male receptacle, 3 pin w/filter	1	
16	00027-015	. Jumper	1	
17	00027-021	. Screw, pan hd, 8-32 x 1/2 self-tapping	4	
18	00030-009	. Speed Clip - Tinnerman, round	2	
19	00031-013	. Fuse, cartridge, 1A, SLB	1	
20	00031-015	. Fuse, cartridge, 2A, SLB	1	
21	00032-002	. Fuseholder	1	
22	00035-002	. Mount, cable tie	A/R	
23	00035-003	. Cable Tie, small	A/R	
24	00035-004	. Cable Tie, large	A/R	
25	00038-002	. Insulator, nylon #6	3	
26	00048-002	. Nut, hex, 4-40	A/R	
27	00048-003	. Nut, hex, 6-32	A/R	
28	00048-012	. Nut, hex, sm pattern, 10-32	A/R	
31	00062-010	. Screw, pan hd, 4-40 x 1/4	A/R	
32	00062-012	. Screw, pan hd, 4-40 x 3/8	A/R	
33	00062-029	. Screw, pan hd, 6-32 x 1/2	A/R	
34	00062-027	. Screw, pan hd, 6-32 x 3/8	A/R	
35	00062-030	. Screw, pan hd. 6-32 x 5/8	A/R	



10947-0,-1 POWER SUPPLY ASSEMBLY (continued)

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
36	00062-040	. Screw, pan hd. 8-32 x 3/8	A/R	
39	00070-002	. Switch, slide, 3 PDT	1	
40	00071-007	. Solder Lug, #6	2	
41	00072-004	. Terminal Strip, 4 lugs	2	
42	00076-003	. Washer, int. tooth lock #6	A/R	
43	00076-005	. Washer, int. tooth lock #10	A/R	
44	00077-001	. Washer, ext. tooth lock #4	A/R	
45	00077-002	. Washer, ext. tooth lock #6	A/R	
46	00078-002	. Washer, plain, #4	A/R	
47	00078-003	. Washer, plain, #6	A/R	
48	00083-002	. Screw, round hd, 10-32 x 2-3/4	4	
49	00097-005	. Fan, 65CFM, 115V	1	
50	00099-060	. Tubing, heat shrink, 3/4 inch	A/R	
51	00099-100	. Tubing, heat shrink, 2 inch	A/R	
52	00119-005	. Rivet, universal head 1/8 dia. x 1.00 lg	2	
53	00155-006	. Spacer, threaded, 4-40 x 1/4 o.d. x 1.00 lg	2	
54	00161-002	. Capacitor, 4uf, 400VDC, 10%	1	



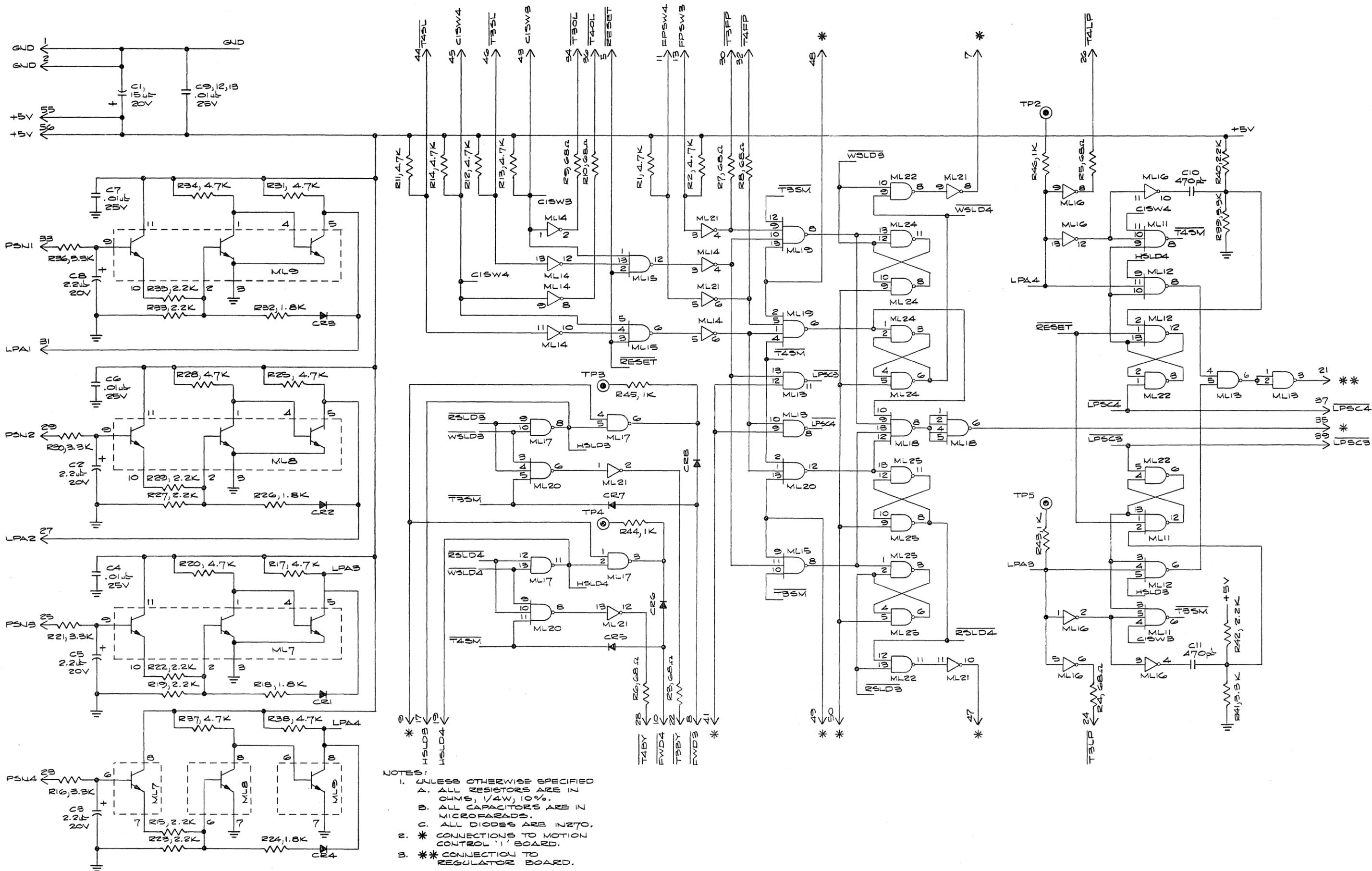
10959-0 POWER SUPPLY BOARD ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
1	10958-0	Circuit Board	1	
2	00011-024	Cap., fxd, cer, .1uf, 50W C5/7	3	
3	00012-001	Cap., fxd, elect, 1300uf, 50W C1	1	
4	00012-002	Cap., fxd, elect, 3600uf, 40V C3	1	
5	00012-003	Cap., fxd, elect, 8400uf, 40V C4	1	
6	00012-004	Cap., fxd, elect, 9200uf, 15V C2	1	
7	00054-002	Diode, 1N4998 CR1/8	8	
8	00059-002	Res., WW, 1000 ohm, 10%, 2W R2	1	
9	00098-001	Terminal, turret, Useco 2010B-1	19	
10	00152-020	Screw, pan hd, #10-32 x 3/8 long	8	
11	00076-005	Washer, lock, int. tooth #10	8	



10962-0 EXTENDER BOARD ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
1	10015-0	Connector, modified	1	
2	10691-0	Circuit Board	1	
3	00062-017	Screw, pan hd., #4-40 x 3/4 lg.	1	
4	00064-053	Spacer, fiber, tubular 3/8 lg	1	
5	00077-001	Washer, lock, ext. tooth	1	
6	00130-001	Solder	A/R	



NOTE:

1. UNLESS OTHERWISE SPECIFIED:
 - A. ALL RESISTORS ARE IN OHMS, 1/4W, 10%.
 - B. ALL CAPACITORS ARE IN MICROFARADS.
 - C. ALL DIODES ARE IN 270.
2. * CONNECTIONS TO MOTION CONTROL BOARD.
3. ** CONNECTION TO REGULATOR BOARD.

10968-0 MOTION CONTROL 2 BOARD ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
1	10182-3	Handle, test point, marked	1	
2	10967-0	P.C. Board	1	
4	00011-001	Cap., fxd, cer, .01uf, 50V	6	
5	00011-003	Cap., fxd, cer, 470uf, 500 V	2	
7	00015-017	Cap., fxd, Tant., pol., 2.2uf, 20V	4	
8	00015-027	Cap., fxd, Tant., pol., 15uf, 20V	1	
10	00024-001	Diode, Ge, 1N270	8	
12	00033-004	Intergrated Circuit, CA3046	3	
14	00045-001	Intergrated Circuit, 7400N	4	
15	00045-002	Intergrated Circuit, 7420N	2	
16	00045-011	Intergrated Circuit, 7410N	4	
17	00045-013	Intergrated Circuit, 7404N	3	
18	00045-014	Intergrated Circuit, 849P	1	
20	00057-011	Res., fxd, comp., 68ohm, 1/4W, 10%	8	
21	00057-025	Res., fxd, comp., 1K, 1/4W, 10%	4	
22	00057-028	Res., fxd, comp., 1.8K, 1/4W, 10%	4	
23	00057-029	Res., fxd, comp., 2.2K, 1/4W, 10%	10	
24	00057-031	Res., fxd, comp., 3.3K, 1/4W, 10%	6	
25	00057-033	Res., fxd, comp., 4.7K, 1/4W, 10%	14	
27	00087-001	Pin, roll 3/32 x 1/4	1	

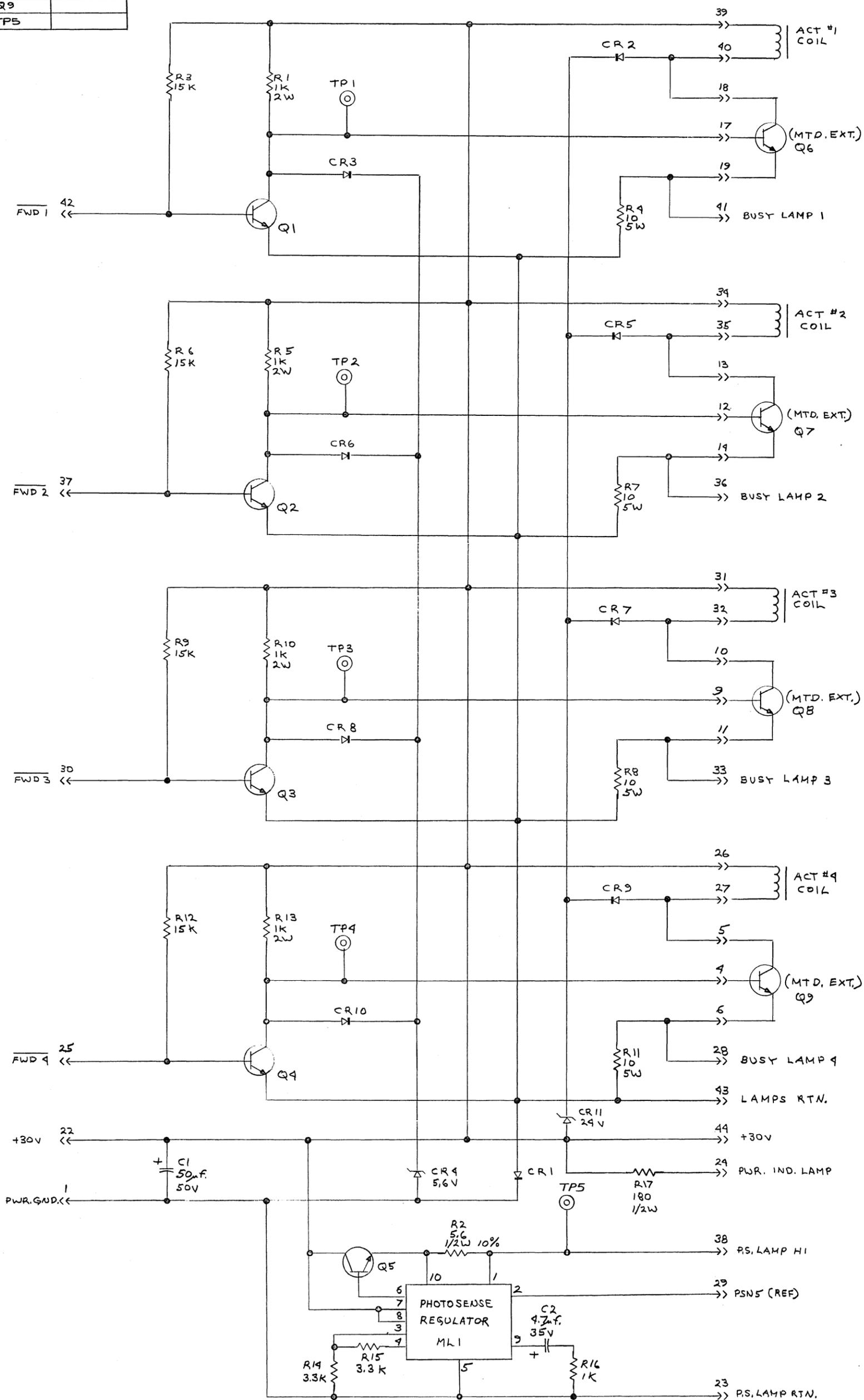


TRI-DATA

10972-0 PHOTONSENSE & LAMP BOARD ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
2	10971-0	P.C. Board	1	
3	10987-0	Lens, photosense	1	
5	00015-013	Cap., fxd, Tant., pol., luf, 35V	1	
7	00026-002	Diode, Zener, 5.6V, 1N4734A	1	
9	00030-004	Clip	3	
11	00041-007	Lamp, 14V, 100ma.	1	
13	00050-015	Ink, black, gloss	A/R	
15	00057-037	Res., fxd, comp., 10K, 1/4W, 10%	10	
16	00060-001	Res., var., 100K, 3/4W	5	
17	00075-001	Transistor, Si., 2N3904	5	
18	00079-001	Res., fxd, comp., 1.5K, 1W, 10%	1	
21	00098-004	Terminal, bifurcated	10	
23	10995-1	Photo-Transistor, medium	3	
24	10995-0	Photo-Transistor, high	2	

COMPONENT	LAST USED	OMITTED
CAPACITOR	C2	
DIODE	CR11	
INTEG. CIRCUIT	ML1	
RESISTOR	R17	
TRANSISTOR	Q9	
TEST POINT	TP5	



NOTES:

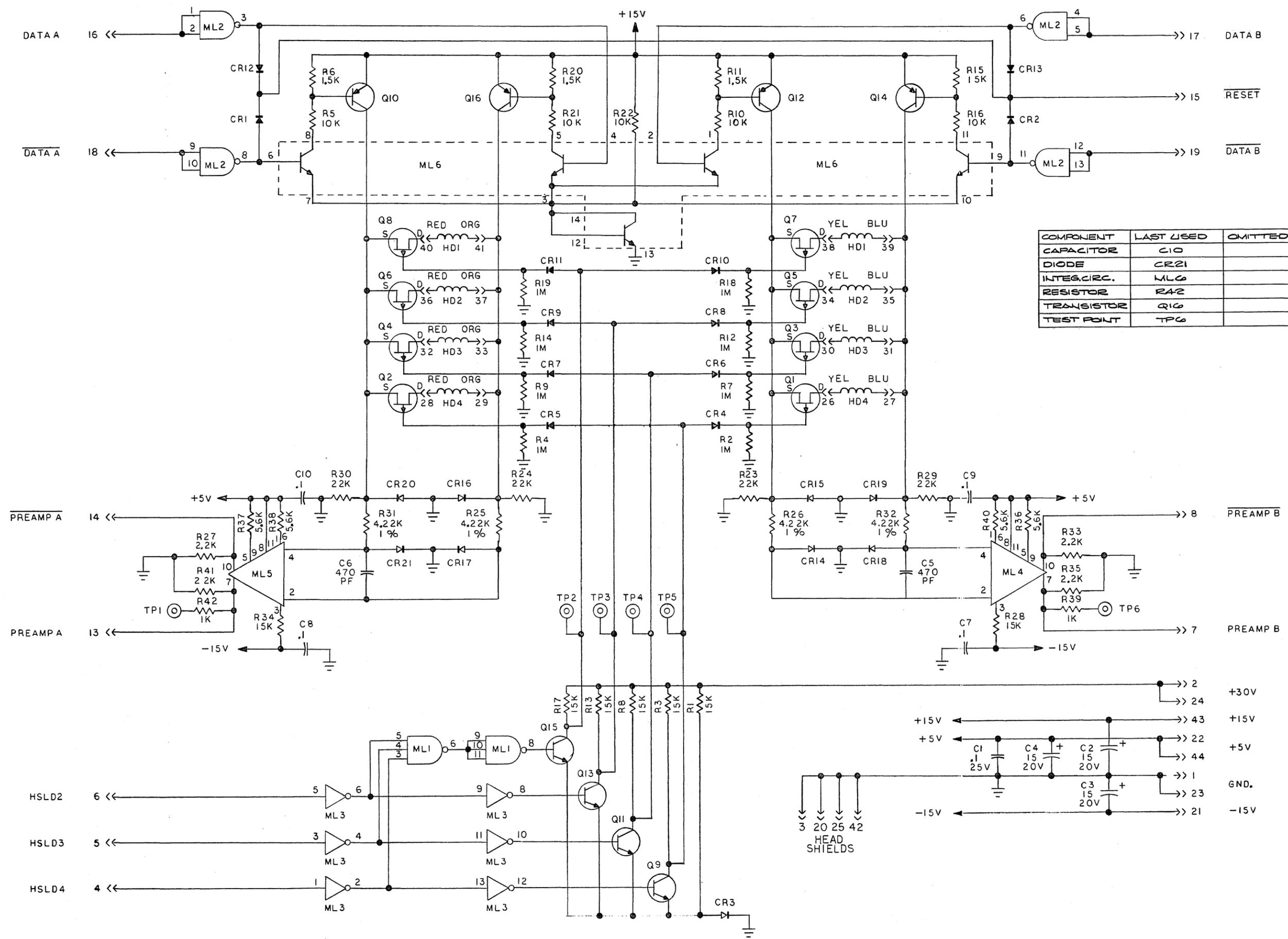
- UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS, 1/4W ±10%.
ALL CAPACITORS ARE IN MICROFARADS.

—K— SILICON DIODE



10974-0 ACTUATOR DRIVER BOARD ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
1	10973-0	P.C. Board	1	
3	00015-021	Cap., fxd, Tant., pol., 4.7uf, 35V	1	
4	00016-001	Cap., fxd, elect., 50uf, 50V	1	
6	00025-001	Diode, Si., 1N4496	4	
7	00026-002	Diode, Zener, 5.6V, 1N4734A	1	
8	00026-004	Diode, Zener, 24V, 1N4749	1	
10	00033-003	Intergrated Circuit, 723C	1	
11	00049-002	Nut, hex., self-locking, #4	A/R	
12	00054-001	Rectifier, Si., 1N4002	4	
13	00054-002	Rectifier, Si., 1N4998	1	
15	00057-025	Res., fxd, comp., 1K, 1/4W, 10%	1	
16	00057-031	Res., fxd, comp., 3.3K, 1/4W, 10%	2	
17	00057-039	Res., fxd, comp., 15K, 1/4W, 10%	4	
20	00059-002	Res., fxd, W.W., 1K, 2W, 10%	4	
21	00059-012	Res., fxd, W.W., 10ohm, 5W, 5%	4	
22	00062-011	Screw, mach., pan hd., 6-32 x 5/16	A/R	
23	00075-001	Transistor, Si., 2N3904	4	
24	00075-005	Transistor, Si., 2N5298	1	
26	00088-005	Res., fxd, comp., 5.6ohm, 1/2W, 10%	1	
27	00088-023	Res., fxd, comp., 180ohm, 1/2W, 10%	1	



COMPONENT	LAST USED	OMITTED
CAPACITOR	C10	
DIODE	CR21	
INTEG.CIRC.	ML6	
RESISTOR	R42	
TRANSISTOR	Q10	
TEST POINT	TP6	



10976-0 TRANSPORT BOARD ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
2	10975-0	P.C. Board	1	
4	00011-022	Cap., fxd, cer., .1uf, 25V	5	
5	00011-003	Cap., fxd, cer., 470pf, 500V	2	
6	00015-027	Cap., fxd, Tant., pol., 15uf, 20V	3	
8	00024-001	Diode, Ge., 1N270	12	
9	00025-001	Diode, Si., 1N4446	9	
11	00033-004	Intergrated Circuit, CA3046	3	
13	00045-014	Intergrated Circuit, 849P	1	
14	00045-015	Intergrated Circuit, 863P	1	
15	00045-023	Intergrated Circuit, 837P	1	
17	00057-025	Res., fxd, comp., 1K, 1/4W, 10%	2	
18	00057-027	Res., fxd, comp., 1.5K, 1/4W, 10%	4	
19	00057-029	Res., fxd, comp., 2.2K, 1/4W, 10%	4	
20	00057-034	Res., fxd, comp., 5.6K, 1/4W, 10%	4	
21	00057-037	Res., fxd, comp., 10K, 1/4W, 10%	5	
22	00057-039	Res., fxd, comp., 15K, 1/4W, 10%	5	
23	00057-041	Res., fxd, comp., 22K, 1/4W, 10%	4	
24	00057-061	Res., fxd, comp., 1M, 1/4W, 10%	8	
29	00075-001	Transistor, Si., 2N3904	4	
30	00075-002	Transistor, Si., 2N3906	4	
31	00075-007	Transistor, Si., 2N5464	8	
33	00085-039	Res., fxd, comp., 15K, 1/4W, 5%	2	
35	00086-048	Res., fxd, film, 4.22K, 1/8W, 1%	4	

10990-0 TAPE TRANSPORT ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
1	10041-1	Spacer, capstan	1	
2	10042-0	Washer, capstan	1	
3	10043-3	Flywheel, capstan	1	
4	10065-1	Pulley, motor	1	
5	10194-0	Cartridge Detent Assembly	4	
8	10923-0	Divider, cartridge	3	
9	10928-0	Bracket, switch	1	
10	10931-0	Cartridge Protector-Top	1	
11	10931-1	Cartridge Protector-Bottom	1	
12	10943-0	File Protect Seitch Assembly	2	
16	10972-0	Photosense & Lamp Board Assembly (see separate list)	1	
17	10974-0	Actuator Driver Board Assembly (see separate list)	1	
18	10976-0	Transport Board Assembly	1	
19	10978-0	Busy Light Board Assembly	1	
19.5	00041-004	. Lamp, type 328	1	
19.6	00041-009	. Lamp, type 327	1	
19.8	00042-006	. Filter, red	1	
22	10985-0	Hinge, Transport	1	
23	10988-0	Harness, Tape Transport	1	
24	10991-0	Transport Casting	1	
25	10993-0	Head/Actuator Assembly	1	
30	00001-009	Compound, retaining (Loctite)	A/R	
31	00004-002	Bearing, ball .500 x 1.125 x .312	2	
32	00007-004	"O" Ring Drive Belt	1	
35	00020-004	Connector, female	1	
36	00021-004	Contact, male	2	
39	00030-002	Clip, Tinnerman	1	
40	00030-009	Clip, Tinnerman	2	
41	00035-002	Mount, cable tie	A/R	
42	00035-004	Cable Tie	A/R	
45	00046-005	Motor, 115V	1	
47	00059-001	Nut, hex, self-locking, 1/4-28	1	
50	00062-010	Screw, mach., pan hd, 4-40 x 1/4	A/R	

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
51	00062-012	Screw, mach., pan hd, 4-40 x 3/8	A/R	
52	00062-014	Screw, mach., pan hd, 4-40 x 1/2	A/R	
56	00062-027	Screw, mach., pan hd, 6-32 x 3/8	A/R	
57	00062-030	Screw, mach., pan hd, 6-32 x 5/8	A/R	
58	00062-031	Screw, mach., pan hd, 6-32 x 3/4	A/R	
59	00062-032	Screw, mach., pan hd, 6-32 x 7/8	A/R	
60	00062-033	Screw, mach., pan hd, 6-32 x 1"	A/R	
61	00069-001	Switch, toggle, SPDT	1	
64	00077-001	Washer, ext tooth lock, #4	A/R	
65	00077-003	Washer, ext tooth lock, #6	A/R	
68	00078-002	Washer, plain, #4	A/R	
69	00078-003	Washer, plain, #6	A/R	
72	00080-013	Screw, socket hd, cap, 8-32 x 5/8	A/R	
73	00094-007	Setscrew, headless, hex, 4-40 x 3/16	A/R	
76	00119-005	Rivet, solid, 1/8 dia x 1.00 lg (SST 303)	2	
77	00119-006	Rivet, CSK, solid, 1/8 dia x 3/16 lg. Al	2	
78	00120-080	Tape, foam, 1/32 thk	A/R	
79	00129-004	Washer, split lock, #8	A/R	



TRI-DATA

10993-0 HEAD/ACTUATOR ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
1	10058-0	Cap, tape guide	8	
2	10075-0	Pinch Roller Actuator Assembly	4	
5	10467-0	Pad, felt	4	
6	10643-0	Spring Assembly, tape edge guide	8	
9	10927-0	Separator, tape	4	
12	10951-1	Rod, threaded	2	
13	10989-0	Bracket, connector	2	
14	10992-0	Mounting, head actuator	1	
15	10994-0/2	Head Plate Assembly - Top	2	
16	10994-3/5	Head Plate Assembly - Bottom	2	
18	00001-005	Acetate Cement	A/R	
19	00022-015	Key, polarizing	1	
20	00022-003	Connector, female (44 Pin)	2	
21	00027-025	Card Guide	2	
22	00038-001	Insulator	4	
23	00048-002	Nut, hex, #4-40	A/R	
24	00048-003	Nut, hex, #6-32	A/R	
25	00048-004	Nut, hex, #8-32	A/R	
27	00050-007	Red Glyptal	A/R	
28	00062-010	Screw, pan hd #4-40 x 1/4	A/R	
29	00062-011	Screw, pan hd #4-40 x 5/16	A/R	
30	00062-012	Screw, pan hd #4-40 x 3/8	A/R	
31	00062-014	Screw, pan hd #4-40 x 1/2	A/R	
32	00062-017	Screw, pan hd #4-40 x 3/4	A/R	
33	00062-030	Screw, pan hd #6-32 x 5/8	A/R	
35	00075-005	Transistor, 2N5298 Q6, Q7, Q8, & Q9	4	
38	00077-001	Washer, ext. tooth lock, #4	A/R	
39	00077-002	Washer, ext. tooth lock, #6	A/R	
41	00078-004	Washer, plain, #8	A/R	
42	00078-009	Washer, plain, #4	A/R	
45	00080-001	Screw, socket hd, cap, 4-40 x 1/4	A/R	
46	00080-005	Screw, socket hd, cap, 4-40 x 3/4	A/R	
47	00080-006	Screw, socket hd, cap, 6-32 x 1/4	A/R	
51	00127-021	Setscrew, hex, oval point, 6-32 x 5/8	A/R	



ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
55	00134-009	Pin, dowel, 3/32 dia x 3/8 lg, 18-8 SS	8	
56	00135-006	Spring, head	4	
57	00143-002	Setscrew, hex, cone point, 4-40 x 1/4	12	
61	00155-008	Spacer, threaded, tubular, 4-40 x 1½	2	
62	00159-001	Grease, silicone	A/R	

11048-0 FRONT PANEL ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
1	00001-001	Adhesive (Loctite #73)	A/R	
2	00001-006	Adhesive (Eastman 910)	A/R	
3	00030-011	Stud, ball	2	
4	10872-0	Lens	5	
5	10980-0	Panel, front	1	
6	00099-150	Tubing, shringk, blk.	A/R	



11049-0,-1 CABINET ASSEMBLY

ITEM NO.	TRI-DATA PART NUMBER	DESCRIPTION	QTY PER NEXT ASSY	SPARES
	11049-0	CABINET ASSEMBLY (External Interface)		
	11049-1	CABINET ASSEMBLY (Internal Interface)		
1	10929-0	. Bracket, transport lock	1	
2	10940-0	. Transistor Assy	1	
3	10940-1	. Transistor Assy	1	
4	10940-2	. Transistor Assy	1	
5	10941-1	. Wire Wrap Assy	1	
9	10981-0	. Cover	1	
10	10982-0	. Card Guide-Lower	1	
11	10982-1	. Card Guide-Upper	1	
12	10983-0	. Bracket, upper rear	1	
13	10983-1	. Bracket, upper rear	1	
14	10984-0	. Bracket, lower rear	1	
15	10984-1	. Bracket, lower rear	1	
18	10986-0	. Bracket, front panel	1	
21	00030-002	. Clip, Tinnerman	1	
22	00038-001	. Insulator	3	
24	00047-003	. Foot, black polyurethane	4	
25	00048-003	. Nut, hex. #6	A/R	
26	00048-010	. Nut, hex. #4 (small pattern)	A/R	
28	00062-014	. Screw, pan hd #4-40 x 1/2	A/R	
29	00062-018	. Screw, pan hd #4-40 x 7/8	A/R	
32	00077-001	. Washer, ext. tooth, #4	A/R	
33	00077-002	. Washer, ext. tooth, #6	A/R	
36	00078-002	. Washer, plain, #4	A/R	
37	00078-003	. Washer, plain, #6	A/R	
40	00089-003	. Clamp, cable, 1/4 x 3/8	1	
43	00119-006	. Rivet, CSK, solid AL, 1/8 Dia x 3/16	2	
44	00120-080	. Tape, adhesive coated (foam 1/32 thk.)	A/R	
47	00159-001	. Silicone Compound	A/R	

SPARE PARTS LIST
CARTRIFILE 20, 40, PD 20



PART
NUMBER

DESCRIPTION

CARTRIFILE 40 PLUG-IN CIRCUIT BOARDS

10746-1	Amplifier A/B
10786-0	Timing A/B
10788-0	Control "1"
10790-0	Regulator
10968-0	Control "2"
10962-0	Extender Board
10972-0	Photosense and Lamp Board
10974-0	Actuator Driver Board
10976-0	Transport Board
10978-0	Busy Light Board

CARTRIFILE 20 PLUG-IN CIRCUIT BOARDS

10746-1	Amplifier
10786-0	Timing A/B
10788-0	Control
10790-0	Regulator
10962-0	Extender Board
10780-0	Transport "2" Board
10782-0	Transport "1" Board
10784-0	Photosense Board
10871-0	Busy Lamp Board

PD 20 TRANSPORT PLUG-IN CIRCUIT BOARDS

10780-0	Transport "2" Board
10784-0	Photosense and Lamp Board
10871-0	Busy Light Board
11062-0	PD 20 #1 Board
11064-0	PD 20 #2 Board

INTERFACE CIRCUIT BOARDS CARTRIFILE 20, 40

10876-0	PDP-8I, PDP-8L Interface Board
10880-0	PDP-8E Interface Board
10888-0	PDP-11 Interface Board
10884-0	Nova Interface Board
11072-0	Honeywell Interface Board
11074-0	Interdata Interface Board
11078-0	Hewlett-Packard Computer Board
10896-0	Hewlett-Packard CartriFile Board

SPARE PARTS KITS FOR TAPE UNITS

10691-001	Component parts kit CartriFile 20/40. This kit is designed to provide the customer with spare components not readily available elsewhere and will provide for regular preventative maintenance and corrective maintenance if required. Contains 3-year supply of lamps and drive belts, linear and digital ICs (approx. 25), transistors, rectifiers, diodes, switches, relays and fuse.
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PART
NUMBER

DESCRIPTION

10692-001 Motor replacement kit CartriFile 20/40. Provides motor replacement with connector attached. Ready for plug-in.

SPARE PARTS KITS FOR CARTRIFILE 20/40 INTERFACES

10639-001 Spare components for PDP-8I, PDP-8L interface circuit board. Integrated circuits.

10693-001 Spare components for PDP-8E interface circuit board. Integrated circuits.

10694-001 Spare components for PDP-11 interface circuit board. Integrated circuit.

10695-001 Spare components for Nova interface circuit board. Integrated circuit.

10696-001 Spare components for Honeywell interface board. Integrated circuit.

10697-001 Spare components for Interdata interface board. Integrated circuit.

10698-001 Spare components for Hewlett-Packard interface board. Integrated circuits.

10699-001 Spare components for SPC-12/6 interface boards. Integrated circuits.

FIELD REPLACEABLE ASSEMBLIES AND MECHANICAL PARTS

00004-002 Bearings
00046-005 Motor, Capstan Drive (CartriFile 20/40)
00097-005 Fan (CartriFile 20/40)
10947-002 Power Supply (CartriFile 20)
10947-101 Power Supply (CartriFile 40)
10946-004 Tape Transport (CartriFile 20)
10990-001 Tape Transport (CartriFile 40)
10944-002 Head/Actuator Assembly (CartriFile 20, PD 20)
10993-001 Head/Actuator Assembly (CartriFile 40)
10075-004 Single Actuator (4096, 4196, CartriFile 20/40, PD 20)
10945 Single Head/Plate (CartriFile 20, PD 20)
10994 Single Head/Plate (CartriFile 40)
10043-201 Capstan/Flywheel (CartriFile 20)
10043-301 Capstan/Flywheel (CartriFile 40)
10943-001 Insert/Protect Switch Assembly (CartriFile 40/20, PD 20)
10643-002 Tape Edge Guide
10720-201 Alignment Tape (CartriFile 20/40)

TAPE UNIT EXERCISER

10840-0 Model 4092 Exerciser (CartriFile 20, 40)