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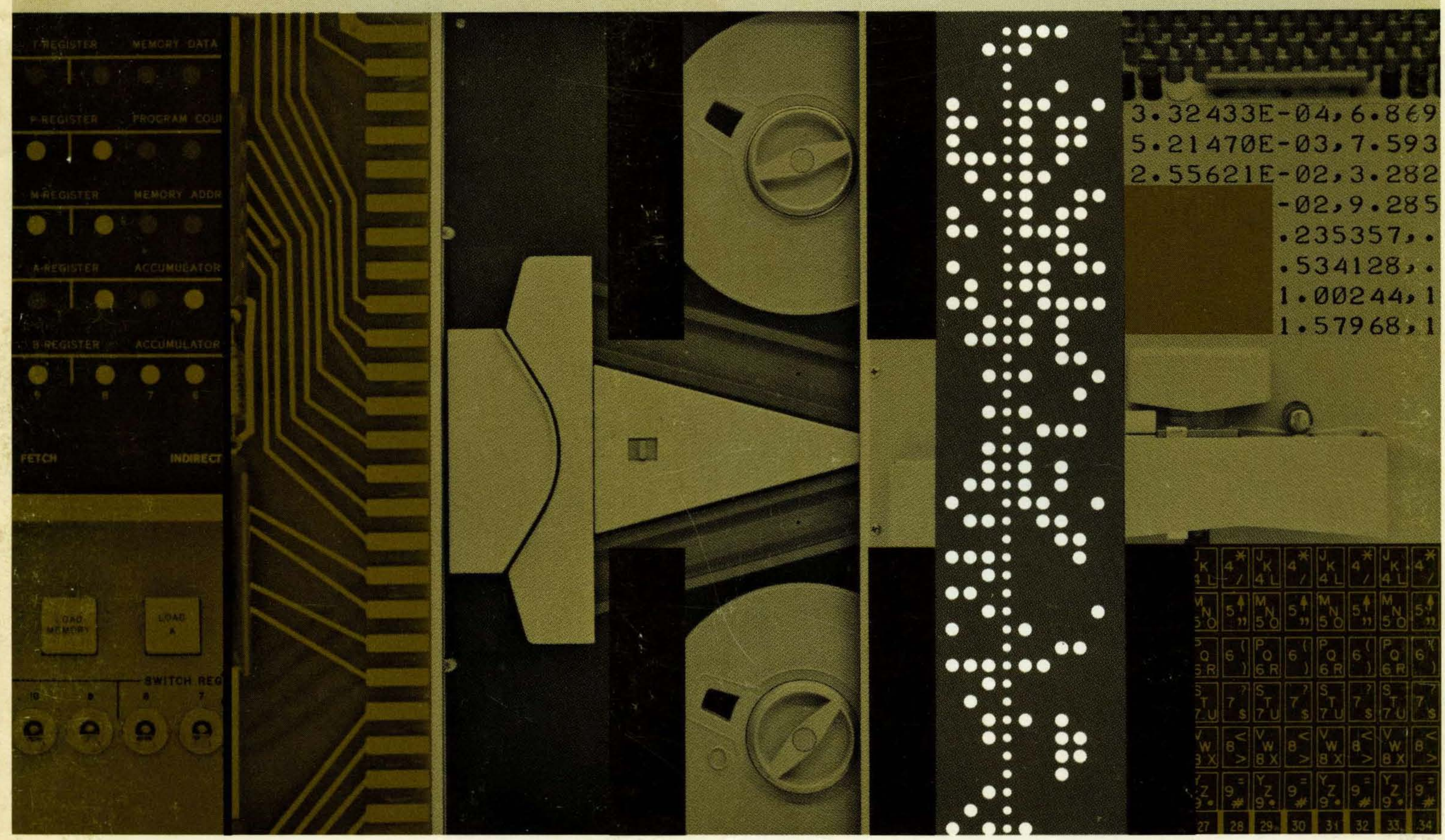
COMPUTER MAINTENANCE COURSE



VOLUME XIII

HP 2737A/B TAPE READERS

HEWLETT-PACKARD

COMPUTER MAINTENANCE COURSE

VOLUME XIII

STUDENTS MANUAL

HP 2737A/B TAPE READERS

(HP STOCK NO. 5950-8771)

-NOTICE-

The information contained in this manual is for training purposes only. Consult the Hewlett-Packard documentation supplied with the computer for current information concerning the specific computer system furnished.

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ILLUSTRATIONS

FOREWORD

THE HP TAPE READER COURSE

The HP2737A/B Tape Reader Course has been developed, under supervision of the Cupertino Division Training Department, to teach service engineers and technicians the basic fundamentals of Tape Reader operation and repair. All necessary course materials and training manuals are also supplied and may be retained by the student.

Although the basic HP Tape Reader Course does not provide for the disassembly and/or assembly of the Tape Reader units, it does provide a logical and effective learning vehicle for both the experienced and inexperienced computer specialists. The course does assume, however, that the student has an elementary understanding of electromechanical principles and basic machines in general. As in any professional endeavor, proper and effective execution of the best-planned program requires practice, skill and cooperation. The student is encouraged to study, review and practice the course material until he is satisfied that he has mastered the basic rudiments of Tape Reader operation and repair.

THE STUDENTS TRAINING MANUAL

The objective of this students Training Manual is to provide the student with an easily accessible reference manual which provides supplementary reading and study material, and complements the classroom lectures. The material presented in this manual, in general, follows the logical format used in the classroom and contains all the overhead visual slides that will be shown during the course.

The student is cautioned not to use this training manual as an operating or service manual. Those manuals are supplied with the computer documentation provided with all HP computer systems. The student should always consult the proper operating and service manual before attempting the operation, service or repair of any HP computer system. The information contained in this manual is for training purposes only.

SECTION INDEX

general information

I

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION

1-2. DESCRIPTION

1-3. The HP2737A and HP2737B Punched Tape Readers consist of a tape transport mechanism with associated electronics. These Readers detect, through photoelectric means, the coded data characters punched on paper tape. An electrical output derived from these detected characters is then made available as an input to associated instruments such as the HP2116A Digital Computer. The Readers also detect feed (sprocket) holes which are present on punched tapes between tracks 3 and 4 (IBM channel numbers 4 and 8, respectively). The output signal derived from these feedholes is then applied to the associated instruments to synchronize the detected data characters.

1-4. The HP2737A and HP2737B are similar except that the HP2737A does not include motors and control circuitry for tape wind and rewind. Both models, however, include the motor and control circuitry for tape advance, and a special feedhole differential amplifier circuit to compensate for variations (0 to 40%) in tape transmissivities. Forward tape drive is started by an external step command (positive or negative); removal of this command causes the tape to stop. Reading speed is 300 characters per second synchronous (continuous command) or 100 characters per second asynchronous (10 ms step command). The standard instruments as shipped accept one-inch tape (IBM 8 track).

1-5. POWER REQUIREMENTS

1-6. Power requirements for the Tape Readers are 115 VAC ± 10%, 50 to 60 Hz, at 150 watts for the model HP2737A or 420 watts for the model HP2737B.

1-7. OPERATION

1-8. MODES OF OPERATION

1-9. The operating modes for the HP2737B Punched Tape Reader are READ, READ/SPOOL and REWIND. The HP2737A Punched Tape Reader has only one operating mode which is READ. Therefore, the operating procedures given for READ/SPOOL and REWIND do not apply to HP2737A instruments.

a. READ MODE. This mode is applicable to both the HP2737A and HP2737B Punched Tape Readers. It is specifically intended to read unspooled or tape loops only. To start this mode of operation, throw the POWER switch to ON (HP2737A) or READ (HP2737B).

b. READ/SPOOL MODE. This mode is applicable to the HP2737B Punched Tape Reader only. It is specifically intended for reading spooled tapes. To start this mode, place the POWER switch to READ/SPOOL.

c. REWIND MODE. This mode is applicable to the HP2737B Punched Tape Reader only. It is specifically intended to rewind tapes completely or search a particular section of tape. This mode may be started by one of two methods.

(1) Local: Place the front panel REWIND switch ON (up).

(2) Remote: Make a contact closure between pins EE and HH on connector J2.

- NOTE -

The POWER switch must be set to the READ/SPOOL position for rewind operation.

1-10. Semi-transparent tapes which transmit up to 40% of the light applied are capable of being read by the Readers. Any higher level may not be compensated for by the Feedhole Differential Amplifier thereby giving false outputs. A tape that has a transmissivity higher than 40% must not be used with the HP2737A/B Punched Tape Readers. Mylar or high-quality paper tape are therefore always recommended for optimum operation.

1-11. COMPUTER PROGRAMMING

1-12. The HP2737A and HP2737B Tape Readers may be computer programmed using standard HP software supplied with all computer systems.

1-13. The BCS (Basic Control System) Tape Reader Driver Tape is a flexible Input/Output routine which permits transfer of data between the computer and the Tape Reader. The Driver is accessed through the BCS I/O Control Subroutine (.IOC.) by a 5-word calling sequence. The Driver is made part of the Basic Control System through the use of the Prepare Control System routine which is furnished with each computer. Reference Volume I (HP Computer Maintenance Course) for a detailed description of BCS and PCS routines.

1-14. The SIO (System Input/Output) Tape Reader Driver (4K or 8K depending on computer memory size) is a simple, unbuffered Input/Output routine used by standard software systems (Fortran and Assembler) to permit transfer of data between the computer and the Tape Reader. The Driver is incorporated into the system through the use of the SIO Dump Routine furnished with each computer. The Driver may also be accessed directly by a 3-word calling sequence in the user's program. Reference Volume I (HP Computer Maintenance Course) for a detailed description of the SIO calling sequence.

1-15. A simple machine program to input data to the computer is given in Table 1-1. This program will pack two 8-bit characters into the A or B Register.

TABLE 1-1. INPUT PROGRAM

LABEL	OP CODE	REMARKS
	CLF ØØ	TURN-OFF INTERRUPT
	STC,C17B	START READER
A	SFS 17B	FLAG SET?
	JMP A	NO - LOOP
	LIA	YES - LOAD 8 BITS
	ALF,ALF	ROTATE 8 BITS
	STC,C17B	START READER
B	SFS 17B	FLAG SET?
	JMP B	NO - LOOP
	MIA 17B	YES - MERGE 8 BITS
	PROGRAM CONTINUATION	

theory of operation

II

SECTION II

THEORY OF OPERATION

2-1. INTRODUCTION

2-2. ORIENTATION

2-3. The theory of operation for the HP2737A and HP2737B Punched Tape Readers is similar except for the wind and rewind circuitry added to an HP2737B Reader. Descriptions provided in the following sections are therefore valid for both models unless otherwise specified.

2-4. Applicable schematic and logic diagrams for both models are included as Figures 2-2, 2-3 and 2-4. Figure 2-2 is a schematic and logic diagram for the HP2737A; and Figure 2-3 is a schematic and logic diagram for the HP2737B. The Read and Control Board (A2) schematic shown in Figure 2-4 is valid for both models.

2-5. Figure 2-1 diagrams the mechanical parts which are referenced in the following descriptions.

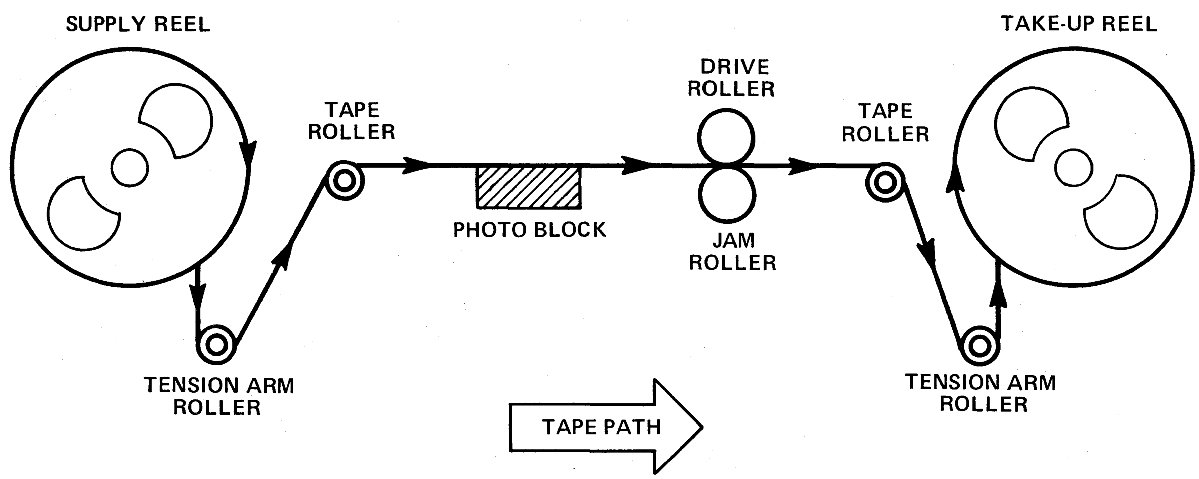

Figure 2-1. Tape Reader Mechanics

2-6. ELECTROMECHANICAL THEORY OF OPERATION

2-7. LAMP CIRCUIT

2-8. The lamp control circuitry is shown in Figure 2-4 and in either Figure 2-2 (HP2737A) or Figure 2-3 (HP2737B). An axial cartridge lamp (DS1) is used as a constant intensity light source to illuminate photo-block A1. This light activates the nine photo-cells (A1PD1 through A1PD9) when passed through a perforated tape. Variable resistor A2R53 sets the lamp voltage at approximately 20 volts. Transistors A2Q30 and Q3 then provide the necessary voltage regulation. The bias on Q3 is set by the conduction of A2Q30. In turn, the conduction of Q3 sets the voltage appearing across the lamp and variable resistor A2R53. In this manner, any voltage change across the lamp appears across A2R53 which changes the conduction of A2Q30 and hence the bias on Q3. Thus, any attempted lamp voltage change from 20 volts is immediately compensated for by the conduction of Q3.

2-9. FORWARD DRIVE CIRCUIT

2-10. The forward drive circuit is shown in either Figure 2-2 (HP2737A) or Figure 2-3 (HP2737B), and Figure 2-4 for both models. A negative input to pin J2-w (or a positive input to pin J2-s) is inverted by transistor A2Q31, amplified by A2Q32, and then inverted again by A2Q33. This conditioned input is applied to switching transistors Q1 and Q2. When the RUN-LOAD switch S1A is closed (RUN), Q1 is switched on by the negative input appearing at A2-y. Transistor Q2 is simultaneously switched off by the positive input appearing at A2-z. Now with Q1 switched on, forward jam roller coil L1 is energized and the drive roller motor B1 advances the tape. Then, when the input at pin J2-w or J2-s is removed, the base of Q2 returns to zero level and Q2 is switched on. Transistor Q1 becomes biased by the voltage appearing across R2 and the current through Q1 is not sufficient to hold L1 energized. Brake shoe coil L2 is then energized and the tape is braked to a stop by the brake shoes.

2-11. When the RUN/LOAD switch S1A is set to the LOAD position (S1A open) the emitter return circuit is broken and neither Q1 nor Q2 can be switched on. This action releases the brake mechanism during the tape loading operation and removes ac power from the drive circuit (via S1B). Also, with S1A open, a ground is applied to A2-15 which complements an "or" gate (A2CR14 and A2CR15) in the differential amplifier circuit. This "or" gate disables the feedhole Differential Amplifier A2Q25 and prevents generation of false feedhole outputs.

2-12. FEEDHOLE CIRCUIT

2-13. Feedholes detected by photocell A1PD9 cause negative pulses to be applied to Differential Amplifier A2Q25 (via J1-9 and A2-1). This differential amplifier circuit compensates for temperature variations and loads the photocell circuitry in such a manner that a 200 mV differential must exist on the base of A2Q25 to detect a feedhole input. This assures that the tape is read correctly even though transmissivities may vary 0 to 40%. This is important because the feedhole output is used by computers and programmers to strobe the data channels.

2-14. Variable resistor A2R33 sets the feedhole sensitivity. Transistor A2Q25 amplifies the feedhole signal appearing at A2-1 which is then applied to a Schmitt Trigger consisting of A2Q26 and A2Q27. This conditioned feedhole signal is then supplied to output connector J2 via transistor drivers A2Q28 and A2Q29.

2-15. DATA CHANNEL CIRCUITS

2-16. The photocell detected input for each data track appears at connector J1, on pins 1 through 8. Channel 1 circuitry for track 1 is shown in Figure 2-4; the remaining seven channels use identical circuitry and are shown in block form on this diagram.

2-17. A negative-going pulse at pin J1-1 and A2-2 is amplified by A2Q1 and A2Q9, and then appears as a negative output at A2-13 and J2-B. This data signal is also inverted by transistor A2Q17 to provide a positive output at A2-14 and J2-F.

2-18. WIND AND REWIND CIRCUITS (HP2737B)

2-19. The wind and rewind circuitry is shown in Figure 2-3. When the POWER switch (S2) is set to READ/SPOOL, forward drive roller motor B1 causes tape to advance and the tension arm drops. This causes the normally open contacts on tension switch S3 to close (slack). Relay K2 is then energized via K1-E, tension switch S3, and the relay rectifier circuit CR9 through CR12. With K2 energized, take-up motor B3 (right reel) is turned on via POWER switch S2B, RUN-LOAD switch S1B, POWER switch S2A, relay K1-A, and the now closed contacts on K2. The tape is then spooled. Now, this action causes tape tension to increase and the contacts on tension switch S3 to open. Relay K2 then de-energizes and the take-up motor B3 is turned off. At the same time, the shading coil for B3 is shorted out (via S3 and K1-F) so that B3 is dynamically braked.

2-20. The feed motor B2 (left reel) operates in a manner opposite to take-up motor B3. When tape tension increases, the normally open contacts on tension switch S4 close, causing B2 to feed out tape until the tension relaxes. The contacts on S4 then open again and power is removed from B2.

2-21. When REWIND switch S5 is closed, or a remote ground closure is applied to pin J2-EE, rewind relay K1 energizes. This causes the forward jam roller and brake shoe circuit to be inhibited (via K1-G) so that the tape is released. The connections to B2 and B3 are now reversed (via K1-C and K1-E) so that both motors run in reverse. The motors now operate in a manner opposite to that for the wind mode. That is, take-up motor B3 now feeds tape whenever tape tension increases. Feed motor B2 is now energized constantly (via K1-B) regardless of tension switch S4. Also, take-up motor B3 is not dynamically braked in rewind as K1-F contacts are now open. Relay K2 is de-energized via the D contacts on relay K1.

2-22. POWER SUPPLY

2-23. The main power supply is shown in either Figure 2-2 (HP2737A) or Figure 2-3 (HP2737B). Either figure is applicable since both models use the same power supply. The line source (115 vac) is accepted through connector J101. When the POWER switch is set to ON (HP2737A) and READ or READ/SPOOL (HP2737B) the source voltage is coupled across transformer T1 to a dual secondary. One secondary winding supplies the bridge rectifier consisting of diodes CR5 through CR8 and an associated filter network (R6 and C1). This rectifier provides the -30 vdc unregulated bus, and the regulated -12 vdc bus via power transistor Q4 and the -12 vdc control circuit. The other secondary winding provides the regulated voltage for the +5 vdc regulated bus via the +5 vdc power supply.

2-24. -12V Regulated Voltage Control. The -30 vdc unregulated bus is applied to power transistor A2Q34 via A4 and J2-17. A breakdown diode connected across this power transistor maintains the output at -12 vdc. This output is then coupled to the -12 vdc regulated bus. Any attempted change in the -12 vdc bus occasions a change in the conduction of Q4 which controls the conduction of A2Q34 in such a manner as to compensate for the voltage change. Breakdown diode A2CR8 assures that the output voltage never drops below 11.7 volts.

2-25. +5 Power Supply. The unregulated source voltage is applied to a bridge rectifier consisting of A2CR10 through A2CR13. A breakdown diode (A2CR9) assures that any attempted change in the +5 vdc bus changes the conduction of regulating transistor A2Q35 which supplies the current for the rectifier. A change in this current then causes a change in the output voltage.

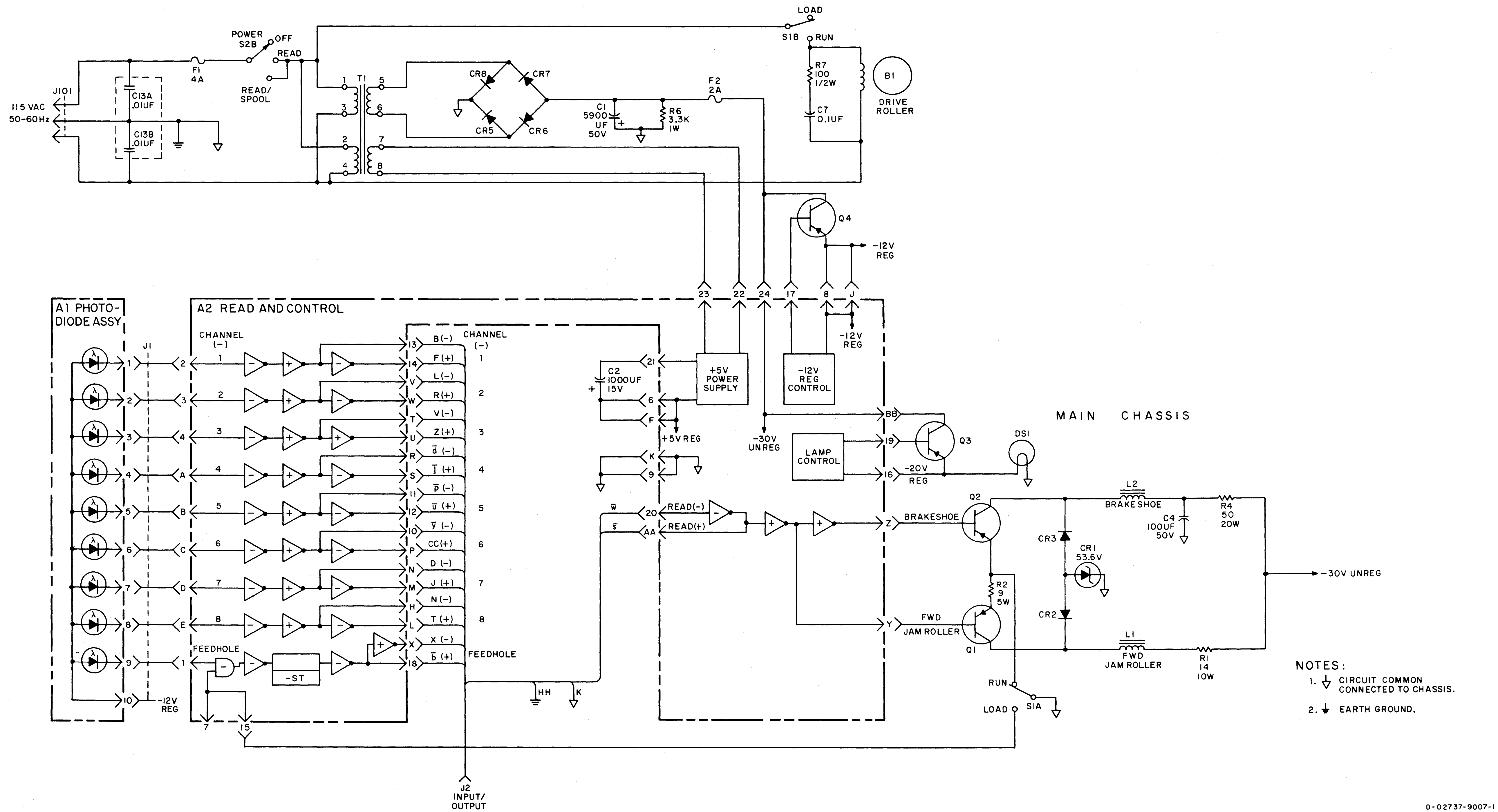

Figure 2-2. HP2737A Logic and Wiring Diagram

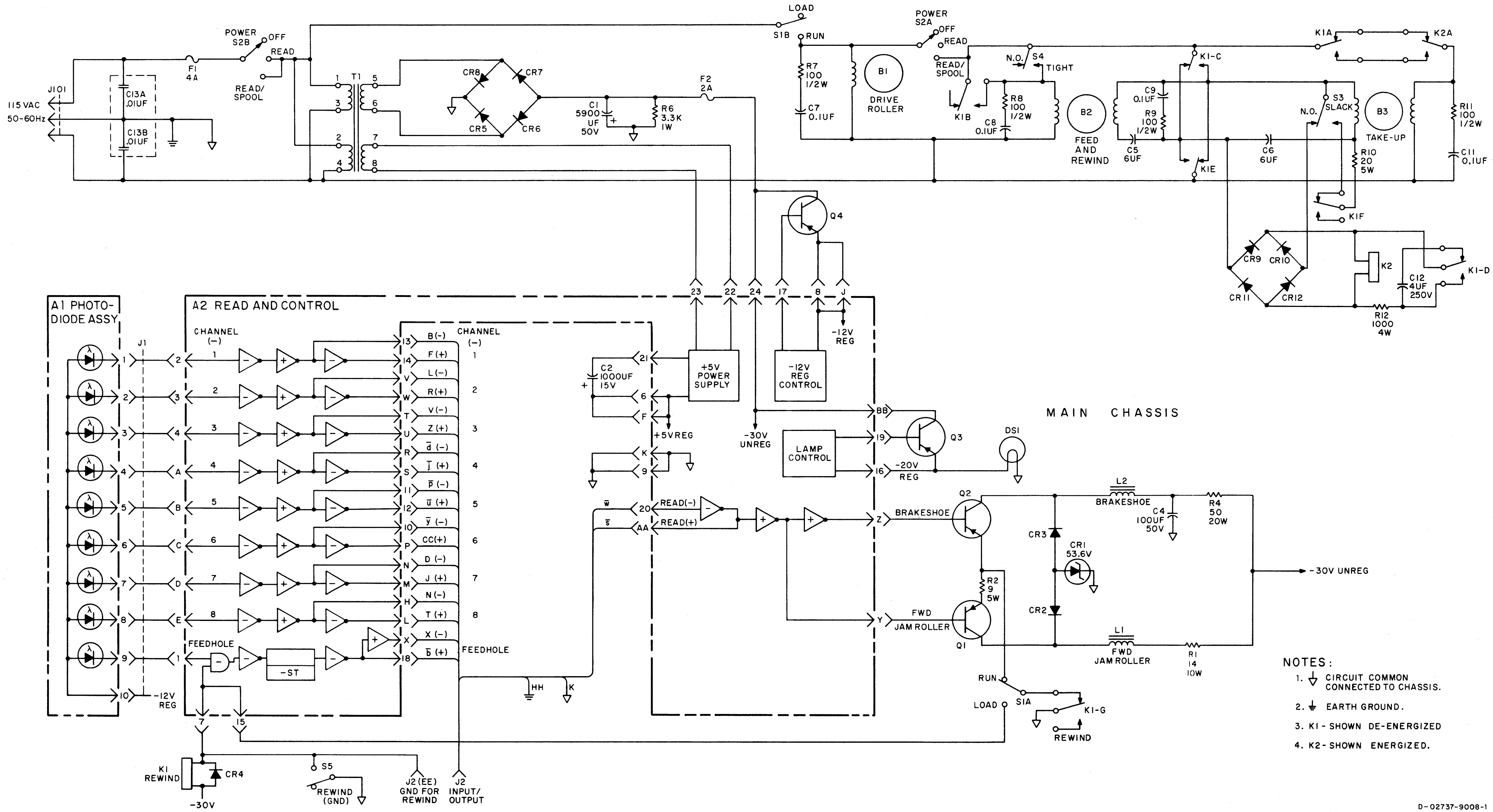

Figure 2-3. HP2737B Logic and Wiring Diagram

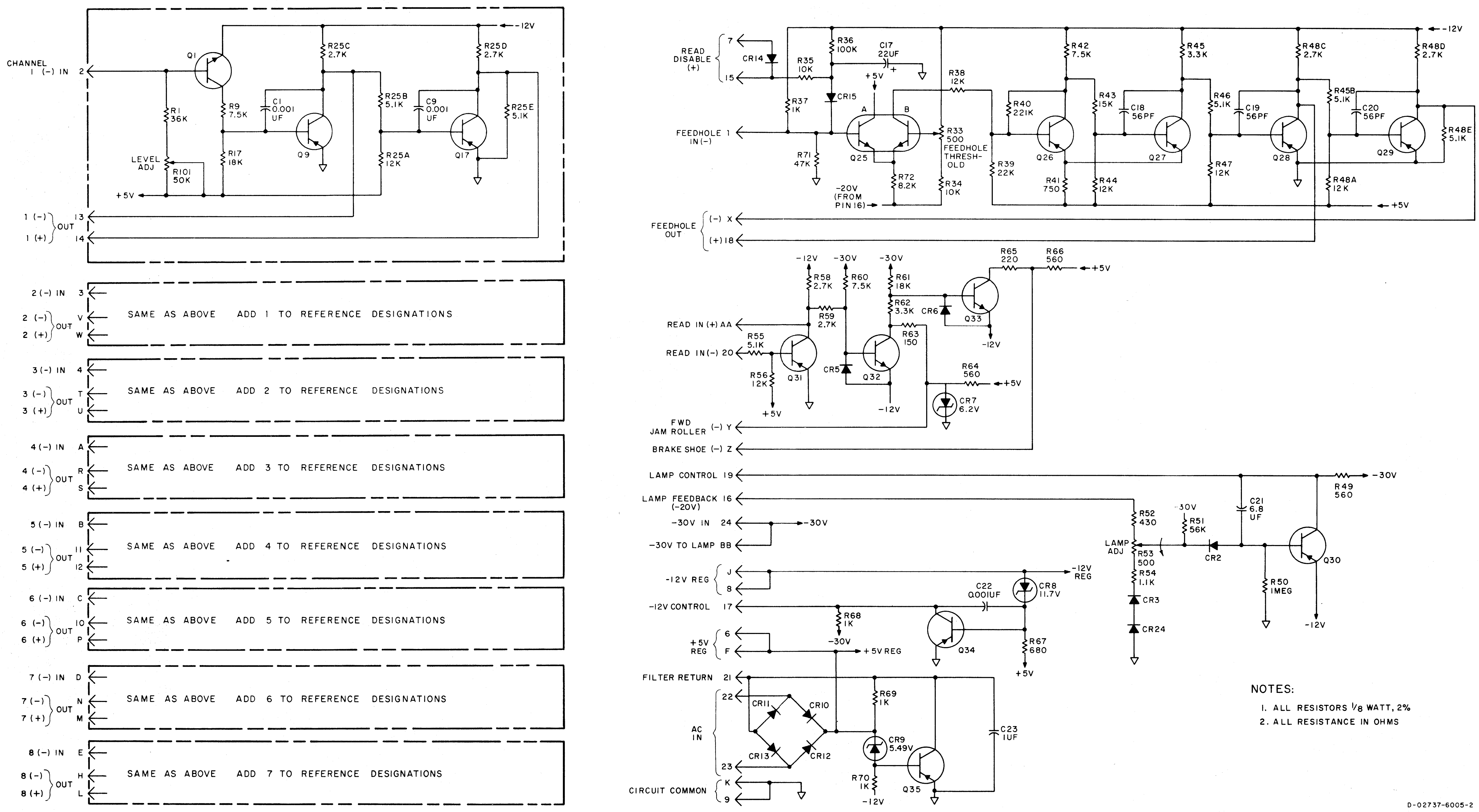

Figure 2-4. HP2737A/B Read and Control Assembly

computer interface

III

SECTION III
COMPUTER INTERFACE

3-1. INTRODUCTION

3-2. DESCRIPTION

3-3. The HP Interface Kit 12532A is used to interface the HP2737A/B Tape Readers with all HP computers. This kit is comprised of one Tape Reader Interface Card (HP02116-6002) and all necessary software to input data to the computer. Also included is a Diagnostic Test Tape which may be used to isolate malfunctions in the Readers, the interface card and/or the computer. This section will be limited to a discussion of the interface card and its interaction with the Reader and computer during the course of processing data.

3-4. The Tape Reader Interface Card may assume any I/O Select Code in the range 10 thru 77 (octal). Consult the documentation supplied with your particular computer system for the correct select code assignment.

3-5. The read operation may begin when the punched tape to be read is placed in the Punched Tape Reader and the POWER ON/OFF switch on the front panel is turned ON. If the interrupt system is to be used to signal that one character of data is available in the interface card Data Register for transfer to the computer, an STF instruction with a Select Code of 00 (octal) must be programmed. This enables the interrupt system.

3-6. The interface card logic is shown in Figure 3-1. The read operation is initiated by an STC, C instruction to the interface card. This initiates the reading of a single character. The CLF portion of the instruction resets the Flag Buffer and Flag Flip-Flops to prevent an interrupt signal from being sent to the computer before the Tape Reader has transferred data to the interface card. The STC instruction sets the Drive Flip-Flop which applies a true input to each of the Data Register Flip-Flops (two true inputs are required to set each Flip-Flop). The set Drive FF also causes a "drive" signal to be sent to the Tape Reader to move the punched tape until a feed (sprocket) hole is directly over the photo-diode assembly. Any holes in the eight data tracks cause the Tape Reader to apply a negative voltage to the eight Data Register circuits which correspond to the tracks containing the punched holes. Thus, the Data Register contains a set Flip-Flop for each hole read and temporarily stores this information.

3-7. When the Tape Reader detects the feed hole in the tape it applies a negative voltage as a "flag" signal to the interface card. The "flag" signal resets the Drive FF, removing the "drive" signal to the Tape Reader and preventing further movement of the tape. Resetting the Drive FF also causes the interrupt logic on the interface card to signal the computer that data is available (either by an interrupt signal or by a SKF signal, depending on the method selected). An LIA or LIB instruction then generates an IOI signal to enable parallel transfer of the eight possible data bits, representing the character read, to the eight least-significant bit positions (bits 0-7) of the A or B Register. To pack two characters in the A or B Register (and then into a memory location), rotate instructions (ALF or BLF) are used to rotate the first eight bits into the most-significant bit positions (bits 8 through 15) of the register. An MIA or MIB instruction is then used to transfer the second eight bits from the interface card to the A or B Register. An LIA or LIB instruction cannot be used for the second character transfer since these instructions would destroy the first character read.

3-8. To read the next character, another STC, C instruction must be programmed. The read operation is then repeated. After all data has been read, a CLC instruction must be programmed to reset the Control FF and remove the Tape Reader from the Input/Output System.

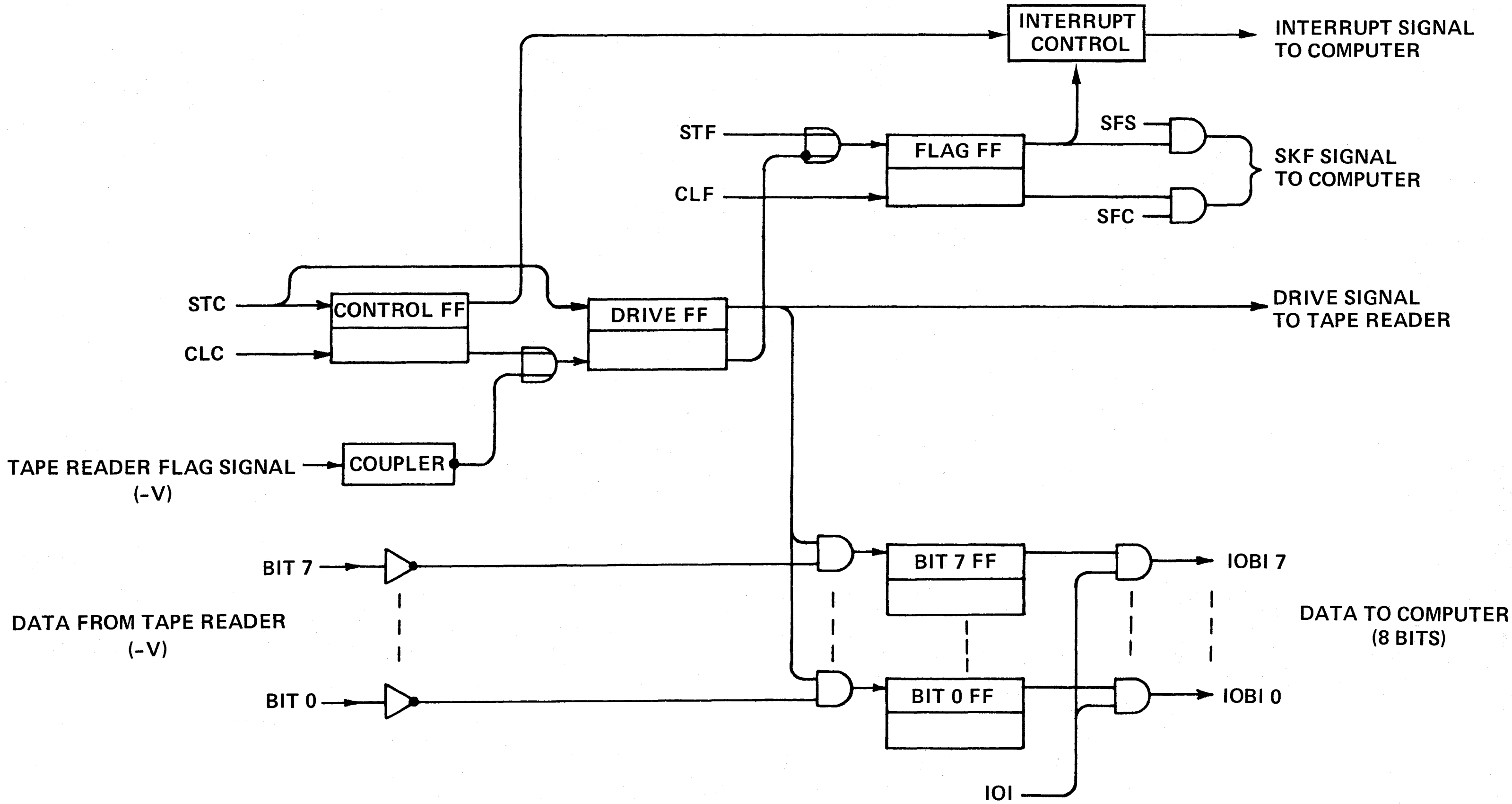

Figure 3-1. Simplified Logic Diagram for Punched Tape Reader Interface Card

3-9. THEORY OF OPERATION

3-10. COMPUTER POWER ON

3-11. The Tape Reader Interface Card schematic is shown in Figure 3-2. When power is initially applied, the POPIO(B) and CRS signals are sent to the interface card (pins 17 and 13 respectively). The POPIO(B) signal sets the Flag Buffer FF through "and" gate MC44C. At time T2, the ENF signal resets the IRQ FF which enables "and" gate MC44A and sets the Flag FF. The CRS signal resets the Control FF and this resets the Drive FF. The interface card has now been initialized.

3-12. THE INTERRUPT SYSTEM

3-13. The interrupt system can be used to signal that one character is available in the Data Register for transfer to the computer. In this case, the Interrupt System Enable FF (on the I/O Control card) must be set by an STF instruction with a Select Code of 00 (octal). This turns the interrupt system on.

3-14. Moving the punched tape to a row of data holes requires an STC instruction with a Select Code of the Tape Reader. This provides the STC, LSCM, LSCL, and IOG(B) signals to the interface card. The STC signal is applied as one true input to "and" gate MC104A. The LSCM, LSCL, and IOG(B) signals are applied to "and" gate MC34C which provides the second true input to gate MC104A. The true output of gate MC104A then sets the Control FF (MC123) and the Drive FF (MC103).

3-15. The true output of the Drive FF is applied as one true input to each of the Flip-Flops in the Data Register, preparing them to receive new data from the Tape Reader. The Drive FF also applies a positive voltage, through diode CR1, to the base of normally-conducting transistor Q23. This turns off the transistor, sending a negative "drive" voltage to the Tape Reader through pin 21 of the interface card. This negative voltage causes the Tape Reader to drive the tape to the next feed hole.

3-16. When the next feed hole in the tape is directly over the feed-hole sensing photo-diode in the Tape Reader, a negative "flag" signal is applied to the interface card through pin 23. Simultaneously, the Tape Reader is reading the data holes in the tape and causing the appropriate Flip-Flops in the Data Register to set. Resistor R47 and capacitor C9 filter the incoming signal which turns off the normally-conducting transistor Q22. This places a positive voltage on the base of transistor Q21, causing it to conduct. The positive voltage, normally on the collector of transistor Q21 making transistor Q20 conduct, is removed and turns off transistor Q20. This applies a positive voltage through resistor R39 to the base of transistor Q19. Emitter follower transistor Q19 then conducts, causing transistor Q18 to conduct which turns off transistor Q17. When transistor Q17 is normally conducting, about 4 volts is applied to pins 7 and 8 of Drive FF MC103 and to pins 1 and 14 of Flag Buffer FF MC113. This does not reset the Drive FF or set the Flag Buffer FF (since pins 8 and 14 are inverting inputs and will perform their respective function only on receipt of a negative-going signal). When transistor Q17 is turned off, its emitter voltage drops and the negative-going voltage to pins 8 and 14 causes the Drive FF to be reset and the Flag Buffer FF to set.

3-17. When the Drive FF resets, the positive voltage is removed from the base of transistor Q23 and is replaced by a negative voltage through resistor R48 from the -2 volt supply. This permits the transistor to conduct, removing the negative "drive" voltage to the Tape Reader. The Tape Reader cannot now advance the tape. When the Flag Buffer FF sets, the interrupt request to the computer is initiated.

3-18. When the feed hole in the punched tape is directly over the feed-hole sensing photo-diode in the Tape Reader, the data holes will also be directly over their sensing photo-diodes. The data holes in the tape are arranged in tracks numbered 1 through 8. When a data hole is sensed, -12 volts is applied to the appropriate Data Register circuit on the interface card. For example; if a hole is sensed in track 3 of the tape, a negative voltage is applied to pin B of the interface card. In this example, resistor R9 and capacitor C3 filter the incoming voltage which is applied to the base of transistor Q5. This turns off the transistor, applying a positive voltage to the base of transistor Q6. With 4.5 volts applied directly to the collector of transistor Q6, the transistor conducts and sets the Bit 2 FF (MC43A). In the same manner, a data hole in any other track sets the corresponding Flip-Flop in the Data Register.

3-19. The true set side output of each Flip-Flop in the Data Register is applied to an "and" gate. The other input to the "and" gate is from "and" gate MC54B. For gate MC54B to output a true signal, enabling the contents of the Data Register to the computer; an LIA, LIB, MIA, or MIB instruction to the interface card must be programmed. Any of these instructions will provide the true LSCM, LSCL, and IOG(B) signals to get true outputs from "and" gate MC34C and gate MC54B, and a true IOI signal to gate MC54B. One character has now been read from the punched tape and transferred to the computer's A or B Register. Another character will be read when an STC, C instruction is programmed to the interface card. If operation of the Tape Reader is completed, a CLC instruction must be programmed to the interface card to remove the Tape Reader from the Input/Output system.

3-20. THE WAIT-FOR-FLAG METHOD

3-21. The set or reset condition of the Flag FF on the interface card can also be used to signal that one data character is available in the interface-card Data Register for transfer to the computer. With the use of this method, the interrupt system must be disabled by resetting the Interrupt System Enable FF (on the I/O Control card) with a CLF instruction and a Select Code of 00 (octal). This turns the interrupt system off.

3-22. Moving and stopping the tape is identical to that for read control using the interrupt system except that an SFS instruction must be programmed after the STC instruction.

3-23. When the Flag Buffer FF sets, its output is applied to "and" gate MC44A. At time T2, the true ENF signal provides a true output from "and" gate MC54C to gate MC44A. Gate MC44A then sets Flag FF MC94. The set side output of the Flag FF is applied to "and" gate MC64A. (The output of the Flag FF has no effect on "and" gate MC74A since the IEN signal will be false with the interrupt system disabled.) The other inputs to gate MC64A are true since the SFS instruction to the interface card provides a true SFS signal and the LSCM, LSCL, and IOG(B) signals provide a true output from "and" gate MC34C. The true output of gate MC64A is applied to "and" gate MC24A which provides a true SKF signal output to the computer through pin 12 of the interface card.

3-24. On receipt of the SKF signal, indicating that the next instruction is to be skipped, an LIA or LIB instruction may transfer the contents of the Data Register to the computer as in the read control using the interrupt system. An SFC instruction, being the complement of the SFS instruction, can also use the set or reset Flag FF in programming the Tape Reader. With this instruction, "and" gate MC64B provides a true input to "and" gate MC24A which applies the SKF signal to the computer.

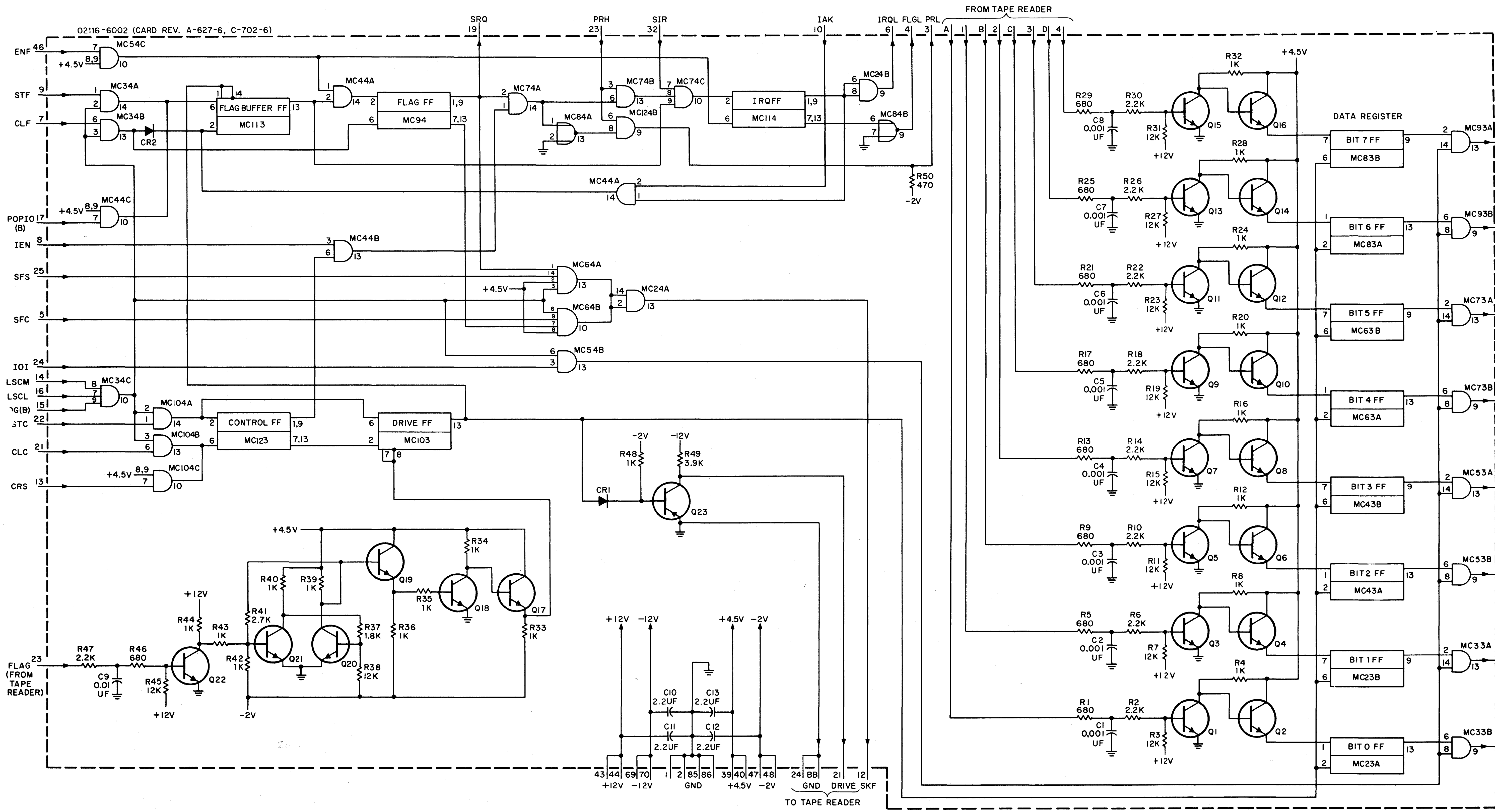

Figure 3-2. Tape Reader Interface Schematic

maintenance

IV

SECTION IV

MAINTENANCE

4-1. INTRODUCTION

4-2. GENERAL

4-3. The HP2737A/B Punched Tape Readers should require very little maintenance when periodically adjusted properly. A suggested preventive maintenance schedule is shown in Table 4-3. This section will describe the procedures for complete mechanical and electrical adjustments for the Readers, and provide information on the more common malfunctions that may occur over a period of extended usage.

4-4. The HP2737A/B Punched Tape Readers will perform satisfactorily with a wide variety of punched tapes. However, the type and condition of the tape can affect operation. In general, Mylar tape is preferred, but any type not seriously affected by moisture will suffice. The tape color should be such that the "transmissivity" does not exceed 40%.

4-5. The condition of the tape can cause serious difficulty in the operation of the Readers. Some of the more common Reader malfunctions can usually be traced to one of the following conditions:

a. Pulled Sprocket Holes: Some tapes have an occasional elongated sprocket hole. This is usually caused by a mis-adjusted tape punch or a mis-loaded supply reel on the punch. If the sprocket holes arrive too soon, the code holes may be completely ignored by the Reader.

b. Chad in Tape: Chad fits tightly in tape holes and may cause misreading of the tape. Tape should never be run on the floor or fed from a chad box.

c. Lint on Tape: Lint on a tape can accumulate under the Reader lamp and block off the light. Tapes and their containers should be kept clean. The Reader should be brushed out and air blasted periodically.

d. Ragged Edges: A code hole that has been torn out leaving ragged edges will normally be read correctly. But the bit of paper that folds back and covers the next hole may cause the following character to be misread.

e. Oil Spots: Normal oil-impregnated tapes should not affect Reader operation. But oil from other sources will. Lubricating oil may even bleach the color from the tape. Oil contamination is usually the result of allowing tape to stand for long periods in the head or tape holder of a tape punch.

4-6. Tape Splicing. A butt splice is recommended whenever a tape breaks. This type splice is made by bringing the ends of the tape together without any overlapping and securing them firmly together with the splicing material. Silver Scotch Tape No. 852 is the recommended splicing material. Make sure the splicing material ends between feed holes and is trimmed coincident with the tape edge.

4-7. MECHANICAL ADJUSTMENTS

4-8. DRIVE AND JAM ROLLER GAP ADJUSTMENT

4-9. The drive and jam roller gap adjustment is made with the rocker stop as shown in Figure 4-1. This adjustment is made as follows:

a. Throw the POWER switch to OFF.

b. Remove tape from the Reader.

c. Loosen the rocker stop lock nut.

d. With the rocker placed against the rocker stop (as shown in Figure 4-1), rotate the stop until the gap is 0.015 ± 0.001 inch.

e. Now tighten the lock nut. Then recheck the gap size.

4-10. DRIVE MAGNET AIR GAP ADJUSTMENT

4-11. The drive magnet air gap adjustment is made with the rocker and magnet as shown in Figure 4-2. The adjustment is made as follows:

a. Throw POWER switch to OFF.

b. Remove tape.

c. Now rotate the rocker until the rollers are fully engaged (as shown in Figure 4-2).

d. Loosen the drive magnet adjustment screws. Then move the magnet until the gap between the angle attached to the rocker and the magnet end is 0.020 ± 0.004 inches. Make sure the longitudinal axis running through the magnet makes a right angle (90°) to the vertical (as shown in Figure 4-2).

e. Tighten the drive magnet adjustment screws. Then recheck the gap size.

4-12. REWIND AND TAKE-UP MOTOR BRAKE TENSION ADJUSTMENT (HP2737B Models only)

4-13. The rewind and take-up motors (M2 and M3) brake tension adjustments are made as shown in Figure 4-3. To make these adjustments, proceed as follows:

a. Use a screwdriver (as shown in Figure 4-3A) to slide the armature back approximately 1/8 inch and hold it in that position.

b. Loosen the set screw at the rear of the motor and move the fan assembly toward the motor until the brake surfaces are engaged. Now tighten the set screw.

c. Remove the screwdriver.

d. Attach a spring scale to the fan (as shown in Figure 4-3B) and pull back the armature shaft until the brake surfaces just separate. The required force should be between 6 and 7 ounces.

e. Now pull the armature shaft all the way back. The gap between brake surfaces must be greater than 0.005 inches.

f. Repeat steps "a" thru "e" until the desired results are obtained.

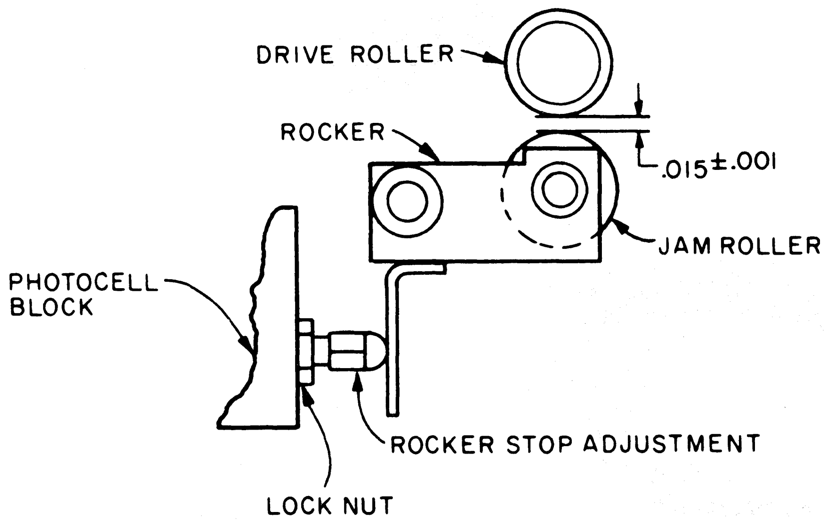

Figure 4-1. Driver and Jam Roller Gap Adjustment

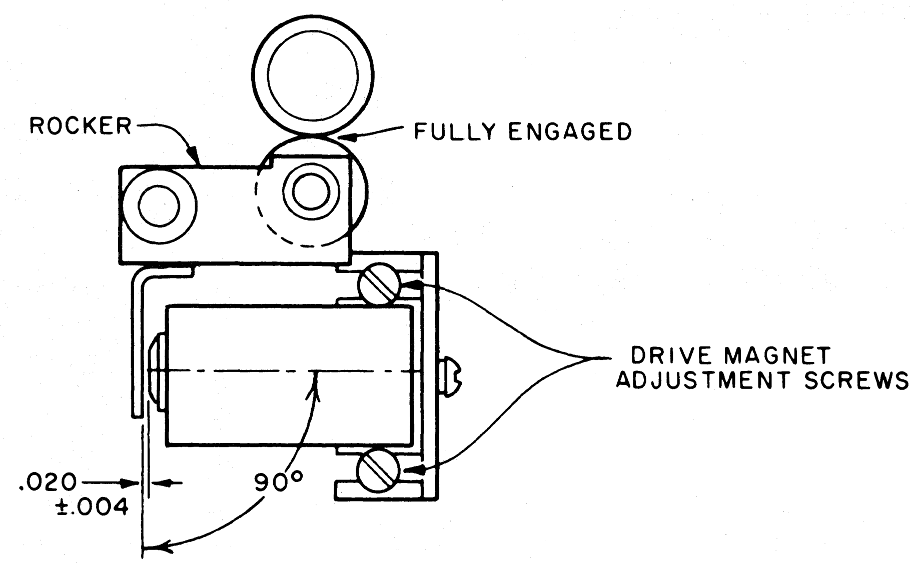

Figure 4-2. Drive Magnet Air Gap Adjustment

4-14. BRAKE MAGNET CLEANING PROCEDURE

4-15. The brake magnet cleaning procedure is accomplished as follows:

a. Remove the upper cover.

b. Refer to Figure 4-4 and loosen the two No. 4-40 allen screws which hold the brake shoe housing (top half of brake).

c. Insert a screwdriver under the brake shoe while carefully removing the housing from the mounting block. Be sure to keep the parts intact while removing the housing, and leave the mounting block secured to the panel.

d. Now use water or alcohol to clean the residue from the housing, the brake shoe, the spring and the magnet face.

e. Reassemble the brake shoe housing (as shown in Figure 4-4) and remount it to the mounting block. It is important for maximum braking action that the spring be placed as shown, and not inverted.

4-16. ELECTRICAL ADJUSTMENTS

4-17. GENERAL

4-18. The following procedure is used for adjusting the lamp brilliance and the output level of the photocells. The lamp voltage is set by variable resistor A2R53 which is accessible on the rear of the main chassis. This adjustment controls the level of brilliance. The gain of each data photocell amplifier is set by variable resistors A2R101 through A2R108 which are accessible through the bottom chassis cover plate. The threshold level for the feedhole amplifier is set by variable resistor A2R33 also accessible on the rear of main chassis. These procedures apply to both the HP2737A and HP2737B models unless otherwise specified.

4-19. PHOTOCELL OUTPUT

4-20. Adjust the lamp voltage and photocell output as follows:

a. Open the top cover on front panel by loosening two screws under the cover and then rotating the cover clockwise.

b. Set the front panel RUN/LOAD slide switch to LOAD. On HP2737B models, set the REWIND switch to off (down) and remove any remote rewind contact closure from connector pin J2-EE.

c. Now place the POWER switch to ON (HP2737A) or READ (HP2737B). Make sure that the lamp (DS1) is shining brightly on all photocells (as shown in Figure 4-5).

d. Now connect a VTVM across the lamp terminals (located on left side of the front panel). Then adjust A2R53 for a VTVM reading of 20.0 volts.

CAUTION

Instruments with serial numbers prefixed 718- and above use an HP Stock No. 2140-0252 lamp. This lamp is identified by yellow dots painted on each lamp end cap. The voltage adjustment for this type lamp is critical at 20.0 volts. Instruments with serial numbers prefixed 650- and lower use an HP Stock No. 2140-0091 lamp. This type lamp has no identifying marks and is adjusted for 21.0 volts. Be sure to check the lamp type before making the above voltage adjustment.

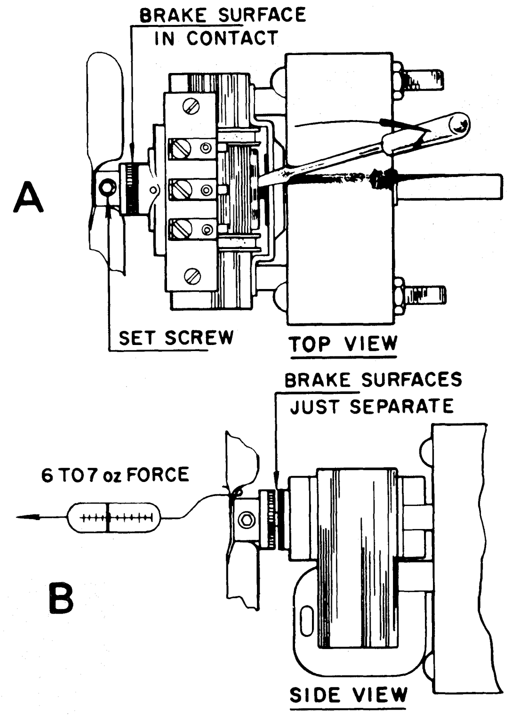

Figure 4-3. Rewind and Take-up Motor Brake Tension

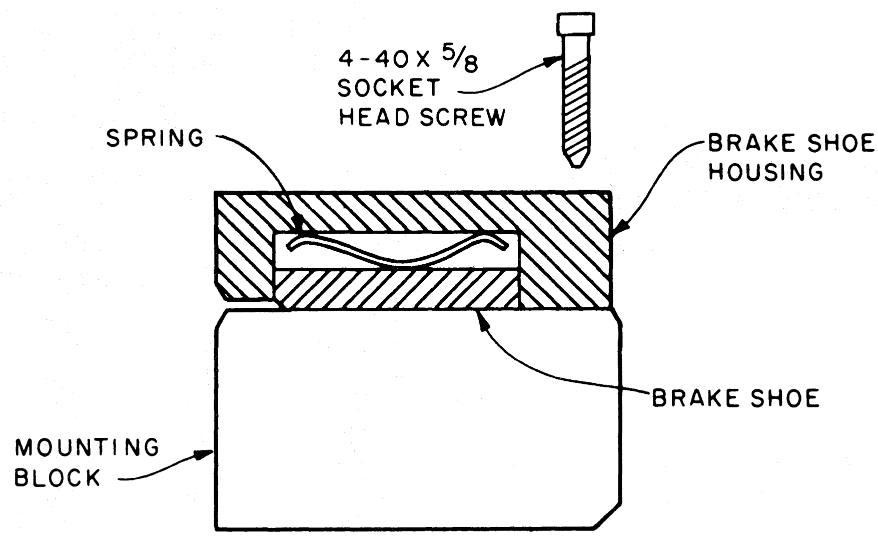

Figure 4-4. Proper Spring Placement

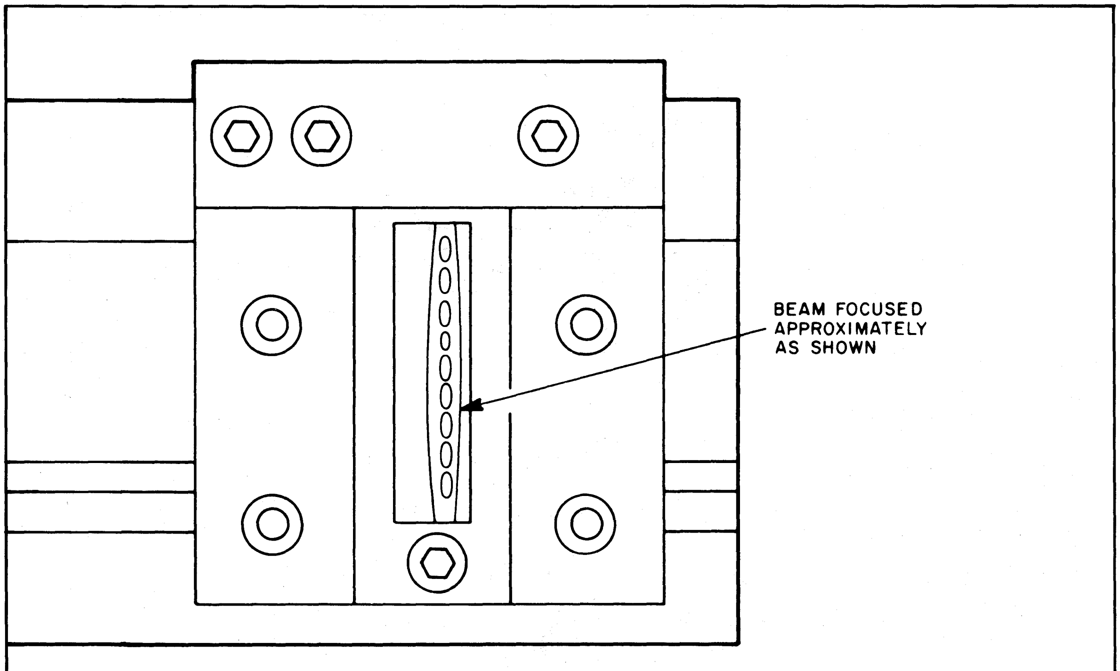

Figure 4-5. Proper Focus Beam Alignment

e. Load a Mylar test tape with all holes punched in the Tape Reader. Then set the RUN/LOAD slide switch to RUN. If Mylar tape is not available, use a good quality paper tape such as the gray tape supplied by Hewlett-Packard, HP Stock No. 9280-0063. The test tape should be prepared by punching all holes (eight levels), and taping into a continuous loop. When paper tape is used, Figure 4-6 is modified to set data and feed hole timing as follows:

Feed hole pulse width - 1.2 msec (Fig. 4-6A)
Data hole pulse width - 2.3 msec (Fig. 4-6B)

f. Now connect one probe of a dual trace Oscilloscope (such as HP 175) to each data output pin on connector J2 (as shown in Table 4-1). These positive-going data pulses should be -8 volts (± 1 volt) to zero volts (± 0.5 volts).

g. Now adjust A2R101 through A2R108 so that each positive-going pulse is 2 ms in duration as shown in Figure 4-6B.

h. Now connect the test probe to connector pin J2-b. Then adjust variable resistor A2R33 so that the displayed waveform is <u>on</u> for 0.9 ms as shown in Figure 4-6A. Leave this test probe connected to pin J2-b.

i. Using the second test probe, monitor each data pulse as in step "f". The minimum delay between any data pulse and the feedhole pulse should not be less then 300 μs as shown in Figure 4-6B.

j. Repeat steps "g" and "h" until the desired results are obtained. If these results cannot be obtained, refer to Paragraph 4-21 and perform the partial lamp adjustment. Then repeat steps "g" and "h" of this paragraph.

k. Remove all test equipment and the test tape. Place the POWER switch to OFF.

TABLE 4-1. TEST POINTS AND ADJUSTMENTS

J2 Pin	A2 Pin	Adjustments
F	14	R101
R	W	R102
Z	V	R103
j	S	R104
u	12	R105
CC	P	R106
J	M	R107
T	L	R108

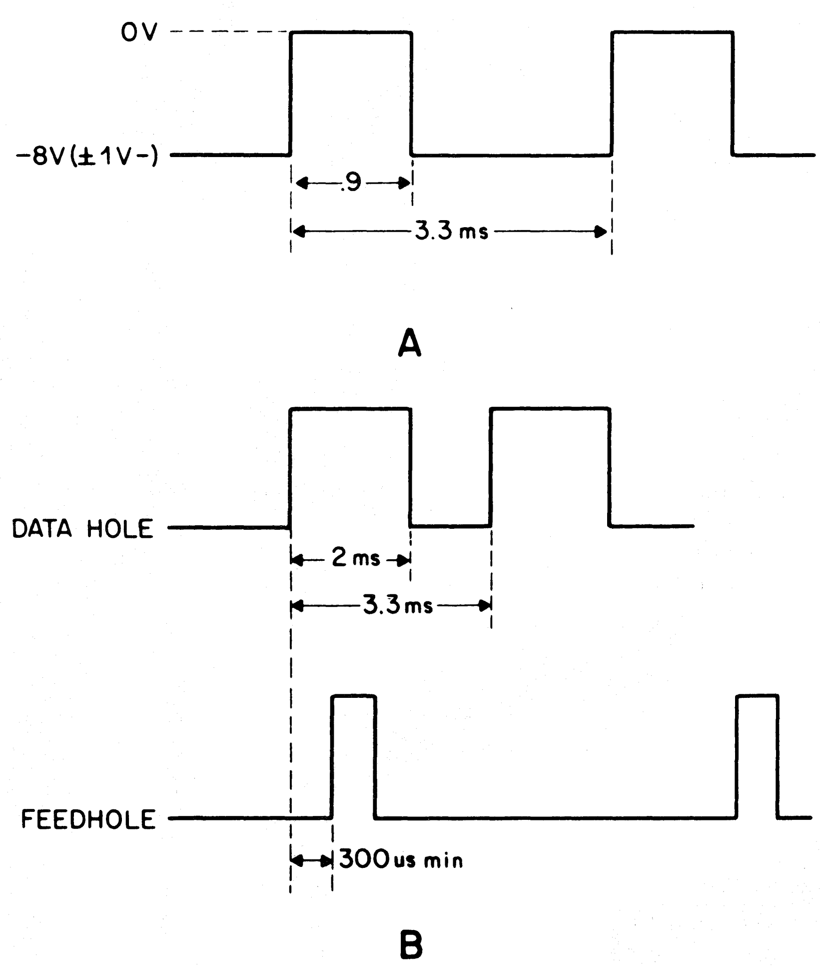

Figure 4-6. Feedhole and Data Pulses

4-21. PARTIAL LAMP ADJUSTMENT

4-22. When errors are detected in the instrument's operation after extended usage, the most probable cause is lamp aging. Errors due to lamp aging may sometimes be corrected by increasing the lamp voltage or lowering the feedhole threshold level.

4-23. The lamp voltage may be increased by turning A2R53 in a clockwise direction 1 or 2 times. Always count the number of turns so that the variable resistor may be returned to its original setting. If adjusting A2R53 does not eliminate the error, vary the feedhole threshold-level variable resistor A2R33 ± 3 turns, both at the original and new setting of A2R53.

4-24. MAINTENANCE PROCEDURES

4-25. GENERAL

4-26. When errors are detected in the instrument's operation after having been adjusted and calibrated, the most probable causes are:

a. Dirty focusing lens, or glass slide covering the aperture plate.

b. Flat spots on the lamp, or focusing lens.

c. Permanently weakened lamp.

d. Defective photocell.

e. Changes in tape transmissivity.

f. Misalignment of photoblock.

4-27. The focusing lens and/or glass slide covering the aperture plate may become contaminated with foreign material. This condition may be corrected using the cleaning procedures given in Table 4-3.

4-28. Variations in construction and/or extended usage may cause flat spots to develop on the focusing lens and lamp. This condition can normally be corrected by rotating the lens or lamp. The lens should be rotated in 90 degree increments until the focused light beam is properly oriented as shown in Figure 4-5.

4-29. A permanently weakened lamp or a lamp with an unsymmetrical filament must be replaced. When replacing a lamp, make certain the filament is parallel with the holes in the photo-block and that the focused beam will just cover all holes as shown in Figure 4-5.

4-30. Because of lamp surface dissymmetry, it may be necessary to rotate the lamp to achieve optimum brilliance. Long nose pliers may be used on the lamp base. Be careful not to break loose the base. It may also be necessary to loosen the lamp mounting bracket screws and move the bracket slightly.

4-31. A defective data or feedhole photocell will cause errors in Reader operation. Figure 4-7 illustrates the minimum photocell output using the lamp voltage described in paragraph 4-20. The data shown is for N on P cells which give negative outputs with respect to the common anodes. Each data track and the feedhole track output may be checked by connecting a high impedance voltmeter between each pin (as shown in Table 4-2) of connector J1 and chassis ground.

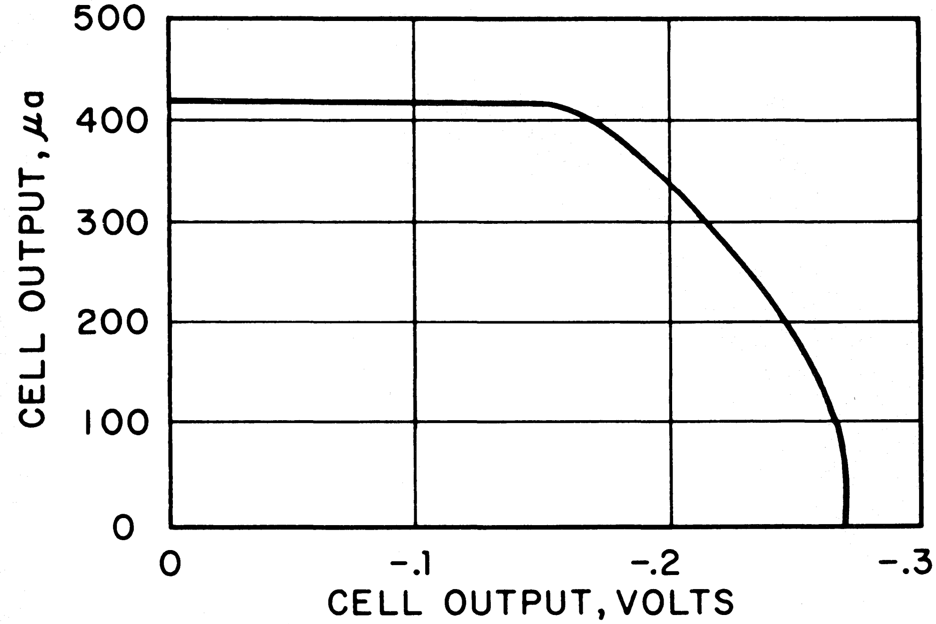

Figure 4-7. Minimum Output by Photocells.

TABLE 4-2. PHOTOCELL OUTPUT TEST POINTS

J1 Pin	Photocell
1	Data Track 1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	Feedhole Track

4-32. PREVENTIVE MAINTENANCE

4-33. A suggested preventive maintenance schedule and procedures are given in Table 4-3. It is essential for optimum operation that these procedures be performed at the time intervals given. Failure to abide by these procedures may cause a degradation in operating performance.

4-34. TRANSMISSIVITY

4-35. The HP2737A/B Punched Tape Readers will perform satisfactorily with a wide variety of punched tapes. However, the type and condition of the tape can affect operation. In general, Mylar tape is preferred, but any type tape not seriously affected by moisture will suffice. The tape color should be such that the "transmissivity" does not exceed 40%.

TABLE 4-3. PREVENTIVE MAINTENANCE SCHEDULE

Item	Time	Procedure
Photocell Block	Semi-weekly or more frequently as required.	Check the condition of the glass slide covering the aperature plate. This is extremely important since any dirt or foreign material covering an aperature can create errors in readout. A stiff bristle brush is included for general cleaning. Use a cotton swab and water, if necessary, to remove foreign matter.
Focusing Lens	Semi-weekly	Check and clean if necessary. Use the same materials for cleaning as mentioned in the Photocell Block Item.
Jam and Drive Rollers	Weekly	Check for the following: a. Cleanliness of the surface. Cleaning is easily accomplished by abrading their surfaces with a soft eraser of the "Pink Pearl" type. b. Wear or indentations on the roller surfaces.
Brake Shoe	Weekly	Check for accumulation of foreign matter that might tend to reduce the braking force and clean, if necessary. Refer to Section 4-15.
Lamp Intensity	Monthly	Check the voltage across the reading lamp. Refer to Section 4-20.
Function	Weekly	Check for waveforms shown in Figure 4-6. See Paragraph 4-20 e thru k. Use Mylar test tape — adjust if necessary.

4-36. Semi-transparent tapes which transmit up to 40% of the light applied are capable of being read by the Readers. Any higher level may not be compensated for by the Feedhole Differential Amplifier thereby giving false outputs. A tape that has a transmissivity higher than 40% must not be used with the HP2737A/B Punched Tape Readers.

4-37. The procedure for determining the percentage of light transmissivity of a tape is as follows:

a. Remove plug P1 connected to J1 on photoblock.

b. Connect a 100-ohm, 1/2 watt resistor across pins 9 and 10 of connector J1.

c. Now connect a VTVM across the 100-ohm resistor.

d. Throw the POWER switch to ON (HP2737A) or READ (HP2737B).

e. Record the VTVM reading.

f. Now insert a non-punched section of the tape to be measured in the Reader.

g. Record this VTVM reading.

h. Divide the reading obtained in step "g" by the reading obtained in step "e".

i. Multiply the result obtained in Step "h" by 100 to give the percentage of transmissivity.

j. Remove the tape and resistor, and replace P1. Turn the Reader OFF.

- NOTE -

The transmissivity of a tape along a longitudinal section is not generally linear. Therefore, several sections of the same tape should be tested to obtain an overall average of the transmissivity.

4-38. PHOTO-BLOCK ALIGNMENT

4-39. Photo-block misalignment will cause disruptions in the feedhole and data-hole output timing sequence. This condition is manifested in misreading of punched characters and misfires. Photo-block alignment may be checked by comparing leading edges of the data-hole pulses on tracks 1 and 8. If there is a difference greater than 300 μs, the photo-block must be realigned.

- NOTE -

A mispunched tape or a tape having a high degree of skew may give a false indication of photo-block misalignment. The tape punch manual should be consulted for instructions on measuring skew before attempting photo-block alignment.

4-40. The procedure for photo-block alignment is as follows:

a. Load a "black" test tape with all holes punched on the Reader.

b. Throw the POWER switch to ON (HP2737A) or READ (HP2737B).

c. Now use a dual-trace Oscilloscope (such as HP 175A) to compare the outputs on pins B and N of connector J2. If the difference between leading edges of the displayed pulses is greater than 300 μs, proceed to step "d".

d. Loosen the front screw on the photo-block. Now, gently tap the photo-block first in one direction and then the other while observing the displayed pulses. Then position the block so that the difference in leading edges is less then 300 μs.

- CAUTION -

Do not loosen the rear screw on the photo-block unless absolutely necessary. Once the block is entirely mispositioned, it requires valuable and costly time to reposition correctly.

e. Now tighten the front screw and recheck the displayed pulses. Repeat this procedure until the desired results are obtained.

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