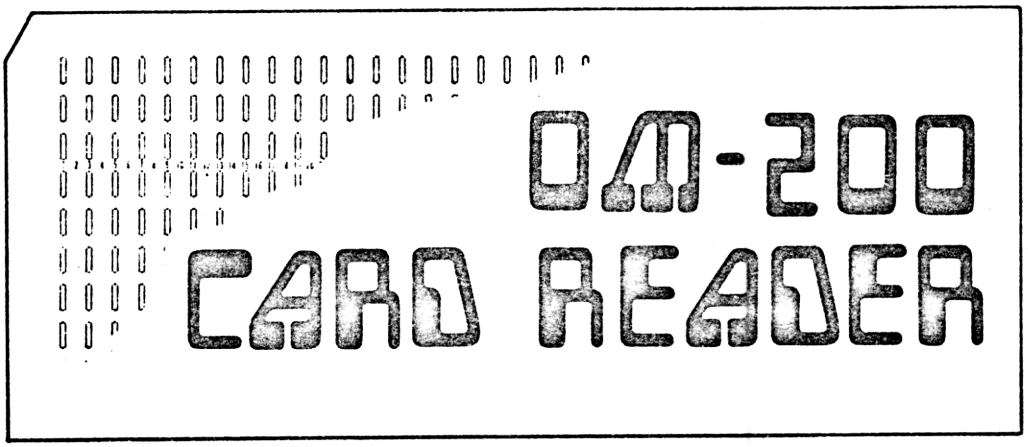
TECHNICAL MANUAL



FEBRUARY 1972

DOCUMATION
INCORPORATED
POST OFFICE BOX 1240
MELBOURNE, FLORIDA 32901

TECHNICAL MANUAL CHANGE RECORD

This Technical Manual has been updated to reflect Customer Specifications. Minor changes to text or schematics are marked on the pages affected. Major changes to text or schematics are corrected by direct replacement of pages affected, or are contained in an Addendum.

Customer: Regaa centralen Date: 10-8-73
Model: AM 200 Voltage: 230 Frequency: 50
Options: A CS: 100
Addendums: N/A
Text Changes: 12, 38, 39
Schematic Changes:

Title	Drawing No. and Modification
Wiring Diagram, AC Power Distribution, 115 V, 60 Hz	
Wiring Diagram, AC Power Distribution, 230 V, 50 Hz	
Wiring Diagram, Card Cage	542330
5 V Power Supply, 115 V, 60 Hz	
5 V Power Supply, 230 V, 50 Hz	
Solenoid Driver, 115 V, 60 Hz	
Solenoid Driver, 230 V, 50 Hz	
Card File	
Error Card Assembly	
Schematic (sheet 1 of 2)	542328
Schematic (sheet 2 of 2)	542328 (Mod)
Data Card Assembly	
Schematic (sheet 1 of 2)	
Schematic (sheet 2 of 2)	
Control Card Assembly	
Schematic (sheet 1 of 3)	
Schematic (sheet 2 of 3)	
Schematic (sheet 3 of 3)	
Pick Card Assembly	
Schematic (sheet 1 of 3)	542329
Schematic (sheet 2 of 3)	
Schematic (sheet 3 of 3)	
Special Cards	
_____	
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DOC. NO.: M 2607 Verified: Jonas Bäcker

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INTRODUCTION

GENERAL

This manual provides operational, interface and maintenance information for the OM 200 Optical Mark Sense Card Reader manufactured by Documation, Incorporated, P. O. Box 1240, Melbourne, Florida 32901. The manual is sectionalized to cover operational instructions, theory of operation, interface details, preventive maintenance, and repair. The appendix includes electrical schematics and wiring details.

The OM 200 Card Reader shown in Figures 1 and 2, is designed to read Mark Sense Cards of ANSI Specification X3.11 1969, for the 12-Row, 80-Column card. The hopper capacity is adequate to hold approximately 550 cards of .007" thickness. These are separated from the stack sequentially and moved past a fiber optics phototransistor read station where the data is recognized in a serial, column-by-column manner. Data columns can be either mark sense or punch columns and can be intermixed on a per card basis. The cards are then stacked into the output hopper in the same order as they were originally put into the reader. The reading cycle is externally controlled for single card selection or continuous run. In the continuous mode, the reader will read 285 cards per minute.

The OM Series card readers are specifically designed for continuous duty operation in adverse operational environments. The chassis is of heavy duty construction and all components have been chosen to provide for rugged, reliable performance. The vacuum-type picker has a remarkable tolerance to mutilated, warped, and edge-damaged cards. The short card track and gentle acceleration forces of the card handling mechanism yield insignificant card wear.

The information contained in this manual is accurate and complete as of the date of publication. Documation will continue to improve bothsits products and the effectiveness of its documentation. Comments and suggestions as to how this manual may be improved are solicited. Address comments to:

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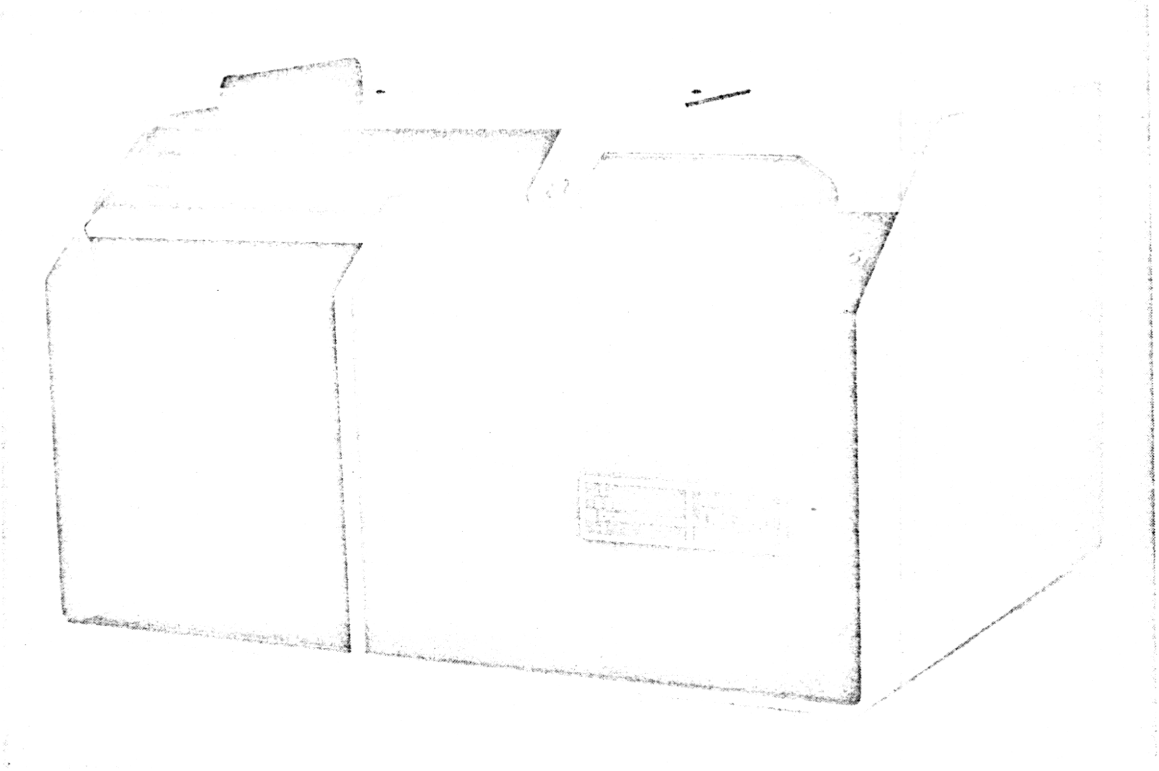


Figure 1. Three-Quarter Front View

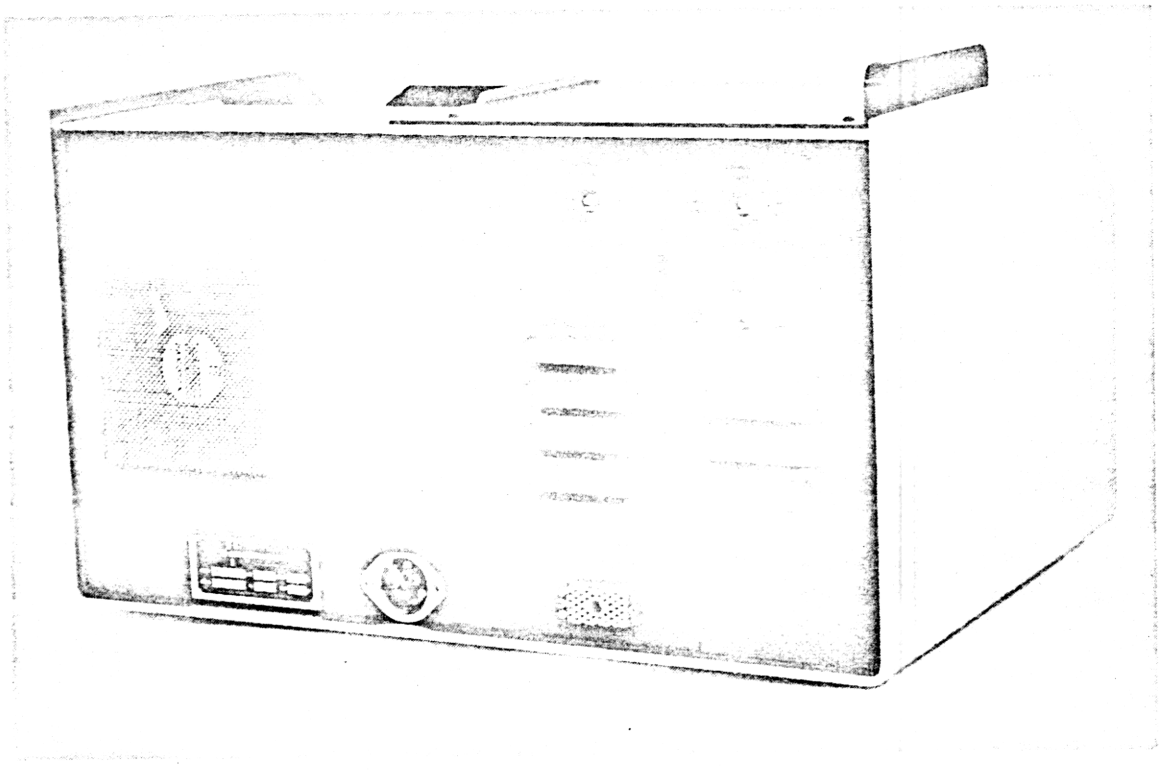


Figure 2. Three-Quarter Rear View

OM 200 SPECIFICATIONS SUMMARY

Reading Speed:	285 cards per minute maximum in continuous run. Single card cycle: 210 milliseconds.
Card Type:	80 Column Mark Sense cards as specified in the Card Specifications Section.
Data Field:	Reads Mark Sense and Punched Columns intermixed on a per card basis.
Control:	Demand feed, one card at a time under external program control. Reader will continuous run as long as the Pick Command remains TRUE.
Hopper Size:	4.0 inches (approximately 550 cards of 7 mil thickness).
STACKER SIZE:	4.0 inches (approximately 550 cards of 7 mil thickness).
Power Requirements:	
Voltage:	115 VAC ± 10%, single phase, @ 60 Hz (standard model) 230 VAC ± 10%, single phase, @ 50 Hz (export model)
Power:	1650 VA (MAX) starting load for 3 sec. 570 VA (MAX) running load

Size:		
Height:	11 inches	27.9 cm
Width:	19½ inches	48.9 cm
Depth:	14 inches	35.5 cm
Weight:	60 lbs.	27.3 kg

CARD SPECIFICATIONS

Card Design

Because the Mark Sense card's image field is determined and tailored by the customer to meet a particular application, the following is presented to aid in the design of a Mark Sense Data Card.

The shaded portions of Figure 3 show the areas in which data and clock marks can be placed.

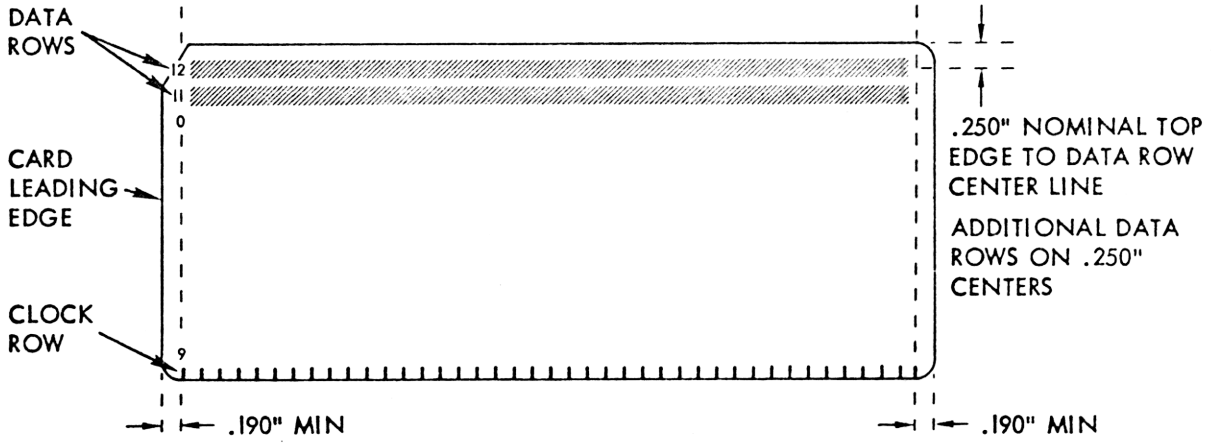


Figure 3. Marking Areas

Data columns are constructed by a clock mark immediately preceding the data column, the data column area and then another clock mark. Figure 4 shows a typical data column and the read area for each data row.

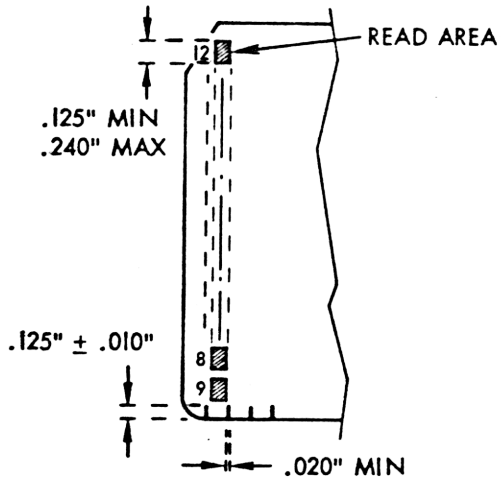


Figure 4. Data Column

Any pencil mark or punched hole meeting the data specification and lying in the shaded area between the clock marks will be read as data.

A marking constraint with mark identifier is normally used to place and identify a data mark in the data field. Figure 5 depicts a typical marking constraint.

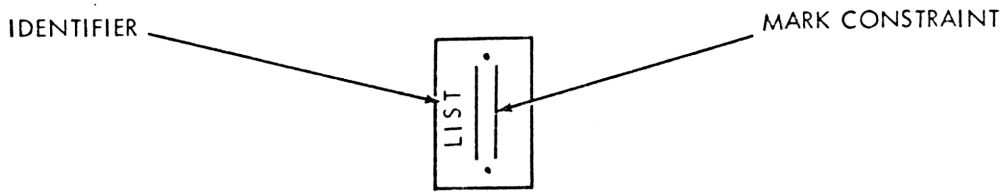


Figure 5. Mark Constraint

To indicate a list a vertical pencil mark would be placed within the constraint.

An example of a general purpose, 40 column Mark Sense Card is shown in Figure 6. This card was designed by Documation Incorporated.

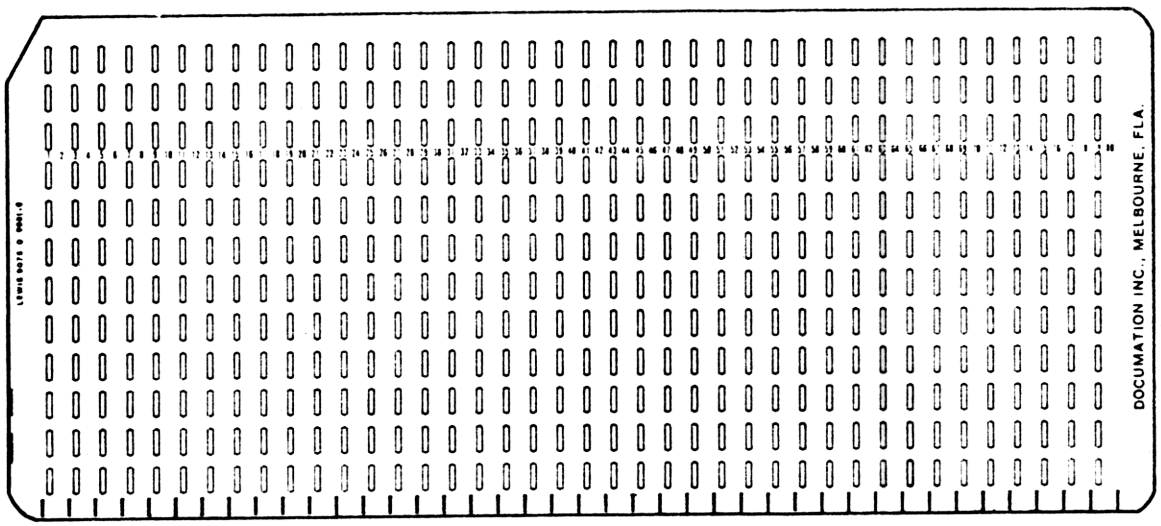


Figure 6. Mark Sense Card

A few important points to consider when designing a Mark Sense Card are:

1) A clock mark should never lie on a vertical line with a data constraint, i.e., data is only read between clock marks.

2) Spacing between clock marks should be no more than .5 inches.

3) Registration from card leading edge to data is important only when punch columns are being set up, i.e., punch columns will be registered by the punch.

4) All data constraints and identifiers must be printed in reflective ink.

Card Stock

A card will be acceptable for use as a Mark Sense Card provided:

1) The card meets American National Standard's specification ANSI X3.11-1969, Specification for General Purpose Paper Cards for Information Processing.

2) The average reflectance* of the card does not fall below 80 percent.

3) Blemishes and printing in the marking field of the card reflect at least 85 percent of the average reflectance of that particular card. (Therefore, a card whose average reflectance is 90 percent may not have a blemish or printing that indicates less than 0.85 x 0.90, or 76.5 percent.)

4) The card does not contain any non-reflective printing or handwriting anywhere to the left of Column 1 except in a vertical band 1/32 of an inch wide along the left edge of the card.

NOTE: White and natural cards manufactured to card industry standards are usually satisfactory. Only those marks described in the Data Section will be permitted on the card surface.

Data Constraints and Identifiers

All Data Constraints and Identifiers must be printed in reflective ink. Reflectance of constraints and identifiers must not fall below 85% of the average background reflectance.

* Reflectance measurements taken using a Macbeth Standard Reflectance plaque as a calibration standard.

DATA

Mark Sense Data

A mark must be a vertical line using a #2 pencil or equivalent marking material.

The minimum dimensions are: width, .015"; length, .125 centered within data row area.

The maximum dimensions are: width, from trailing edge of previous clock mark to leading edge of next clock mark; length, .240" centered within data row area.

The mark must have an average reflectance that is less than or equal to 28% of the reflectance of that portion of the card immediately adjacent to the mark. Single stroke marks with a #2 pencil will meet this specification.

An erasure must have an average reflectance that is greater than or equal to 75% of the reflectance of the portion of the card immediately adjacent to the erasure.

PUNCH DATA

Punch data must meet American National Standard ANSI X3.21-1967 specifications.

Clock Marks will be as specified in Figure 7. All Clock Marks must be printed in non-reflective ink. Marks will have an average reflectance of less than or equal to 28% of the reflectance of the portion of the card immediately adjacent to the clock mark.

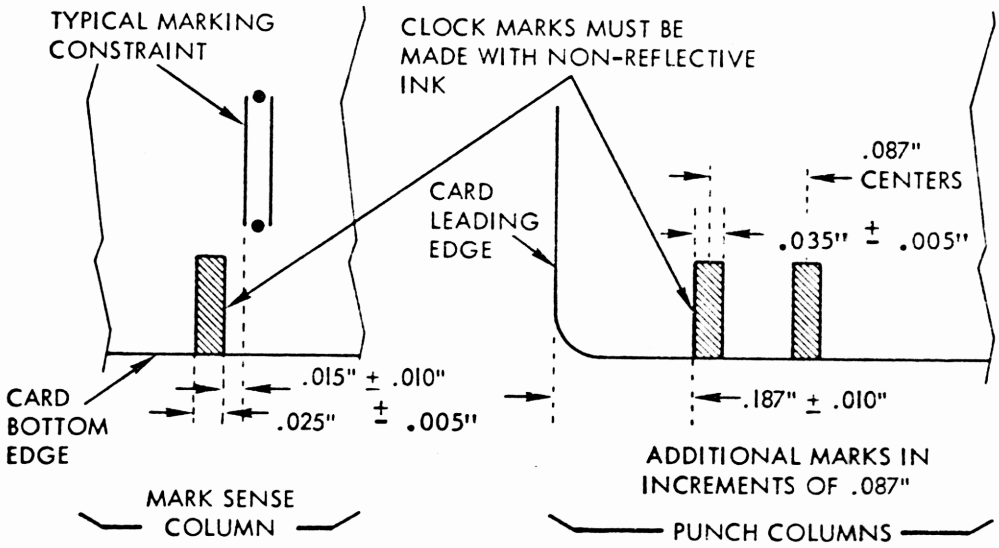


Figure 7. Clock Marks

Figure 7 gives Clock Mark specifications for mark and punch columns. Note that punch column clock marks are registered with respect to the leading edge of the card while mark column clock marks are registered with respect to the mark column.

Clock marks must be used for all columns for which an index mark is required. An additional clock mark is also required in column zero to initialize the data circuits to the card's surface.

OPERATION

GENERAL

The following paragraphs provide description and instructions for normal operation of the OM Series Card Readers. All operator controls and indicators are described with turn-on/shut-down instructions included. Refer to Figure 8 for the location of switches and indicators mentioned in the following description.

INITIAL SET-UP

1. Upon receipt of a new reader from the manufacturer, the two red 8-32 screws in the bottom plate must be removed. These lock the blower motor plate for shipment to prevent damage to the motor plate vibration isolators. If the reader is to be reshipped, these screws should be retained and reinserted prior to packing.

2. Plug in the AC Power Cord. Notice that this is a clockwise twist-lock connector.

3. Set the MODE switch (rear panel) in LOCAL.

4. Set the SHUTDOWN switch (rear panel) in AUTO.

5. Switch the CIRCUIT BREAKER (power switch) to energize the reader (motors will not come on at this time).

6. Press the LAMP TEST switch and observe that all front panel indicators illuminate.

7. Load a deck of cards into the input hopper.

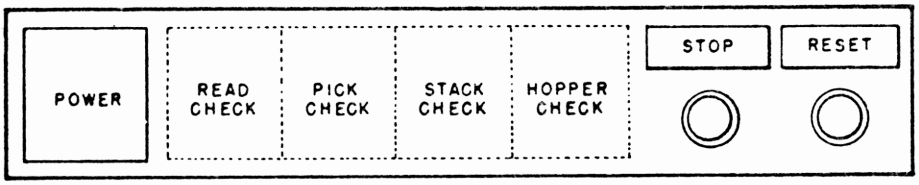
8. Press the RESET switch. The motors should come on and after a short delay (approximately 3 seconds), the cards should be picked and stacked. When the input hopper is empty, the motors should shutdown and the HOPPER CHECK light illuminate.

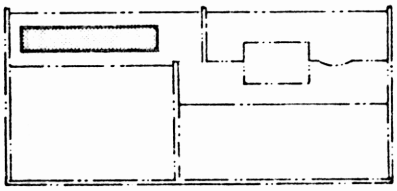
9. This completes the initial off-line operational test.

LOADING THE INPUT HOPPER

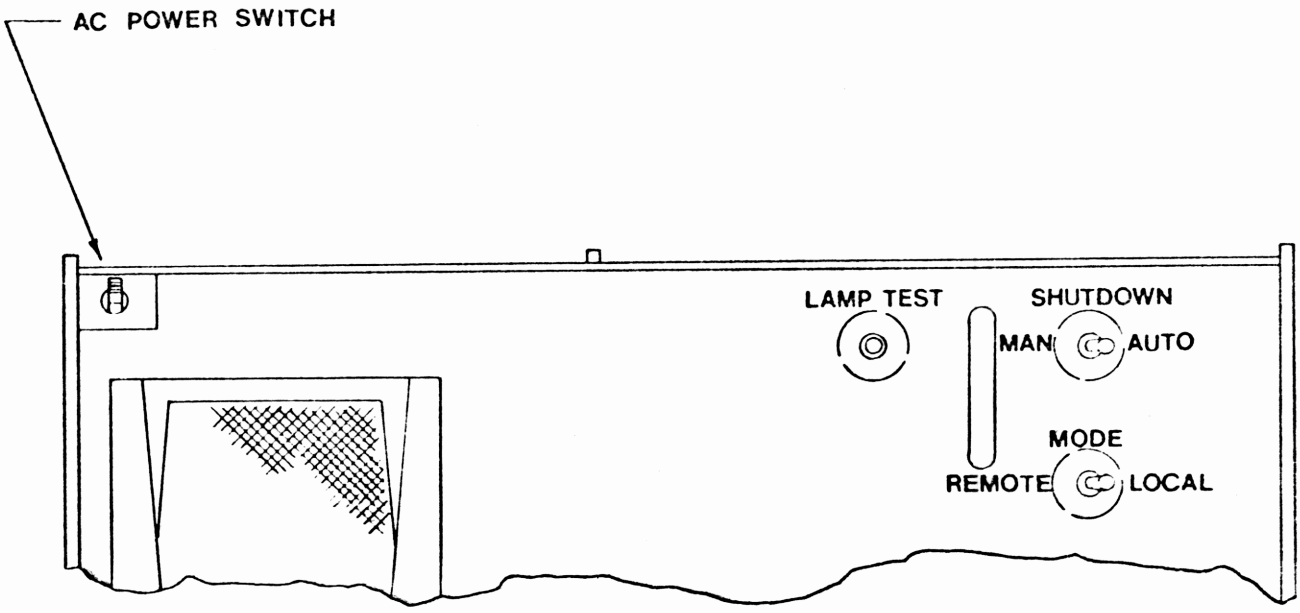
Loading the input hopper with Mark Sense cards to be read is performed as follows:

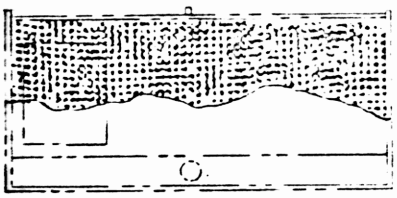
1. Pull the hopper follower back with one hand and load the card deck into the hopper area; the first card to be read must be placed at the front with the "9" edge down, column 1 to the left. Continue placing cards into the input hopper until it is loosely filled (approximately 550 cards).





FRONT CONTROL PANEL





REAR PANEL

Figure 8. Switch Locations

CAUTION

DO NOT PACK THE INPUT HOPPER SO FULL THAT
THE RIFFLE ACTION IS INHIBITED

2. The hopper may be loaded while cards are being read if the operator is careful to keep tension on the front portion of the deck while loading additional cards at the rear. This is best done with the input hopper approximately ½ to 1/3 full. Use just enough pressure to maintain the riffle action.

3. Unloading the input hopper is the reverse of the loading procedure. Normally all cards are processed through the reader; however, if it is necessary to unload the hopper, push the follower down and remove the card deck. If the cards are arranged in a particular order, exercise care in repacking them in their storage container so that the order is maintained.

UNLOADING STACKER

To unload the stacker, perform the following steps:

1. Pull stacker follower back with one hand and remove the front or rear portion of the card deck from the stacker area, being careful that deck order is maintained.

2. The stacker may be unloaded while cards are being read.

SWITCHES AND INDICATORS

POWER (toggle circuit breaker and indicator)

All power to the card reader is controlled by this circuit breaker. Since the indicator is supplied by the +5V power supply, it is illuminated only when power has been applied to the entire AC distribution system. Toggling the switch (indicator is illuminated) in down position removes the power from the card reader.

STOP (momentary-action pushbutton/indicator switch)

Actuation of the STOP switch immediately overrides the PICK COMMAND and lowers the READY line. The card reader will stop operation after the card currently in the track is read completely; power is not removed from the reader by this action. The red STOP indicator is illuminated as soon as the switch is depressed.

RESET (momentary-action pushbutton/indicator switch)

Actuation of the RESET switch clears all error flip-flops and initializes all counters. The reset action is initiated by the return stroke of the RESET switch. The green RESET indicator is the READY signal that also appears at the output connector. The card reader is then ready to accept a PICK COMMAND.

READ CHECK (indicator)

The READ CHECK alarm indicator denotes that the card just read may be torn on the leading or trailing edges or have data in the 0 and 81st columns. The READ CHECK will cause the reader to stop. If it occurs on all cards, it is an indication of a fault in the read electronics.

STACK CHECK (indicator)

The STACK CHECK alarm indicator denotes that the previous card was not fully seated in the output hopper. Check the card track to make sure it is clear and check the stacker for a badly mutilated card.

PICK CHECK (indicator)

The PICK CHECK alarm indicator denotes that a card has failed to reach the read station after a PICK COMMAND has been received. Inspect the cards in the input hopper for excessive leading edge damage, torn webs, or cards stapled together. If so, remove the staple or straighten the card and reinsert.

If no apparent card damage is present, check for excessive card deck warpage (in excess of 1") and/or ink glaze buildup on the picker face. Clean the picker face with solvent.

HOPPER CHECK (indicator)

The HOPPER CHECK alarm indicator denotes that ~~either~~ the input hopper is empty, ~~or the stack hopper is full.~~ This is a normal operational occurrence.

REAR PANEL SWITCHES

LAMP TEST (pushbutton switch)

Depressing the LAMP TEST switch illuminates all front-panel indicators to determine if an indicator lamp is inoperative.

MODE (toggle switch)

When placed in the LOCAL position, this switch disables the PICK COMMAND input to the card reader and allows the operator to run the reader off-line by depressing the RESET pushbutton switch on the front panel. When placed in the REMOTE position, this switch enables the PICK COMMAND input to the card reader, which places the reader on-line for normal remote control operation. Data and other output signals are present at all times.

SHUTDOWN (toggle switch)

When placed in the MANUAL position, this switch energizes the reader for continuous operation whether or not cards are in the input hopper. When placed in the AUTO position, this switch provides an automatic shutdown of the motors

when the input hopper is emptied. The motors will automatically restart when cards are placed in the hopper and the RESET switch is depressed. Expect a delay of approximately 3 seconds for the blower to run up.

OPERATIONAL FLOW CHART

Figure 9 shows a flow chart of the sequence of events which may be encountered in operating the reader. If trouble is experienced, refer to this check list before calling for maintenance.

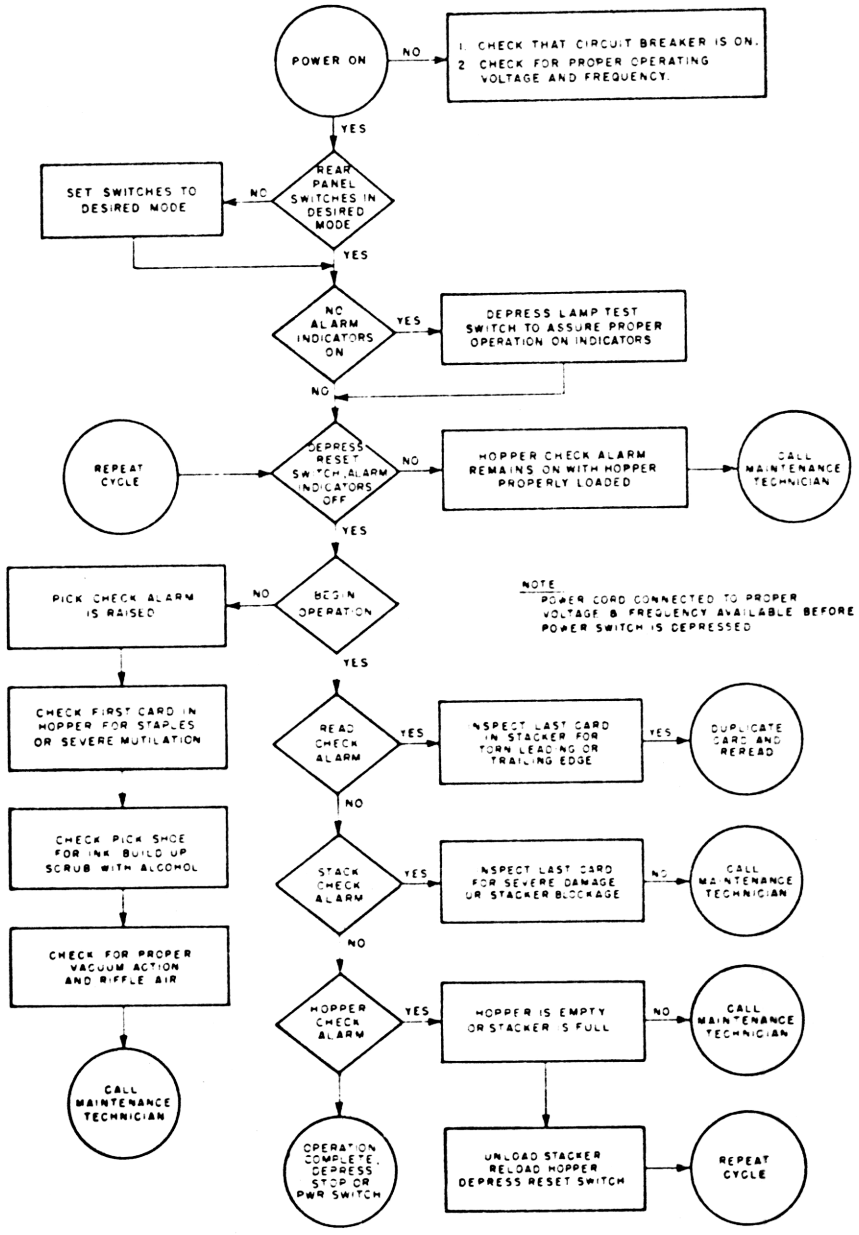


Figure 9. Operational Flow Chart

THEORY OF OPERATION

CARD TRACK

The Documation card reader line is unique in several respects, in that card wear is insignificant and a card jam is virtually an impossibility. The card track is designed around a patented vacuum picker which works in conjunction with riffle air in the input hopper to produce a card reader which is very tolerant to damaged cards. This tolerance extends to cards which have been badly worn, edge nicked, warped, bent, folded or otherwise damaged as a result of rough handling.

The riffle air acts on the first half inch of cards in the input hopper so that they stand apart, individually "air cushioned" from the rest of the card deck and each other. This prevents the cards from sticking together in case of static electricity, hole locking, or torn webs. Should the cards have been subjected to high humidity conditions prior to being loaded into the card reader, the riffle air also minimizes the effect of swelling or frictional increases between the cards.

The picker mechanism utilizes a strong vacuum to grasp the bottom card, and upon command, draw it away from the bottom of the stack. The card is smoothly accelerated through the wide throat into the constant speed drive rollers. The design of the vacuum picker and its associated throat block prevent the unit from double picking so well that cards which are even stapled together will not enter the card track. Should cards which are stapled or taped together be inadvertently put in the input hopper, the card reader will stop, indicating a PICK CHECK. The operator can remove the staples, separate the cards, re-enter them in their proper position in the deck and resume reading.

The card track itself is very short so that at no time is more than one card in motion. The combination of damaged card tolerance, gentle card treatment and short card track have produced a card reader which is virtually jam proof. Card life has proven to be in excess of 1000 passes.

DATA RECOVERY

The logic block diagram for the OM Series Card Reader is shown in Figure 10. The description that follows applies to all Documation OM Series Card Readers since the reliable recovery of data from cards passing down the card track is accomplished in the same manner regardless of track velocity.

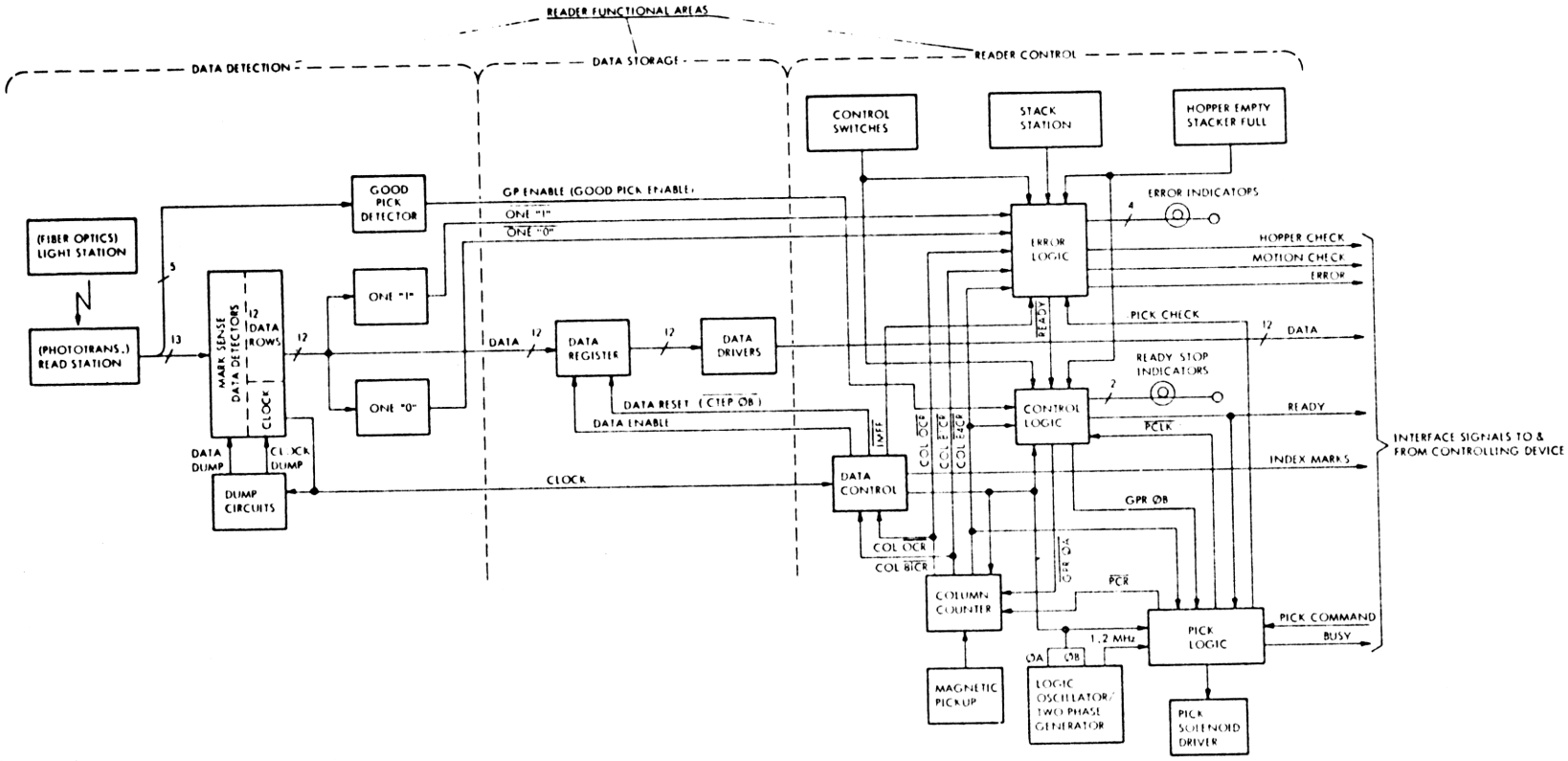


Figure 10. Block Diagram - OM Series Card Reader

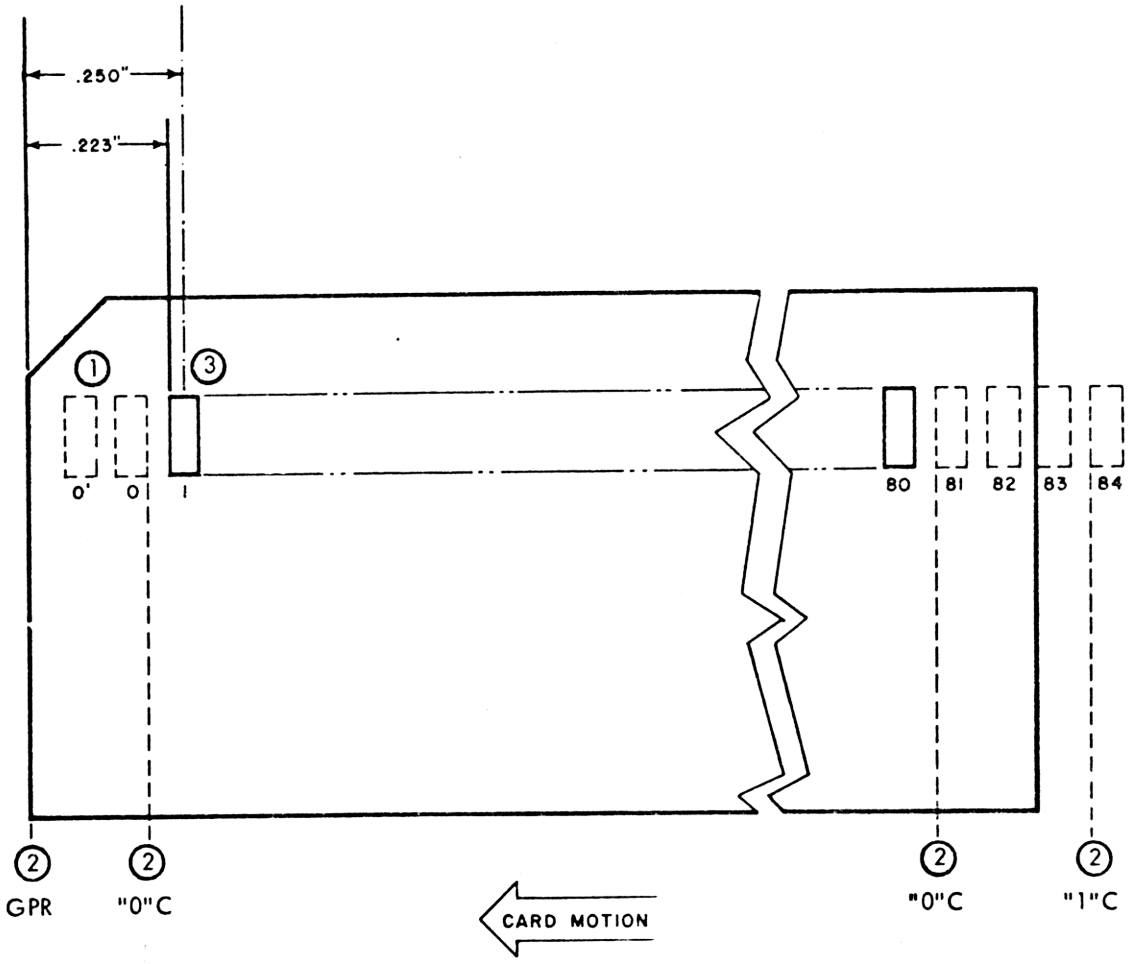
Data recovery is accomplished by the functions of Reader Control, Data Detection and Data Storage. Reader Control synchronizes the electronic scanning of the card with the mechanical actions of the reader. This involves card picking, card movement through the read station, data flow control and card stacking. Data Detection converts the reflections from card surface into usable digital signals for Data Storage. Data storage provides the data buffering and retainment required for data transfer from the reader.

Reader Control

Primary control timing is established by the 1.2 MHz Logic Oscillator and the Two-Phase Generator. These are used to shift, store and control other logic operations. Card movement speed is established by the hysteresis synchronous drive motor, belts and steel drive rollers. Electronic tracking of card movement is accomplished by a timing disk consisting of a ferrous notched wheel mounted to one of the steel drive roller shafts. A magnetic reluctance pickup is used with the timing disk to provide the synchronization signals to the reader electronics.

When a PICK COMMAND is received from the controlling device, card processing will be started provided no alarm conditions exist. The Pick Logic then produces a PICK signal to the Solenoid Driver, a $\overline{\text{PCLK}}$ signal to the Control Logic, and a pick-command reset ($\overline{\text{PCR}}$) to the Column Counter. These actions initialize the various control circuits and energize the solenoid to pick a card from the input hopper. If a card does not reach the read station, the PICK CHECK alarm is raised.

The Read Station and Stack Station utilize phototransistor sensors to both read the card's mark or hole pattern and to monitor the card's movement. When a card is picked and moved into the card track, the leading edge is detected by a phototransistor in the Read Station. This produces a GOOD PICK ENABLE that activates the Column Counter. The Column Counter then counts Magnetic Pick Up Pulses from the timing wheel as the card moves past the Read Station, synchronizing the mechanical card movement with the electronic circuits. The Column Counter generates an all zeros check at column 0 and 81 and an all ones check at column 84. Figure 11, Timing Relationship for Standard Card, shows these check positions. These checks provide a quality check on both the Mark Sense Data Detectors and the mechanical card movement.



NOTES

1. DASHED LINES INDICATE PSEUDO DATA POSITIONS ON CARD.
2. "0"C = ALL ZEROS CHECK
   "1"C = ALL ONES CHECK
   GPR = GOOD PICK RESET
3. HOLE SIZE EXAGGERATED FOR EXPLANATION.

Figure 11. Timing Relationship for Standard Card

Data Detection

Following GOOD PICK ENABLE, the Mark Sense Data Detectors scan the card for pencil marks or punched holes as it passes through the Read Station. Twelve of the Mark Sense Data Detectors scan the 12 data rows and the 13th Mark Sense Data Detector scans the clock channel for clock marks. Since data is recognized only between clock marks, physical registration from the card leading or trailing edge for data columns is irrelevant and no synchronization between mechanical card movement and data columns is required.

Each Mark Sense Data Detector tracks the card's surface reflectivity. A fiber optics Light Station provides a narrow band of light incident upon the card surface for each of the detectors. This light is then reflected from the card's surface through a fiber optics bundle to the Read Station phototransistors. Since the card's surface reflectivity determines the amount of light reflected to the phototransistor, the phototransistor's output is an electronic representation of the card's surface reflectivity. The outputs of the 13 phototransistors are converted from these reflectivity representations to digital signals by the Mark Sense Data Detectors for Data Storage.

Data Storage

Pencil marks and punched holes recognized by the Mark Sense Data Detectors are transferred in column form to the Data Register. Timing for data storage is derived from the card clock marks. The leading edge of each clock mark begins a period of no data storage allowing data to be transferred from the reader. The trailing edge of each clock mark is used to reset the Storage Register and enable a new period of data transfer from the Mark Sense Data Detectors to the Data Register. Data storage includes Data Drivers that provide buffering between the Data Register and the interface lines.

DETAIL OPERATIONAL DESCRIPTION

The following gives a detailed description of each block shown in Figure 10, Block Diagram - OM Series Card Reader. The descriptions are designed to give the reader an in-depth understanding of how the card reader works without the usual logic gate-by-gate description.

The reader should familiarize himself with the signal mnemonics used in the text description and contained in Appendix C since it will aid in interpreting both the description that follows and the detailed logic schematics of Appendix A.

Reader Control

The following is a detailed description of each block shown under Reader Control in Figure 10 - Block Diagram - OM Series Card Reader.

Logic Oscillator/Two-Phase Generator

The block diagram and timing diagram for the Logic Oscillator/Two-Phase Generator is shown in Figure 12. The Logic Oscillator is two monostable multivibrators (MSMVs) connected in a closed loop and oscillating at 1.2 MHz ± 2.5%. The MSMVs used are very stable over a wide range of temperatures and voltages with cumulative change due to temperature and voltage over the reader's specified range of ± .5% or less. The oscillator runs at a frequency determined by two precision RC networks whenever reader power is applied. To ensure oscillation the Restart Logic Monitors the output of each MSMV and as long as one of the MSMVs is active the Restart Logic is held off. If at any time one of the oscillator's MSMVs does not fire, the Restart Logic will begin oscillation within 5 us providing triggering inputs to the MSMV oscillator.

The Two-Phase Generator divides the 1.2 MHz oscillator's output by two and alternately directs the negative going portion of the 1.2 MHz to ØA or ØB. Reference timing waveforms of Figure 12.

The 1.2 MHz, ØA and ØB signals are used throughout the reader as a timing source.

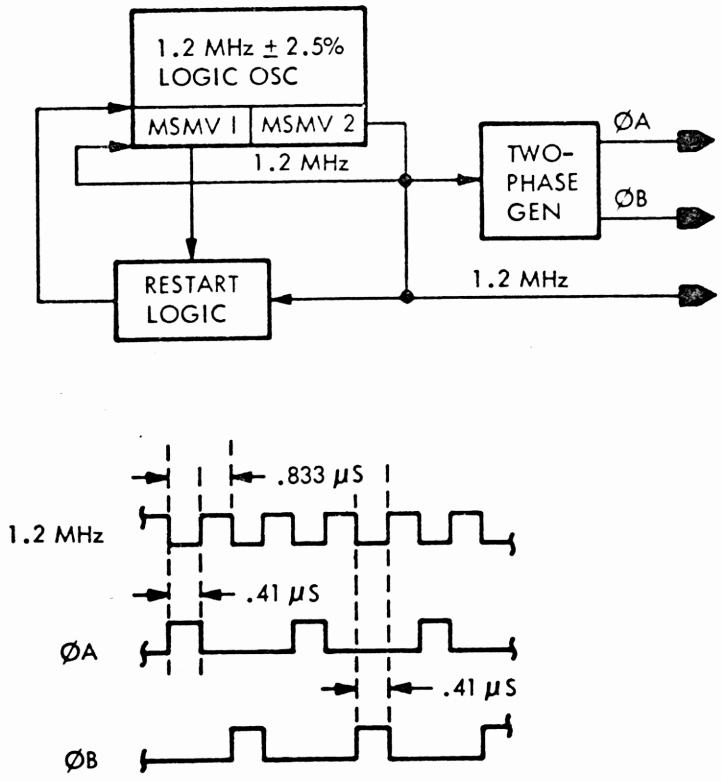
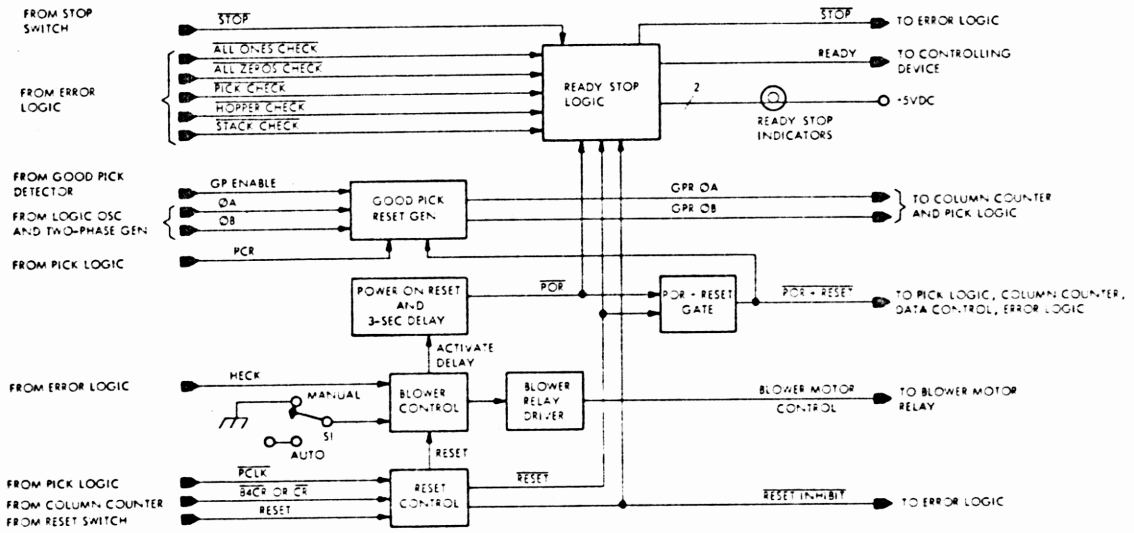


Figure 12. Logic Oscillator/ Two-Phase Generator

Control Logic

The Control Logic (Figure 13) contains the Ready/Stop Logic, Power On Reset, Blower Control, Reset Control and Good Pick Generator.

At reader power turn on, a three-second $\overline{POR}$ is initiated. See timing of Figure 13. $\overline{POR}$ OR'ed with $\overline{RESET}$ to form $\overline{POR + RESET}$ resets all control circuits within the reader and initializes the reader for operation. The long $\overline{POR}$ of three seconds allows the blower to come up to speed before the controlling device or an operator can initiate a reader operation. The reader is now brought to the ready state by the operator depressing and releasing the RESET switch. Note that while the RESET switch is depressed $\overline{POR + RESET}$ again goes low providing a reset to all reader control logic. The Reset Control is designed to ignore all RESET switch signals while a read cycle is in progress. Signals $\overline{PCLK}$ and $\overline{84CR}$ or $\overline{CR}$ identify the beginning and end of a read cycle.



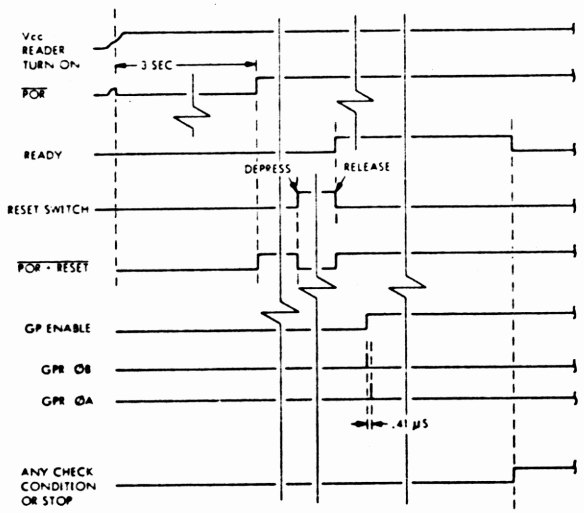


Figure 13. Control Logic Diagram and Timing

Reader READY is signalled to the controlling device by the Ready/Stop Logic when the Reset Switch is released provided $\overline{\text{HOPPER CHECK}}$ is not being presented by the Error Logic. (All other Error Logic Check signals will be reset by $\overline{\text{POR}}$ and $\overline{\text{RESET}}$.) Reader READY is indicated to the operator by the Reset Switch lighting green. The controlling device can now begin a read cycle by transmitting a PICK COMMAND to the reader. READY will be reset upon receipt of any $\overline{\text{CHECK}}$ signal from the Error Logic or if the Stop switch is depressed by the operator and $\overline{\text{RESET INHIBIT}}$ is not present. The Ready/Stop Logic gates the $\overline{\text{STOP}}$ signal with $\overline{\text{RESET INHIBIT}}$ preventing READY from being reset due to $\overline{\text{STOP}}$ during a card read cycle. $\overline{\text{RESET INHIBIT}}$, generated by the Reset Control, is set by $\overline{\text{PCLK}}$ and reset by $\overline{84\ \text{CR}}$ or $\overline{\text{CR}}$. The Stop Condition is indicated by the Stop Switch lighting red.

During a card read cycle, the Good Pick Reset Generator will detect a G P ENABLE and process this signal with the clock phases ØA and ØB to produce $\overline{\text{GPR ØB}}$ followed in .41 microseconds by $\overline{\text{GPR ØA}}$. These signals are used to start the Column Counter and reset the Pick Logic.

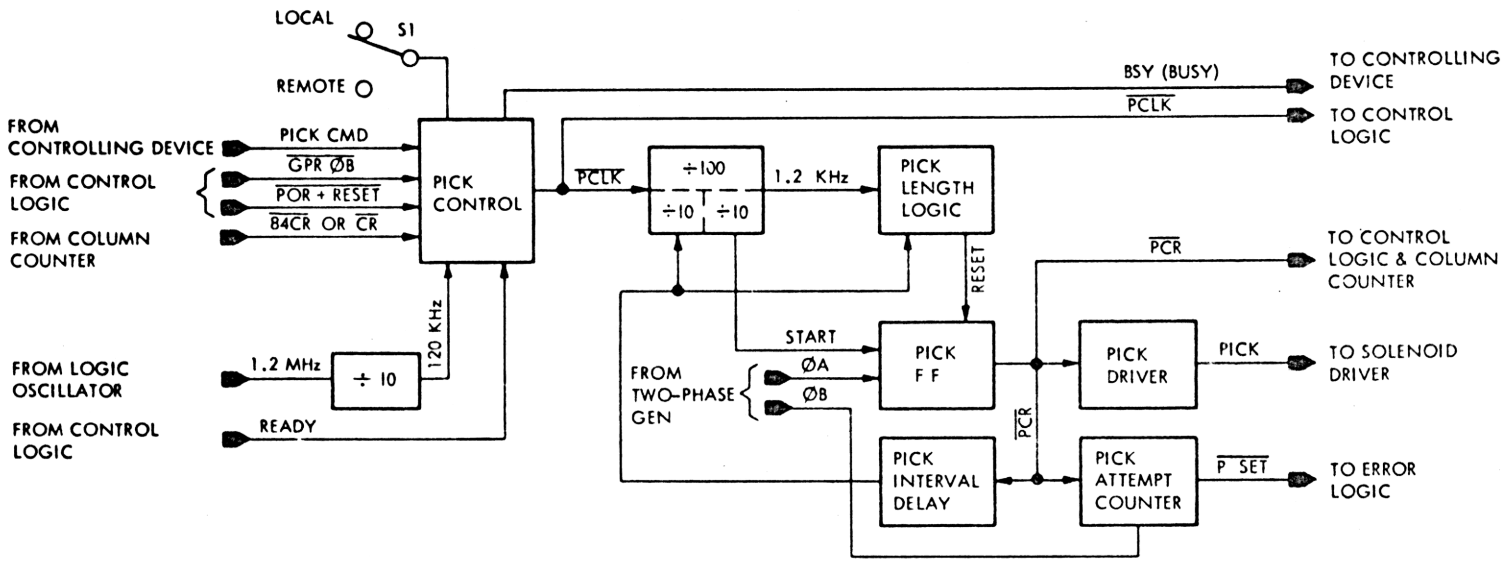
The Blower Control provides signals to control AC power to the reader's motors. The motors automatically shutdown when a HECK (Hopper Empty Check) condition exists and switch S1 is in the Auto position. After the HECK condition is corrected by reloading the input hopper, depressing of the Reset Switch will cause the Blower Control logic to activate the three-second POR. The three-second POR provides sufficient time for the blower to reach operating speed before a reader operation can begin. When the Auto/Manual switch is in the Manual position, the all motors remain on as long as ready power is applied

Pick Control

Once the reader is brought to ready condition, a PICK CMD from the controlling device can be accepted by the Pick Control. (Figure 14, see diagram and timing.)

The Pick Logic will then:

1. Generate the $\overline{\text{PCLK}}$.
2. Initiate a PICK pulse that drives the picker solenoid.
3. Control the PICK pulse length.
4. Wait out the interval while the card leading edge is accelerated to the read station (14 to 27 ms).



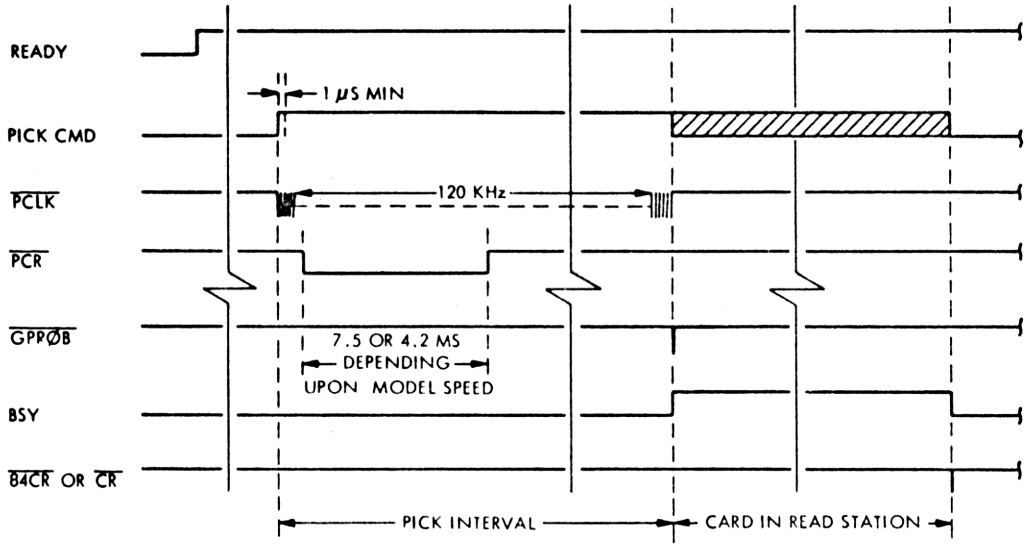


Figure 14. Pick Logic Diagram and Timing

5. If the leading edge has not arrived in 50 ms, generate another pick pulse.
6. Repeat the pick attempt six times and if the leading edge has not appeared, generate a pick fail alarm ($\overline{\text{PSET}}$).

The Pick Control generates $\overline{\text{PCLK}}$ (Figure 14 timing) until a $\overline{\text{GPR ØB}}$ is received or READY goes false due to the pick fail signal or $\overline{\text{P SET}}$. $\overline{\text{PCLK}}$ gated from Pick Control is divided by two decade MSI counters to a frequency of 1.2 KHz. The decade counter provides a Start (clock) signal to the Pick Flip Flop on its second count. This begins the PICK pulse internal. The 1.2 KHz from the second decade counter then drives the four-stage binary pick length logic counter until a preselected count is decoded. When decoded, the count sets the Pick Flip-Flop and ends the PICK pulse.

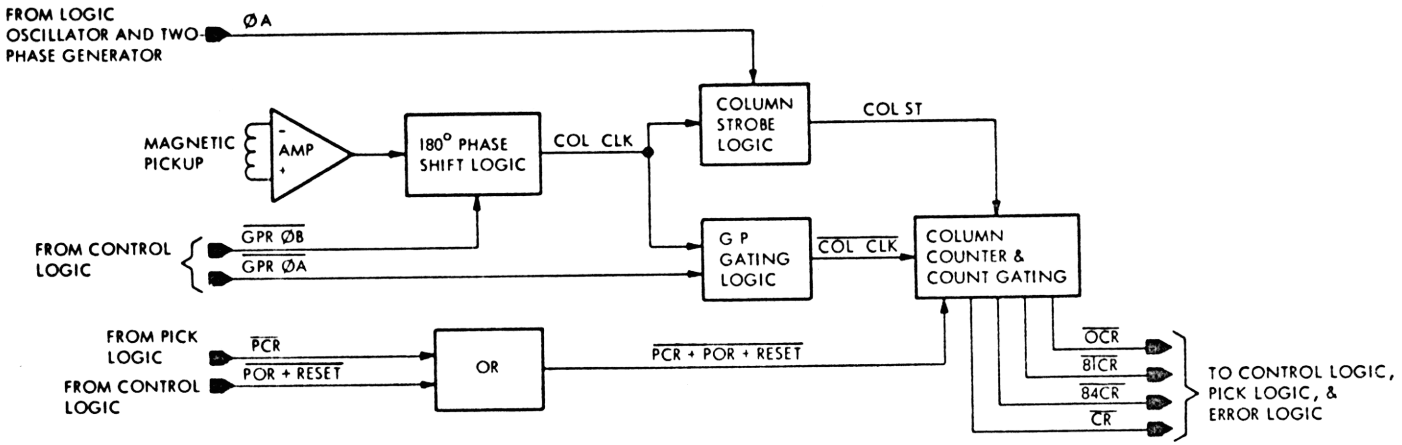
At the end of the PICK pulse, signal PCR initiates the Pick Interval Delay of 50 ms. During this delay period, the ÷ 100 and Pick Length Logic is held reset while the Pick Control waits for a $\overline{\text{GPR ØB}}$. A $\overline{\text{GPR ØB}}$ signals the the entry of a card into the read station and therefore no more pick attempts should be made. If $\overline{\text{GPR ØB}}$ has not been received by the end of the delay, another PICK pulse is generated. This process is repeated until $\overline{\text{GPR ØB}}$ occurs or the Pick attempt counter reaches count six and a $\overline{\text{P SET}}$ is generated. $\overline{\text{P SET}}$ will cause READY to go false terminating $\overline{\text{PCLK}}$.

Upon receipt of a $\overline{\text{GPR ØB}}$, the Pick Control signals BSY (Busy) to the controlling device to indicate a card has entered the read station. BSY remains true until $\overline{\text{84 CR}}$ or $\overline{\text{CR}}$ indicating the card has left the read station and another PICK CMD will be accepted.

The positioning of switch S1 determines the source for the PICK CMD. In local, the PICK CMD signal is held true so that whenever the reader is READY, PICK CMDs are generated internally each time 84 CR or CR is reached. When in REMOTE, only a PICK CMD from the controlling device can initiate a read cycle.

Column Counter

The Column Counter (Figure 15) tracks the card's movement as it passes through the read station by counting magnetic pulses generated by a timing disk mounted to the first capstan roller's shaft. This capstan roller engages the card as it is released by the picker and thereafter determines the speed at which the card will move through the read station. The timing disk provides two pulses for each .087 inch column and therefore provides .043 inch resolution. To improve this resolution to .022 inch, the 180° Phase Shift Logic is used. When a card enters the read station, $\overline{\text{GPR ØB}}$ is generated and used to



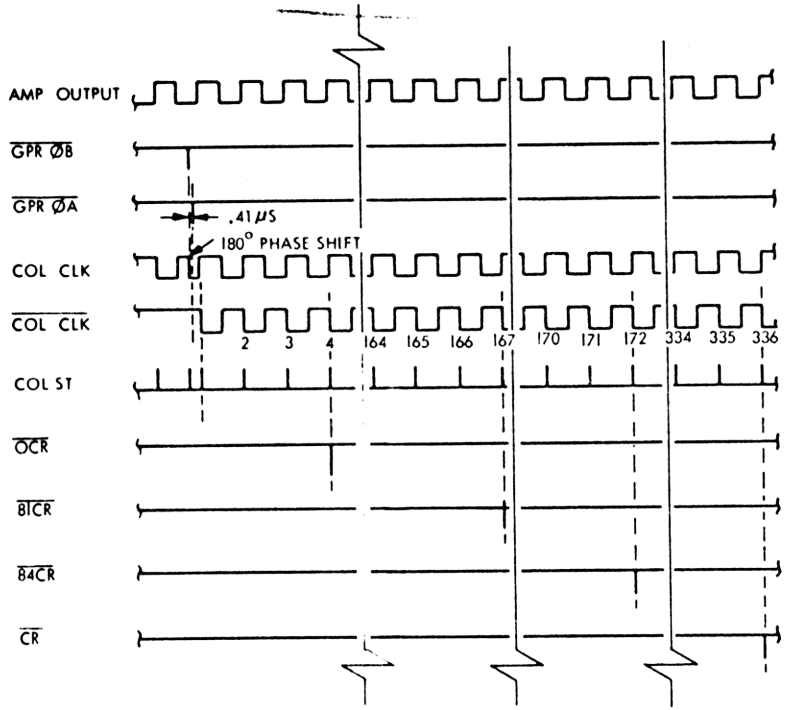


Figure 15. Column Counter Diagram and Timing

sample the AMP's output signal. If the AMP's output is low, a 180^{o} shift will occur. If the AMP's output is high, no phase shift occurs. In effect, this logic causes the AMP's output signal to always be high when a card is detected in the read station.

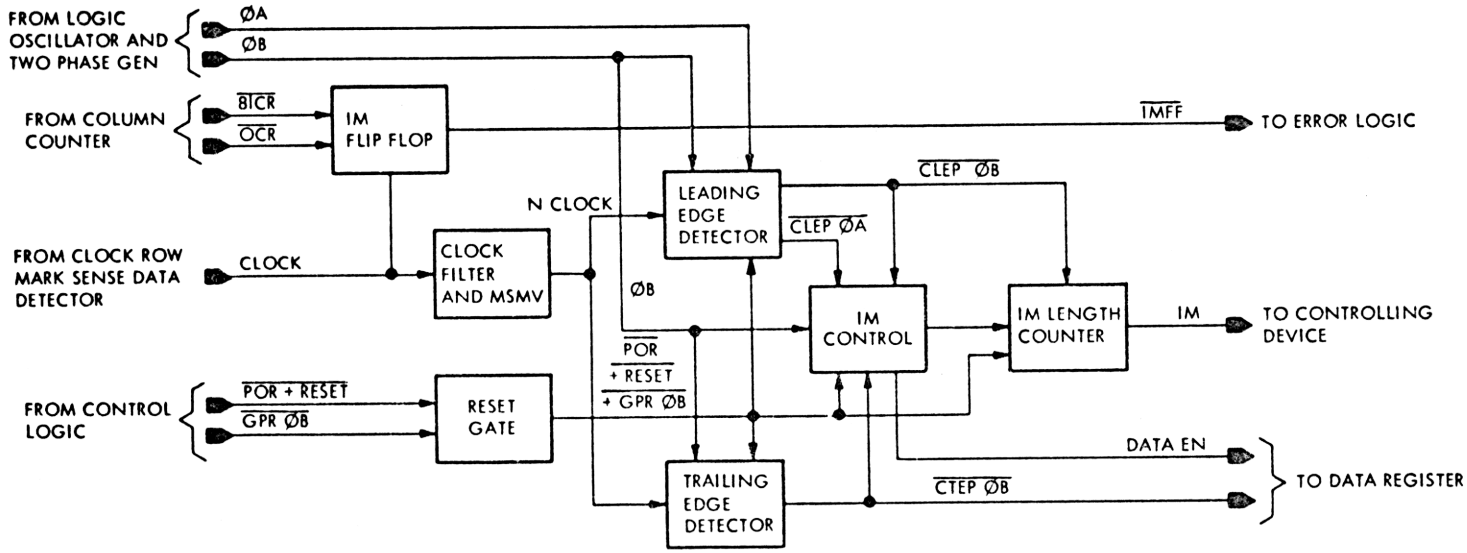
$\overline{\text{GPR ØB}}$ is followed in .41 us by $\overline{\text{GPR ØA}}$. Receipt of $\overline{\text{GPR ØA}}$ by the GP Gating Logic gates $\overline{\text{COL CLK}}$ to the Column Counter and count Gating. The Column Strobe Logic provides a delayed strobe pulse each time COL CLK goes positive. This strobe checks the Count Gating to determine if the counter has reached $\overline{\text{OCR}}$, $\overline{\text{81 CR}}$, $\overline{\text{84 CR}}$ or $\overline{\text{CR}}$. These signals are used by the Control Logic, Pick Logic and Error Logic as follows:

COUNT	USED BY
$\overline{\text{OCR}}$	1) Data Control to set the IMFF Flip Flop 2) Error Logic for an All Zeros Check
$\overline{\text{81 CR}}$	1) Data Control to Reset the IMFF Flip Flop 2) Error Logic for an All Zeros Check 3) Error Logic for an Stack Check
$\overline{\text{84 CR}}$	1) Control Logic to reset the RESET INHIBIT Flip Flop 2) Pick Logic to enable the Pick Control for the next PICK CMD. 3) Error Logic for an All Zeros Check
$\overline{\text{CR}}$ (M 300 only)	1) Control Logic to reset the RESET INHIBIT Flip Flop 2) Pick Logic to enable the Pick Control for the next PICK CMD.

The Column Counter continues its count until $\overline{\text{PCR}}$ is received from the Pick Logic or until count 384 is reached. At count 384 all further $\overline{\text{COL CLK}}$ is inhibited from driving the Column Counter and Count Gating.

Data Control

The Data Control logic (Figure 16) is reset each time a card enters the read station and a $\overline{\text{GPR ØB}}$ is generated. $\overline{\text{OCR}}$ from the Column Counter then clears the IM Flip Flop which releases the CLOCK input to the Clock Filter and MSMV via a wired OR. (The Clock line is held to ground during all intervals of



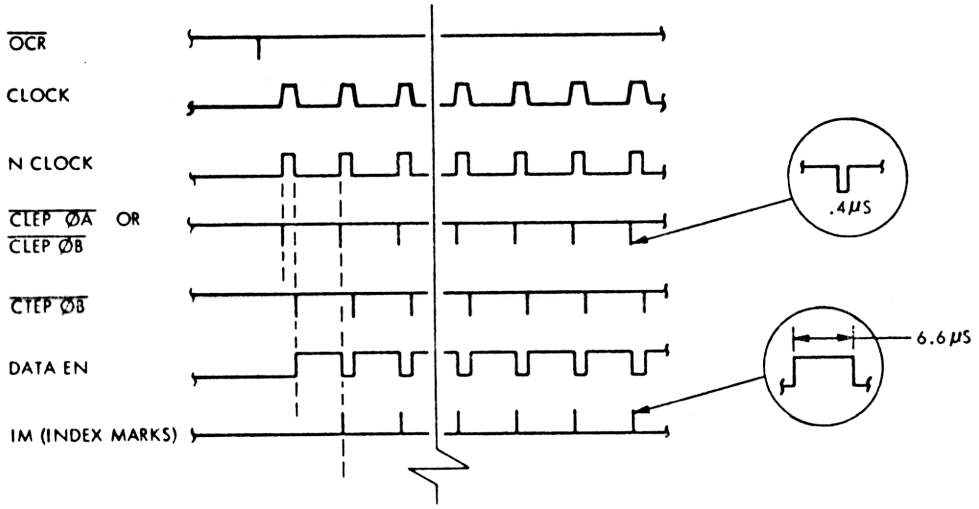


Figure 16. Data Control Diagram and Timing

non-reading to prevent erroneous IM pulses. This is of necessity due to the design of the Mark Sense Data Detectors and the fact that no surface reflectance reference is available when no card is in the read station.)

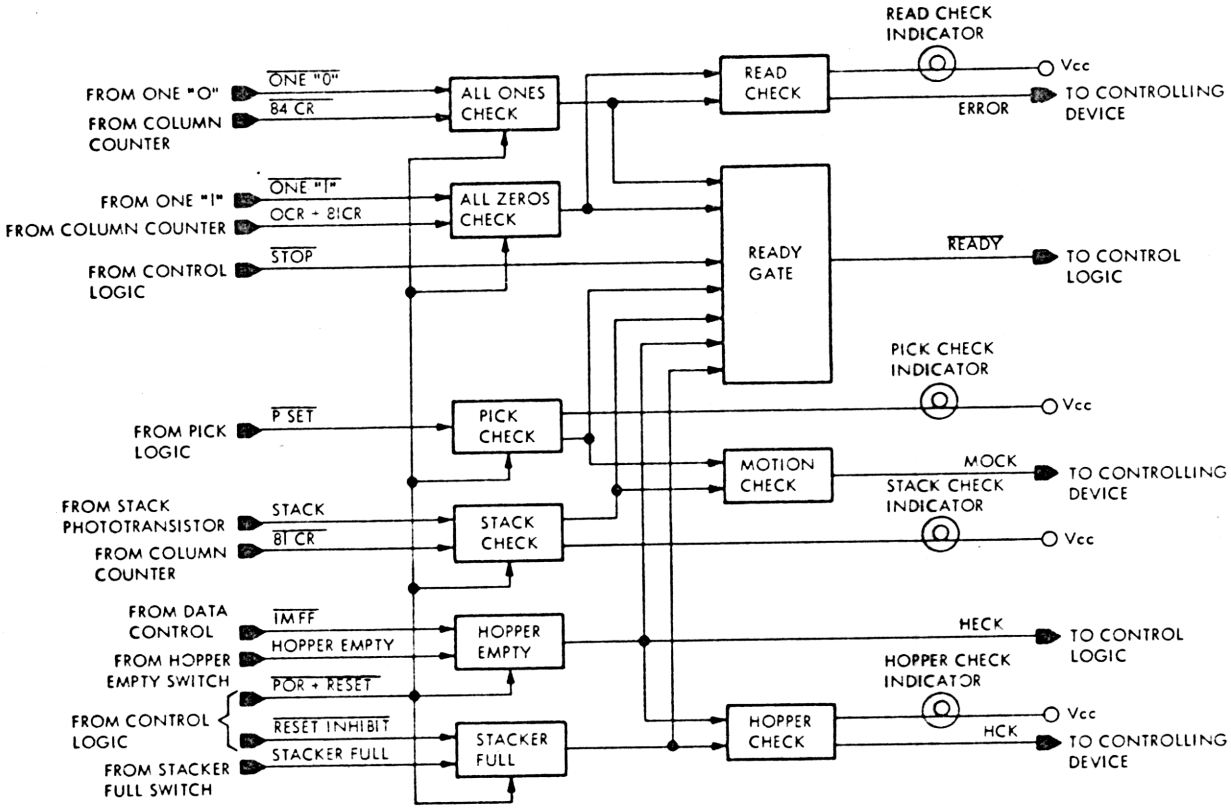
CLOCK signals generated by the Clock Row Mark Sense Data Detector are filtered by the Clock Filter and used to trigger the Schmitt-Trigger input of the MSMV. The MSMV then generates N CLOCK which drives the leading and trailing edge Detectors. These then generate signals $\overline{\text{CLEP ØA}}$, $\overline{\text{CLEP ØB}}$ and $\overline{\text{CTEP ØB}}$ as shown in the timing of Figure 16. $\overline{\text{CLEP ØB}}$ is used to reset the IM Control and Length Counter just prior to CLEP ØA. The first CTEP ØB (N Clock Trailing Edge Pulse ØB) is used to precondition the IM Control so that the second $\overline{\text{CLEP ØA}}$ will generate an IM Index Mark and reset DATA EN. The trailing edge of the first N CLOCK generates $\overline{\text{CTEP ØB}}$ (N Clock Trailing Edge Pulse ØB). $\overline{\text{CTEP ØB}}$ sets a Flip Flop in the IM Control enabling the DATA EN signal and also resets the Data Register. While DATA ENABLE is high all marks or punches detected by the Mark Sense Data Detectors will be transferred to the Data Register. The second N CLOCK generates $\overline{\text{CLEP ØA}}$ number two which resets DATA EN and initiates an IM. The IM Control delays the start of the IM for 1.2 us after DATA EN goes false in order to guarantee data settling on the output lines before the controlling device receives the IM. The IM length Counter counts gated ØB pulses until Count 4 is decoded providing a 6.6 us IM to the controlling device. The trailing edge of the second N CLOCK will again set the DATA EN signal and mark the end of the guaranteed data interval (from $\overline{\text{CLEP ØA}}$ to $\overline{\text{CTEP ØB}}$).

This process is repeated for each clock mark detected until $\overline{\text{81 CR}}$ occurs. $\overline{\text{81 CR}}$ resets the IM Flip Flop and holds the CLOCK line to ground.

Error Logic

The Error Logic of Figure 17 contains the error/alarm detection circuits and the Ready Gate.

Once a PICK CMD is accepted by the reader, the Error Logic is sampled at intervals of card processing for error and reader conditions. The first test is Pick Check. If a $\overline{\text{P SET}}$ is signalled to Pick Check, a MOCK Motion Check will be sent to the controlling device. $\overline{\text{P SET}}$ will occur approximately 300 ms after PICK CMD was received and reader READY will be reset. Pick Check will be signalled to the operator by the PICK CHECK control panel indicator. If PICK CHECK does not occur, a ready cycle will be in process and OCR will sample the All Zeros Check circuits. Should $\overline{\text{ONE "1"}}$ be present during the check, indicating a failed Mark Sense Data Detector or a torn card leading edge, an



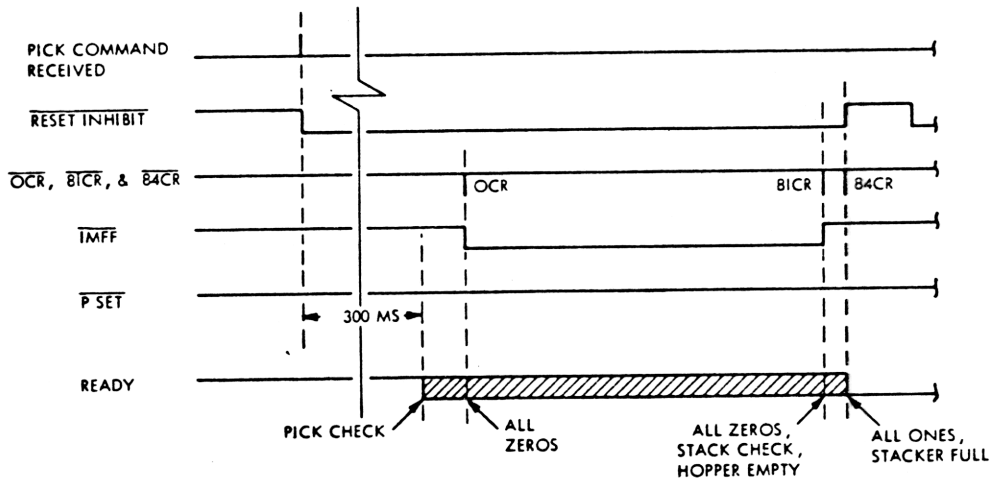


Figure 17. Error Logic Diagram and Timing

ERROR signal will be sent to the controlling device and the READY dropped. The reader control panel will indicate Read Check.

OCR will be followed by $\overline{81\ CR}$ which again samples the All Zeros Check circuits and the Stack Check circuits. The stack check sensor is located at the exit of the card track and detects that the tail of a card is clear of the card track (hence, fully seated in the output stacker). The Stack Check Logic is designed to test the stack sensor dark-to-light transition (i.e., track clear) between the time an 81 CR signal occurs (card tail leaving the read station) and the OCR signal of the next card. Should this transition not have taken place, a STACK CHECK alarm is generated. This signal generates a MOTION CHECK to the controlling device, resets the READY line and lights the Stack Check indicator on the control panel.

Since $\overline{IMFF}$ is reset by $\overline{81\ CR}$, the Hopper Empty circuit will be checked for closure of the hopper empty microswitch. This switch is located in the riffle cap and senses when the last card has left the Hopper. If the hopper is empty at $\overline{81\ CR}$, HCK (Hopper Check) is signalled to the controlling device and READY is reset. Hopper Check is signalled to the operator by the Hopper Check Indicator.

$\overline{84\ CR}$ occurs next in the read cycle and samples the All Ones Check circuitry. A $\overline{ONE}$ "0" present at $\overline{84\ CR}$ indicates a failed Mark Sense Data Detector or excessive card slip in the read track. This error is signalled to the controlling device as an ERROR and the READY line is reset. Visual indication is generated by the Read Check Indicator.

Since $\overline{84\ CR}$ is also used to reset $\overline{RESET\ INHIBIT}$, the Stacker Full circuit will be checked for a closure of the Stacker Full Switch. If the switch is closed, the Stacker Full circuitry will send HCK to the controlling device. reset READY, and light the Hopper Check Indicator.

All error conditions are cleared by the Reset Switch.

DATA DETECTION

The following is a detailed description of each block shown under Data Detection in Figure 11 Block Diagram - OM Series Card Reader.

Mark Sense Data Detectors

Light from the Light Station is reflected from the card's surface and optically coupled to the Read Station's phototransistors by glass fibers. Glass fibers of .002 inches in diameter are packed together to form a window of .010

inches by .100 inches for each of the 13 Mark Sense Data Detectors. These windows scan the card's surface from .007 inches to .010 inches away coupling the reflected light to the phototransistors. All phototransistor collectors are bussed together and connected to +5 VDC. Each phototransistor's emitter is connected to its Mark Sense Data Detector. Figure 18 is a Block Diagram and shows a typical waveform for reflected signals and recovered data for the Mark Sense Data Detectors.

Light reflected into the fiber optics window for Row 12 is coupled to the base of Row 12's phototransistor. The phototransistor's emitter is coupled through R2 to an operational amplifier Voltage Follower. The Voltage Follower combined with D1 and Ref. Storage track and store the positive peaks from the phototransistors emitter. This stored voltage is subsequently divided by a resistor network and used to established the reference for the Voltage Comparator. The reference is dumped (reset) to ground by the Ref. Dump FET each time a DRD pulse is received. DRD pulses are generated on the leading edge of each clock mark and therefore a new reference voltage is established between each data column.

The waveform of Row 12 in Figure 18 shows the reference voltage superimposed on the Phototransistor's emitter output. Whenever the input voltage through R3 to the Voltage Comparator operational amplifier drops below the reference voltage due to a pencil mark or a punched hole, the Voltage Comparators output will go high producing a true data condition (data one). The D Row 12 waveform shows the detected data.

Rows 11 through 9 function identically to ROW 12. The CLOCK ROW data is detected in an identical manner, however the Clock's Ref. Dump circuit receives its dump signal (CRD) on the trailing edge of each clock mark.

Good Pick Detector

To initiate the synchronization process between the card movement and the reader electronics, a GP ENABLE is generated by the Good Pick Detector. The GP ENABLE signal is used by the Control Logic to generate a $\overline{\text{GPR } \emptyset B}$ and $\overline{\text{GPR } \emptyset A}$. These signals reset the Pick Logic and enable the Column Counter.

The Good Pick Detector (Figure 19) receives inputs from the phototransistor emitters for ROWS 12, 0, 4, 7 and 9. These inputs form a diode OR at the input of the Good Pick Detectors voltage comparator. As the card enters the read station, the first phototransistor to receive reflected light from the card surface will generate the waveform shown for ROW 12, 0, 4, 7 or 9.

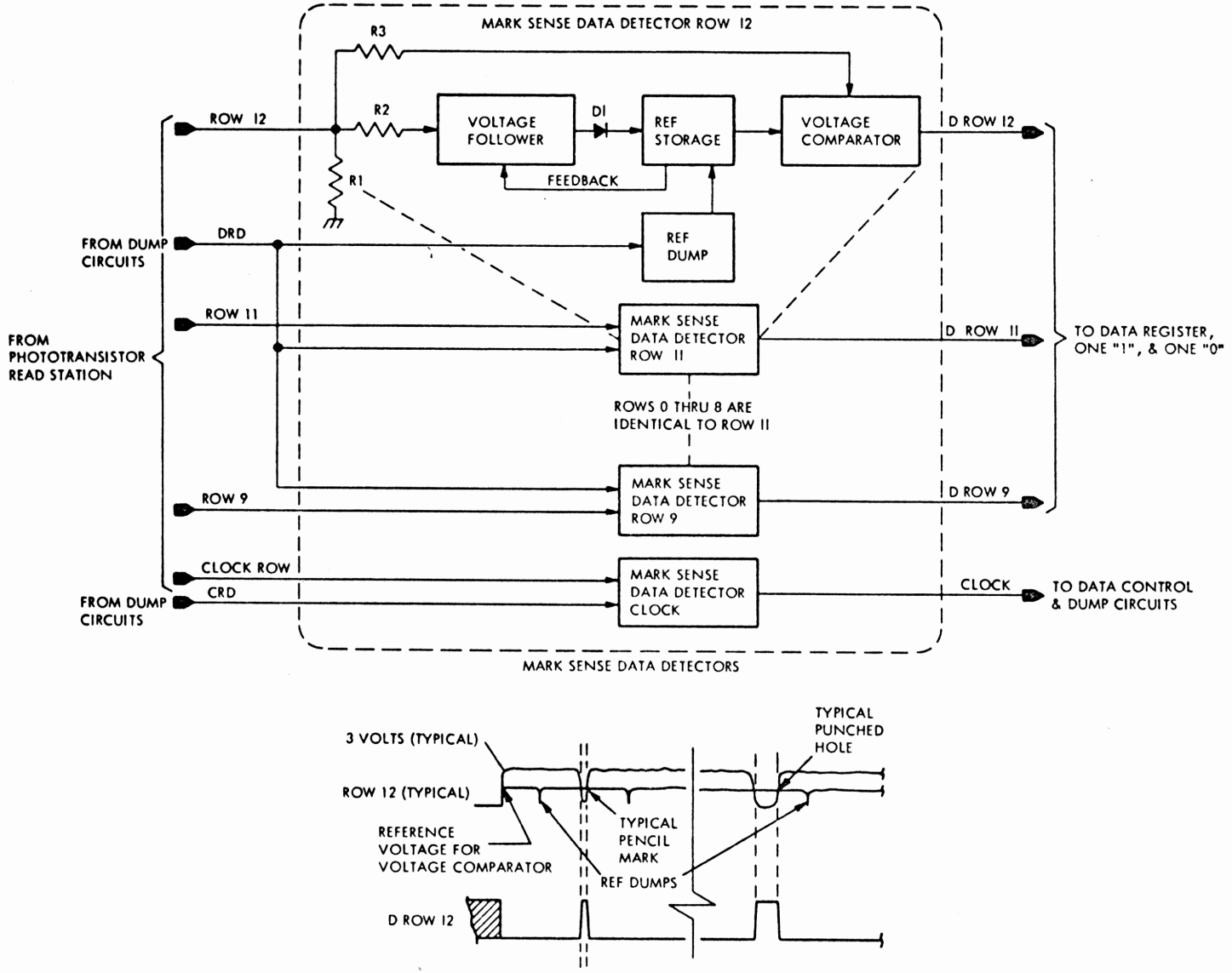


Figure 18. Mark Sense Data Detectors

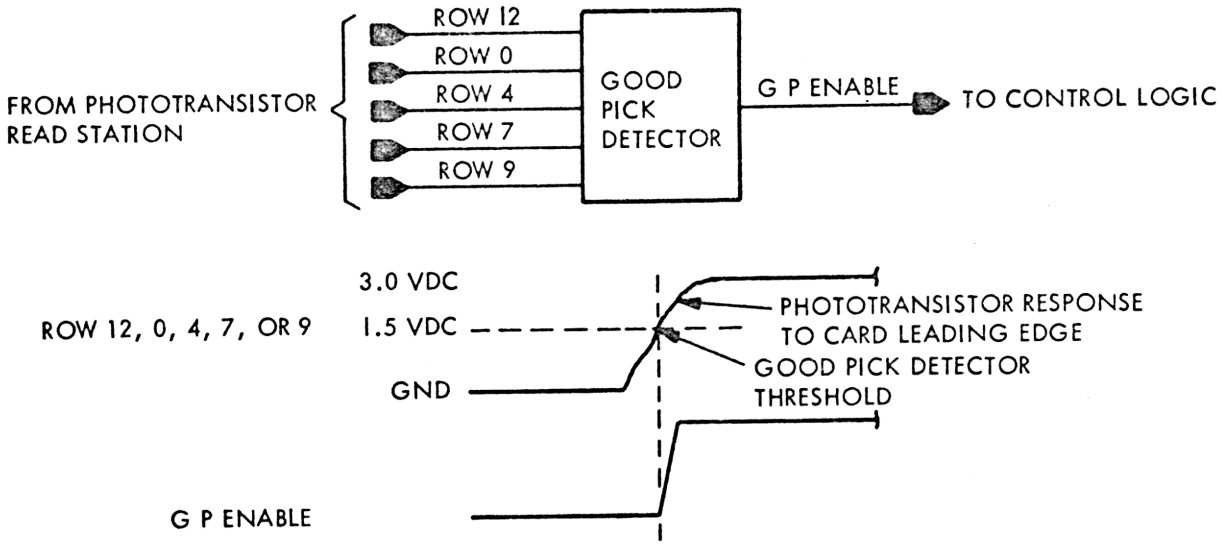


Figure 19. Good Pick Detector and Timing

When the voltage crosses the threshold of approximately 1.5 volts, the voltage comparator will generate the GP ENABLE waveform.

Dump Circuits

As the card passes the Read Station, the clock marks are detected, amplified by logic inverters and used to drive the Dump Circuits.

Figure 20, Dump Circuits and Timing shows the timing relationship of CLOCK to DRD (Data Reference Dump) and CRD (Clock Reference Dump). The Mark Sense Data Detector for the clock row receives the waveform CLOCK ROW and generates CLOCK. CLOCK is buffered by Logic Buffers and then drives the Data Reference Dump and Clock Reference Dump circuits. Both Reference Dump circuits are AC coupled, PNP transistor amplifiers that turn ON when the negative edge of CLOCK or $\overline{\text{CLOCK}}$ are received. The resulting signals DRD and CRD are as shown in Figure 20.

One "1" and One "0"

In order to provide the All Zeros Check at OCR and 81 CR and the All Ones Check at 84 CR, the outputs of the 12 Mark Sense Data Detectors (D ROW 12 THRU D ROW 9) are OR'ed in the ONE "0" nand gate and AND'ed in the ONE "1" nor gate.

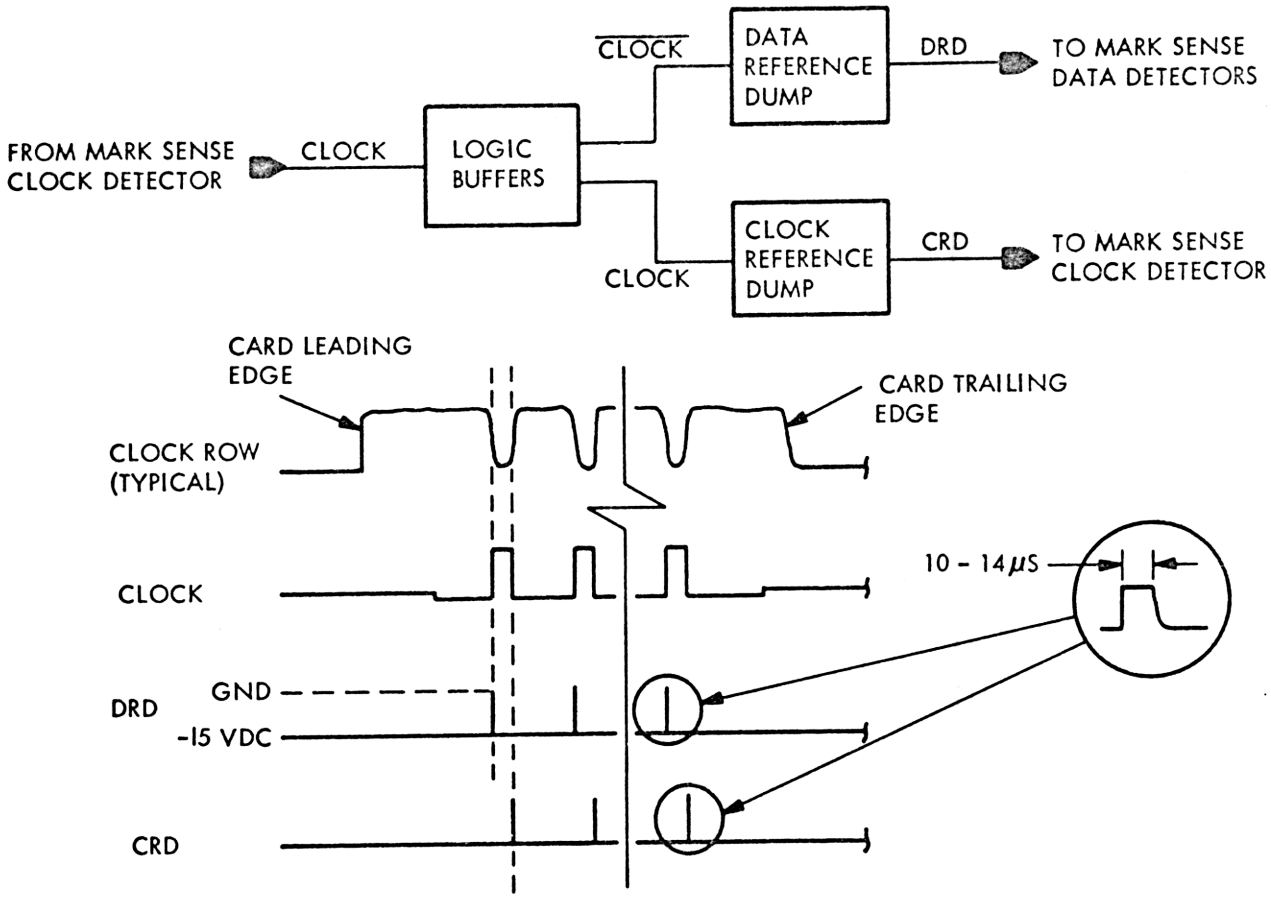


Figure 20. Dump Circuits Diagram and Timing

The timing of Figure 21 shows the normal waveforms for $\overline{\text{ONE "1"}}$ and $\overline{\text{ONE "0"}}$. When OCR occurs, $\overline{\text{ONE "1"}}$ should be high indicating no data was being detected. The same is true at 81 CR. AT 84 CR $\overline{\text{ONE "0"}}$ should be high indicating all ones are being detected by the Mark Sense Data Detectors. If either $\overline{\text{ONE "1"}}$ or $\overline{\text{ONE "0"}}$ is true (LOW) at OCR, 81 CR or 84 CR, a Read Check will result and reader READY will be reset.

Data Storage

The following describes the blocks shown under Data Storage in Figure 11 Block Diagram - OM Series Card Reader.

Data Register and Data Drivers

Data detected by the Mark Sense Data Detectors is stored in the Data Register for transfer through the Data Drivers to the Controlling Device. Figure 22, Data Register and Data Drivers Diagram and Timing details this sequence.

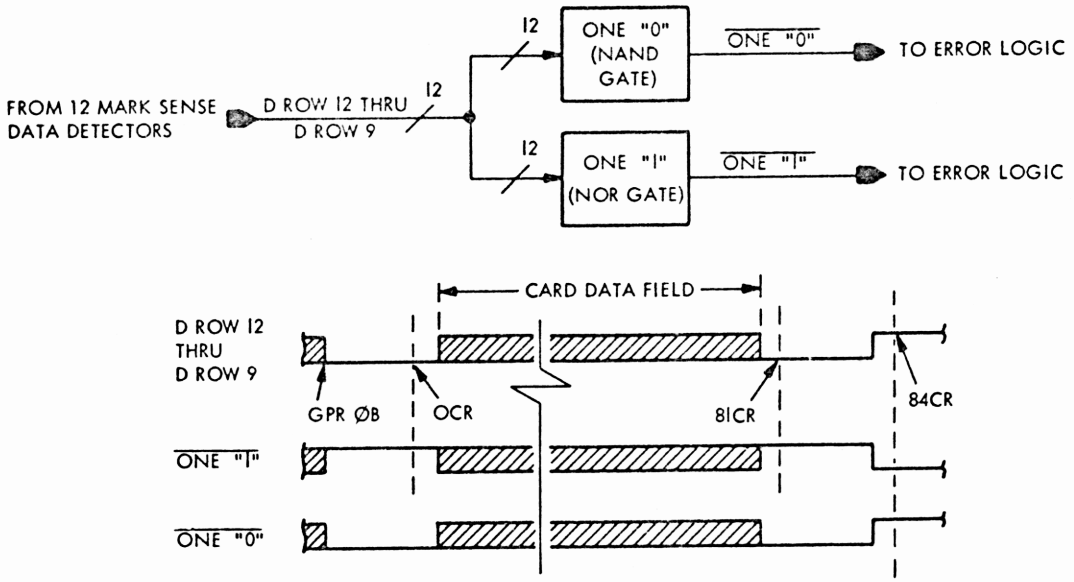


Figure 21. One "1" and One "0" Diagram and Timing

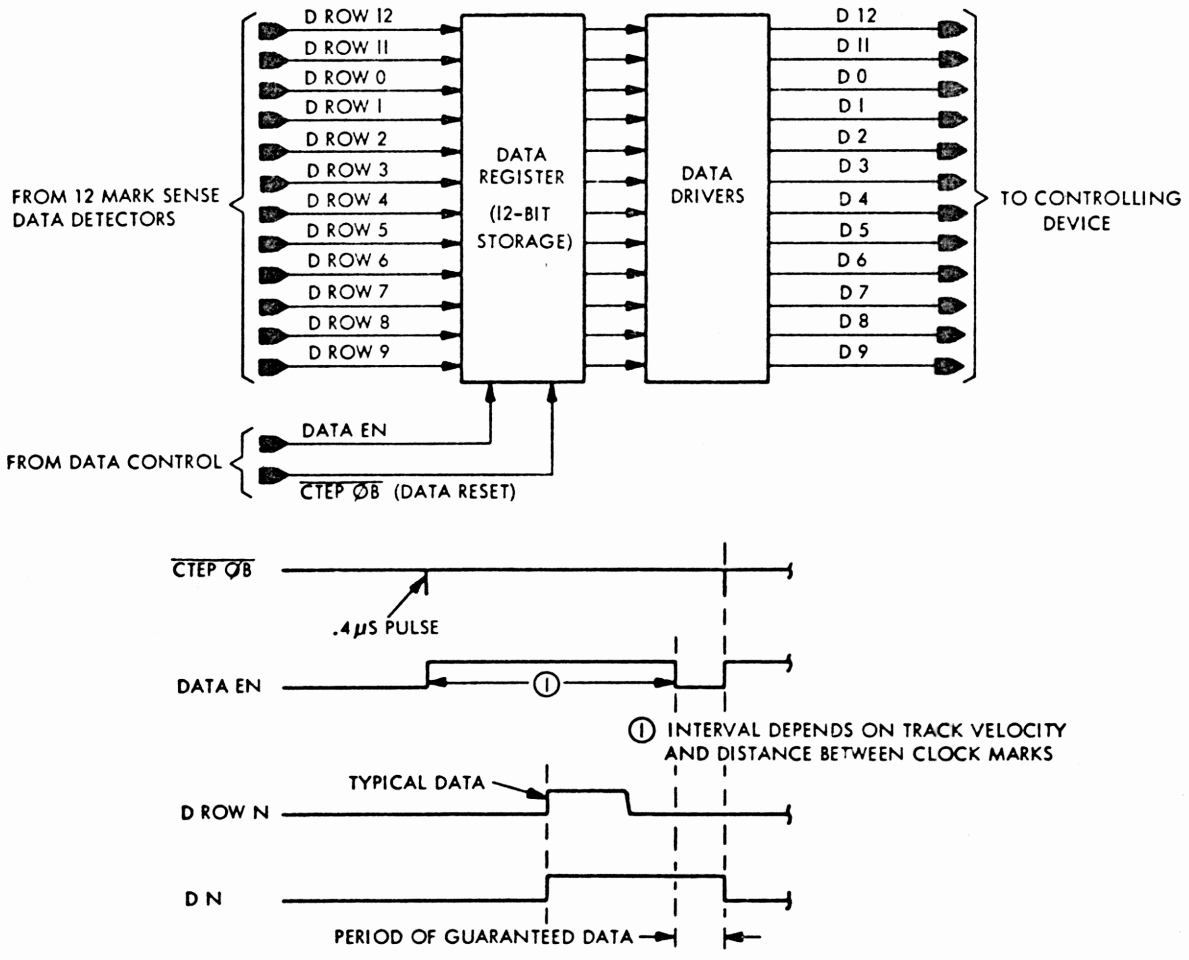


Figure 22. Data Register and Data Drivers Diagram and Timing

The 12 bit Data Register is reset each time $\overline{\text{CTEP ØB}}$ is generated by a clock mark. Coincident with $\overline{\text{CTEP ØB}}$ the DATA EN signal becomes true allowing storage of detected data (see example shown in Figure 22's timing). Any D ROW input that is high during DATA EN will cause a "1" to be stored for its row. The end of the DATA EN period is generated by detection of a clock mark's leading edge. While DATA EN is low, no more data can enter the register thus giving a period of guaranteed data from DATA EN going low until another $\overline{\text{CTEP ØB}}$ is generated resetting the data.

The Data Drivers provide the necessary buffering between the Data Register and the Controlling Device.

INTERFACE

GENERAL

This section covers the interface between the OM Series Optical Mark Sense readers and the equipment into which it transfers data.

TIMING

In interfacing the OM Series card readers to an external system or card reader controller, the designer should appreciate that three separate categories of interface signals are being dealt with. The first are the signals which control and report the status of card processing, the second are the data signals themselves with their associated index marks, and the third are the various alarm signals provided. In the description following, the designer should refer to the timing diagram shown in Figure 23.

Pick Control

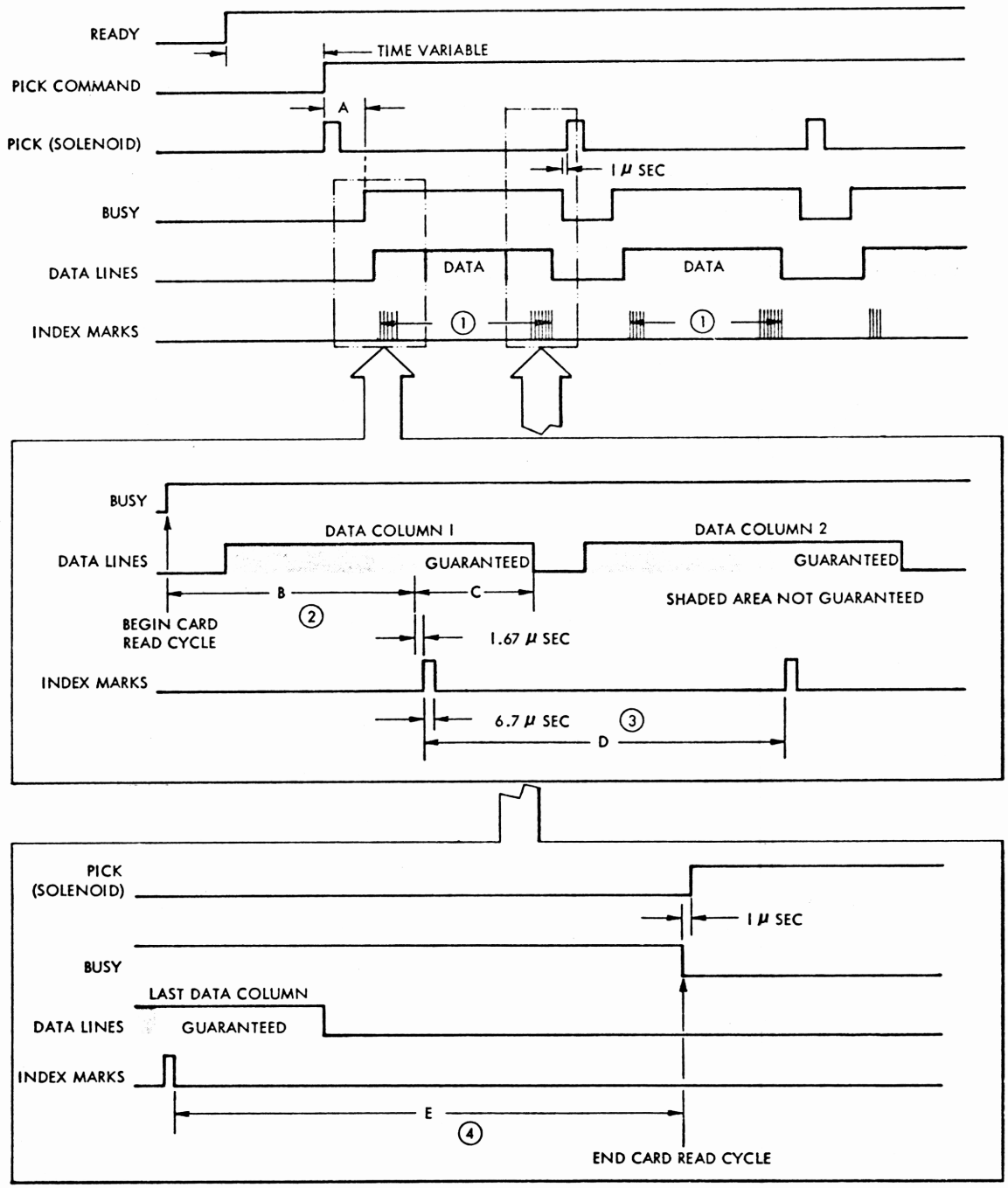
The PICK COMMAND initiates the card read cycle, and depending upon its duration, the card reader will either continuous run or operate in a card-at-a-time mode. This signal can be presented to the reader at any time, but the reader will only accept it when the READY line is TRUE. The READY signal indicates that the card reader is cleared of errors and is ready to receive a PICK COMMAND from the external program control. A visual indication of the READY line is the green RESET indicator on the front control panel.

The conditions which must be present for the READY line to be TRUE are:

1. Power applied and the 3 second run-up completed.
2. The input hopper has been loaded.
3. Depressing the RESET pushbutton switch will bring the READY line TRUE.

Should all of the above conditions be satisfied, the presence of a PICK COMMAND signal will generate the PICK pulse to the picker solenoid. The first card is introduced into the card track, and after a delay (see A, Figure 23), the leading edge will arrive at the read station. The BUSY signal will go TRUE as soon as the leading edge of the card enters the read station.

To initiate the card pick cycle, the PICK COMMAND must be present for at least 1 microsecond (us) concurrently with the READY signal. Once the pick cycle is initiated, the PICK COMMAND line is ignored until the BUSY signal



(1) Index marks = N-1, where N = number of clock marks

(2) B (in sec) = $\frac{1}{\text{Track velocity}}$ X distance in inches from card leading edge to second clock mark leading edge

(3) D (in sec) = $\frac{1}{\text{Track velocity}}$ X distance in inches between clock marks (leading edge to leading edge)

(4) E (in sec) = $\frac{1}{\text{Track velocity}}$ X distance from last clock mark leading edge to end of card

NOTE:

MODEL	A (MIN)	C	CARD PICK CYCLE	TRACK VELOCITY
M 200	24	600	210	43.06
M 300	24	235	200	100.67
M 600	24	235	100	100.67
M 1000	15	130	60	175.38
M 1200	14	100	50	214.75
	M SEC	μ SEC	M SEC	INCHES/SEC

Figure 23. Standard Interface Timing for OM Series Readers

goes FALSE, indicating the end of the card read cycle. In card-at-a-time operation, it is suggested that the PICK COMMAND be retained TRUE until receipt of the first index mark. In the continuous run mode, the PICK COMMAND may be left in the TRUE condition and a new PICK signal will be automatically generated within 1 us of the BUSY signal going FALSE.

Should the picker fail to engage the card, the Pick Control logic will wait 50 milliseconds (ms) and automatically try again. It will continue to generate a PICK pulse every 50 ms until 6 attempts have been made. After 6 attempts have been unsuccessful (300 ms), a PICK CHECK alarm will be generated, disabling the READY line.

Data Readout

The card read cycle starts with the recognition that the card leading edge has entered the read station. At this time the BUSY line goes TRUE. Index Marks of 6.67 us duration are generated while the BUSY signal is present. The time spacing of the Index Marks and the BUSY signal are shown by intervals B, D, and E on Figure 23.

It can be seen from the timing diagram that data signals may appear on the data output lines before the occurrence of the associated Index Mark. During this pre-Index Mark interval, any positive signal from the 13 Mark Sense Data Detectors indicates a mark or hole, and therefore is recognized as a valid data bit and is stored in the data register. Since the contents of the data register are subject to change throughout this interval, the data is not guaranteed until the end of the acceptance interval. This period is terminated 1.67 us prior to the Index Mark.

By the time the Index Mark is generated, the data will have been read, stored, and the data lines will have settled. Data levels are guaranteed to remain on the output lines available for transfer to the external equipment for interval C.

Alarms

A description of the standard alarm signals provided in the OM Series reader follows:

Hopper Check

The HOPPER CHECK signal remains FALSE during normal card reader operation, but goes TRUE if ~~either~~ the input hopper is empty~~, or the output stacker is full.~~ If the input hopper is empty and the SHUTDOWN switch is in AUTO position, the

motors are also automatically switched off; when the input is reloaded and RESET pressed, the motors are automatically re-energized.

The hopper empty switch is sampled at 81 CR for each card read. When the last card leaves the input hopper, the switch closes causing a HOPPER CHECK when 81 CR occurs. HOPPER CHECK then disables the READY signal. ~~In the case of a full output stacker, the HOPPER CHECK signal appears at the 81 CR of the read cycle during which it occurred.~~

Error

The ERROR signal is produced by failure of the all ones or all zeros check. This usually indicates that a card has a tear at the leading or trailing edge (all zeros) or if the read station experienced an emitter/sensor failure while reading a card (all ones). Either type of failure will be signalled by the ERROR line going TRUE and a READ CHECK indication on the front panel. The ERROR signal can occur at OCR, 81 CR or 84 CR.

Motion Check

The MOTION CHECK signal is a composite of the PICK CHECK and STACK CHECK alarm. Both alarms are conditions requiring operator intervention and are furnished to the interface as a single alarm line. The condition is displayed on the front panel indicator lights as either a PICK CHECK or a STACK CHECK. The MOTION CHECK signal will occur within 300 ms of the initiation of an unsuccessful pick attempt or in time to inhibit the picking of the second card after the stacker sensor detects that a card is not completely clear of the card track.

CONNECTORS

The 38 pin output connector provides access for all control, data and alarm lines. A separate twist-lock connector provides entry for AC power. The output connector is Elco Part No. 00-8016-038-000-707 and the mating connector is Elco Part No. 00-8016-038-217-704. This mating connector assembly is available from Documation and is shipped unassembled as a kit with connector base, cover and 38 solder type pins (#60-8017-0513).

The power connector is Hubbell Part No. 7486. The mating connector is Hubbell Part No. 7484. The mating AC power connector is supplied on the standard accessory power cord; however, it is identified in case it is desired to fabricate a special power interface.

The standard OM Series pin assignment configuration is given in the following table:

SIGNAL CONNECTOR PIN LIST

PIN	SIGNAL	DESCRIPTION	PIN	SIGNAL	DESCRIPTION
A	D12	Row 12 Data	X	D7 (RET)	
B	D11	Row 11 Data	Y	D8	Row 8 Data
C	D0	Row 0 Data	Z	D9	Row 9 Data
D	D1	Row 1 Data	AA	IM	Index Mark
E	D12 (RET)		BB	RDY	Ready
F	D11 (RET)		CC	D8 (RET)	
H	D0 (RET)		DD	D9 (RET)	
J	D1 (RET)		EE	IM (RET)/GRD	Signal Ground
K	D2	Row 2 Data	FF	RDY (RET)	
L	D3	Row 3 Data	HH	ERROR	Error
M	D4	Row 4 Data	JJ	HCK	Hopper Check
N	D5	Row 5 Data	KK	MOCK	Motion Check
P	D2 (RET)		LL	PC	Pick Command
R	D3 (RET)		MM	BSY	Busy
S	D4 (RET)		NN	Error (RET)	
T	D5 (RET)		PP	HCK (RET)	
U	D6	Row 6 Data	RR	MOCK (RET)	
V	D7	Row 7 Data	SS	PC (RET)	
W	D6 (RET)		TT	BSY (RET)	

POWER CONNECTOR PIN LIST

PIN	SIGNAL	
W	Safety ground	(green)
X	Neutral	(white)
Y	115 Volts	(black)

SIGNAL CHARACTERISTICS

The standard interface is supplied as the output of TTL type 7416 or 7417. Circuit characteristics are shown in Figure 24. Other output drive configurations are available.

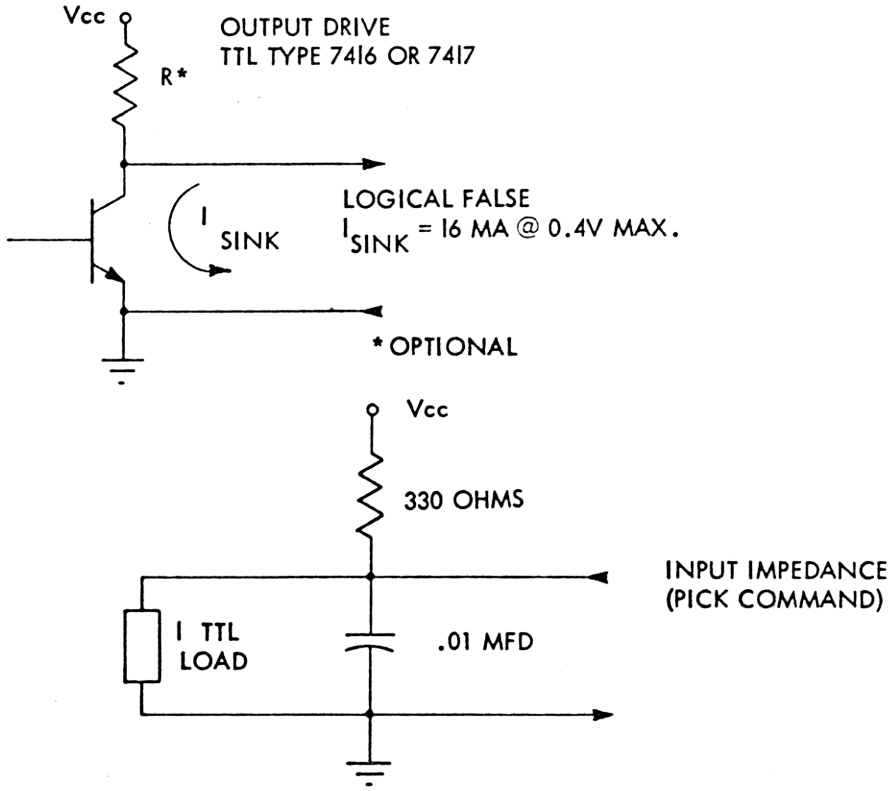


Figure 24. Circuit Characteristics

GROUNDING

Grounding within the OM Series card readers maintains AC power and signal ground separate. Signal ground is the logic power return (Vcc return) and is transformer isolated from the AC power distribution system. The chassis is protected by connection to the safety wire (green) in the AC power cord.

It is recommended that twisted pair cable be used to connect the OM Series Card Readers to external equipment. The signal returns should be terminated as close as possible to the signal receivers. It should be noted that pin EE (Index Mark return) is designated as SIGNAL GROUND on the pin assignment chart. If twisted pair interconnection is not used, it is recommended that pin EE be connected to the external equipment signal return.

PREVENTIVE MAINTENANCE

GENERAL

The following paragraphs provide information for preventive maintenance and general care of the OM Series card readers. The OM Series card readers are of rugged construction and are designed to provide many hours of failsafe, reliable operation; as such, preventive maintenance consists primarily of cleaning the picker shoe, stack casting cavity and fan screen as necessary.

CLEANING

Picker Shoe

IMPORTANT

AFTER EACH 40 HOURS OF OPERATION, THE NEOPRENE SURFACE OF THE PICKER SHOE SHOULD BE WIPED WITH A SOLVENT SUCH AS DENATURED ALCOHOL OR LACQUER THINNER.

This will remove the glaze buildup from the ink which rubs off of the cards. This is especially prevalent where new cards are used exclusively. If this glaze is allowed to remain, it reduces the coefficient of friction of the picker shoe to the point that erratic pick operation may result.

After each 160 hours of operation, the picker shoe should be examined to see if any of the vacuum holes have become plugged with lint, trash, or card meal which the solvent scrub has failed to dislodge. If so, gently push this debris through the holes with a paper clip while the reader is on. The vacuum system will remove the debris.

Stack Casting Cavity

After each 160 hours of operation, the stack casting cavity, Figure 26, should be cleaned of dust and particle buildup. Remove debris with small vacuum nozzle. If a large amount of debris is allowed to collect, light will be reflected back into the read station resulting in Read Checks at 84 CR.

Cooling Fan

The cooling fan air-intake screen prevents dirt and dust from entering the card reader interior. Depending upon the operational atmosphere, the screen should be cleaned as necessary. Use a flat-blade screw-driver and remove the filter (Figure 25); then clean in a solvent or a vacuum cleaner as necessary.

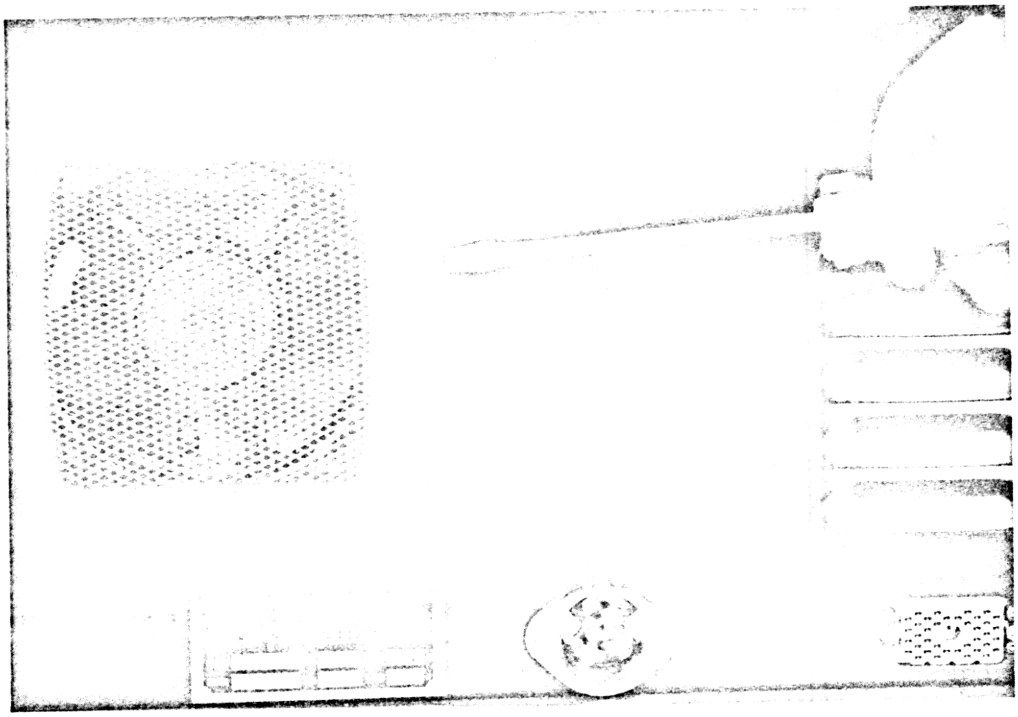


Figure 25. Removal of Fan Screen

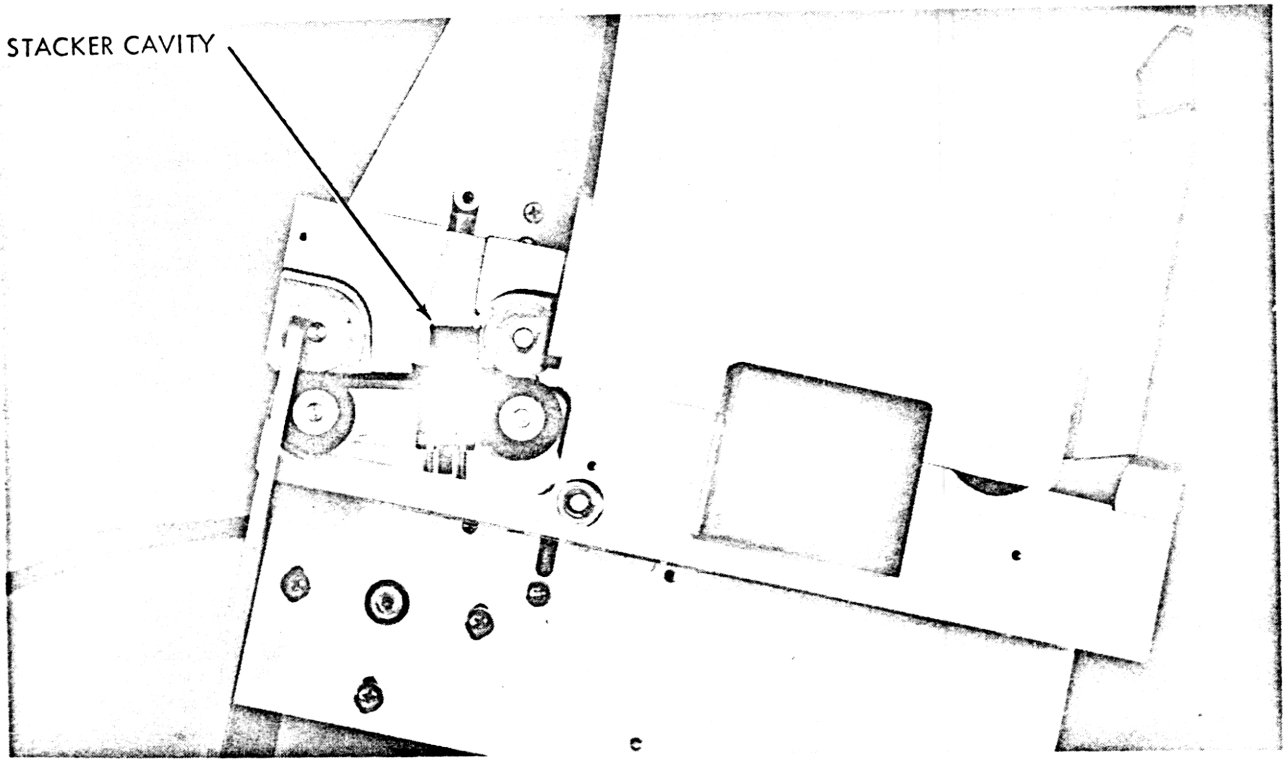


Figure 26. Stacker Cavity

Exterior Cleaning

The exterior OM Series Card Readers should be cleaned as often as practical. Wipe the exterior with a clean, lint-free cloth saturated with a mild solvent such as denatured alcohol or household ammonia after each 40-hour operational period. If persistent dirt buildup is present, the exterior should be rubbed down with a heavier solvent. Attention to this routine will keep the anodized finish of the reader with a like-new appearance indefinitely.

LUBRICATION

Rotary Solenoid

The rollers of the rotary solenoid normally require grease only after 40 million cards have been processed through the reader. Since there is a possibility that the grease may dry out in certain low humidity localities, it is recommended that these rollers be lubricated every six months. Apply one drop of Ledex No. 2 lubricant to each of the three roller grease points (Figure 27). A lubricant kit is available from Ledex Inc., Dayton, Ohio (Part No. 124048-001) or from Documation, Incorporated.

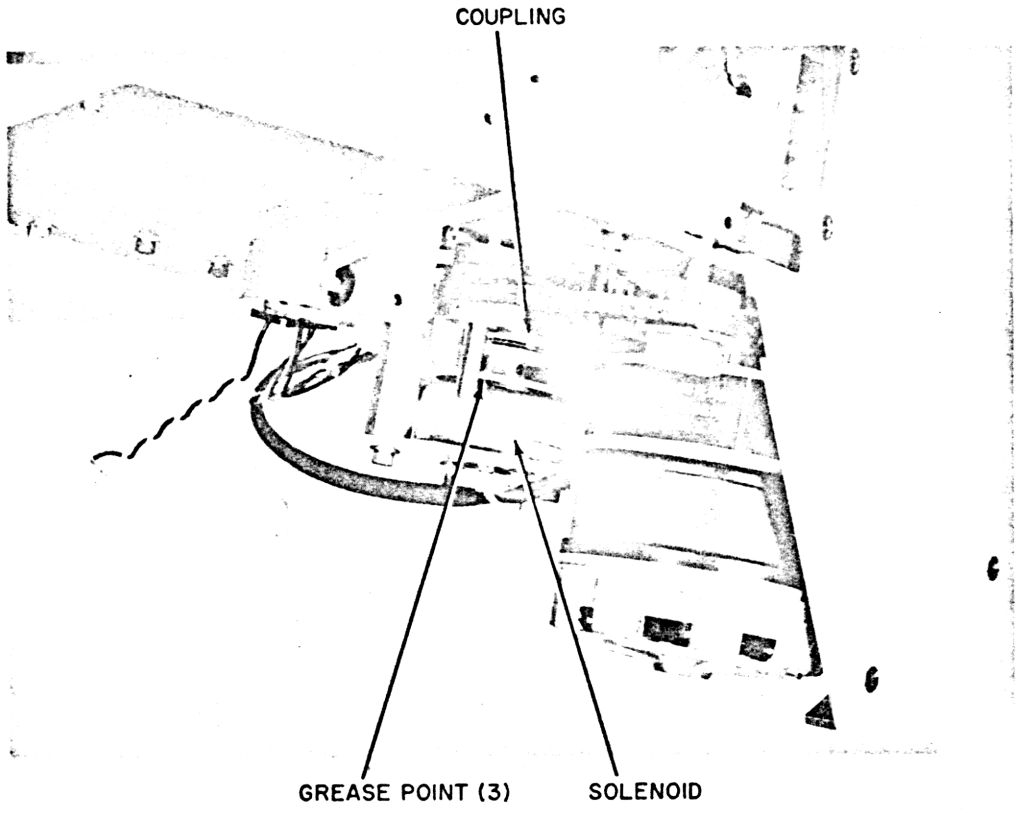


Figure 27. Solenoid Lubrication

REPAIR

GENERAL

The following repair procedures detail step-by-step methods for those parts for which replacement may be required during the life of the reader. It is recommended that these procedures are followed closely and performed by a person familiar with tools, their use and assembly/disassembly techniques.

REPAIR PROCEDURES TABLE OF CONTENTS

REQUIRED TOOLS

The following tools are required to perform assembly/disassembly on the OM Series Card Readers.

TOOL DESCRIPTION	MANUFACTURER/PART NUMBER SPECIAL TOOLS
1. 1/16" - Allen Screwdriver	
2. 3/32" - Allen Wrench (long arm)	
3. 5/64" - Allen Wrench (long arm)	
4. 7/64" - Allen Wrench (long arm)	
5. 1/8" - Allen Wrench (long arm)	
6. 9/64" - Allen Wrench (long arm)	
7. .050" - Allen Wrench (short arm)	
8. 1/16" - Allen Wrench (short arm)	
9. AMP Extraction Tool	AMP 91022-1
10. "AMP Leaf Contact" Extraction Tool	AMP 465195-2 or 465275-1
11. "AMP Modified Fork" Contact Extraction Tool	AMP 91037-2
12. "AMP" Mod IV" Contact Extraction Tool	AMP 91029-1A
13. Deutsch Insertion/Extraction Tool	NAS 1664-16
14. Elco Extraction Tool	Elco 061877-02
15. Elco Insertion Tool	Elco 061742-04
16. Feeler Gauge Set 0.0015" thru 0.025"	
17. Flat Nose Pliers	
18. Knife Blade - 2 1/2" blade	
19. Medium Flat Blade Screwdriver 3" long	
20. Medium Flat Blade Screwdriver 6" long	
21. 6" Metal Scale, decimal/fraction per inch	
22. 1/4" - Open End or Socket Wrench	
23. 1/32"- Open End or Socket Wrench	
24. 7/16"- Open End or Socket Wrench	
25. #1 Phillips Screwdriver 6" long	
26. #2 Phillips Screwdriver 6" long	
27. Printed Circuit Card Extender	Documation P/N 1040405
28. #2 Retaining Ring Remover	
29. Side Cutter	
30. Solder Removal Tool	
31. 60-watt Soldering Iron	
32. 32-oz. Spring Scale	

REPLACEMENT OF HOPPER EMPTY SWITCH

1. Using a 5/64 Allen wrench, LOOSEN five 6 x 32 button head screws (1) retaining top cover, Figure 28.

2. Lift top cover sufficiently to reveal the control panel connector, Figure 30, and disconnect the control panel connector. The top cover may now be removed.

3. Using a 3/32 Allen wrench, remove two socket head screws holding riffle cap, Figure 30.

4. Remove two leads from hopper empty switch, Figure 30.

5. Using a 1/16 Allen wrench, remove two button head screws holding switch, Figure 30.

6. Replace switch and adjust so that microswitch is mechanically activated with card in hopper and disengaged with hopper empty.

7. Reassemble in reverse order of disassembly.

ADJUSTMENT OF PICKER SECTOR TRAVEL

1. Perform steps 1 and 2 of Replacement of Hopper Empty Switch Procedure.

2. Using a 7/64 Allen wrench, LOOSEN two 6 x 32 socket head screws (2) holding picker stop, Figure 30.

3. Adjust picker stop so that the rear edge of the last row of holes in picker sector is in a vertical line with the pick vacuum set screw's centerline, Figure 31. Tighten the two socket head screws holding the picker stop.

4. Using a 9/64 Allen wrench, LOOSEN the two 8 x 32 socket head screws (3) retaining the picker bumper, Figure 30.

5. Adjust the picker bumper so that a card picked by hand just makes contact with the first set of rollers. Tighten the two socket head screws holding the picker bumper, making sure bumper is in vertical contact with picker sector.

6. Reassemble in reverse order of disassembly.

7. Using a Phillips screwdriver, LOOSEN the throat block screw and adjust throat block for .007" to .008" clearance between picker sector and throat block, Figure 31. Tighten throat block screw.

ADJUSTMENT OF TENSION ON MAIN DRIVE MOTOR BELT

1. Perform Steps 1 and 2 of Replacement of Hopper Empty Switch Procedure.

2. Using a Phillips screwdriver, LOOSEN three main drive motor mounting screws (4), Figure 30.

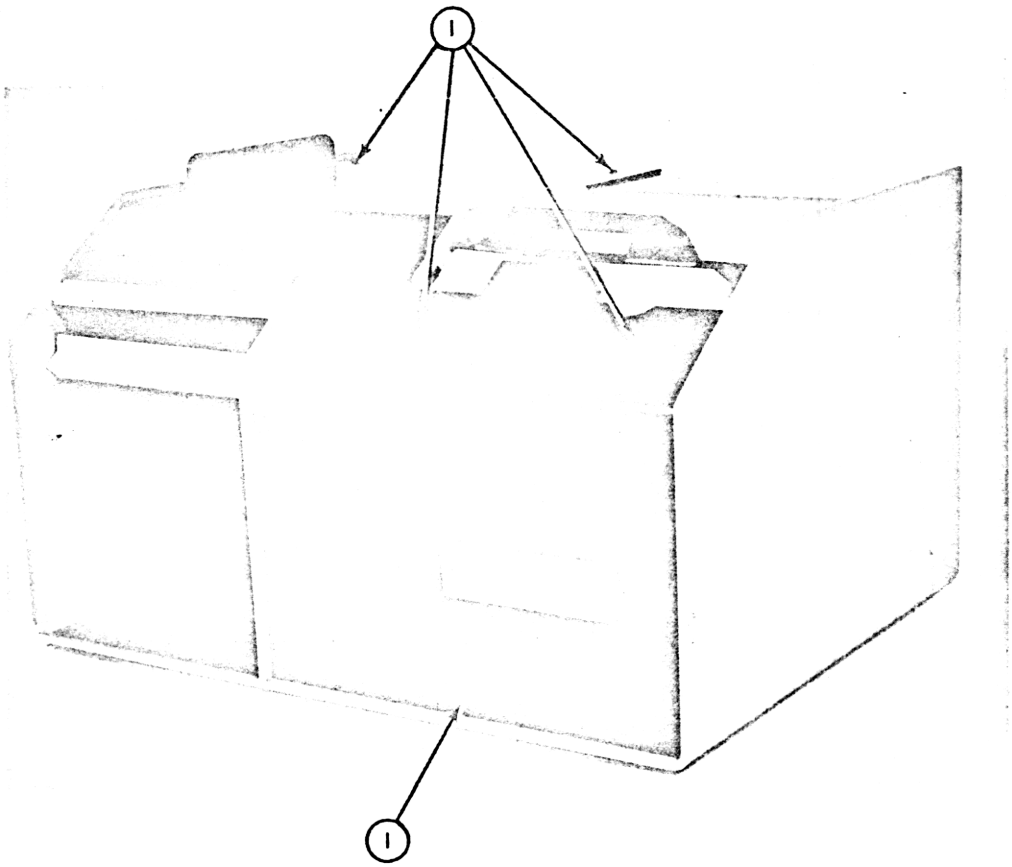


Figure 28. Three-Quarter Front View

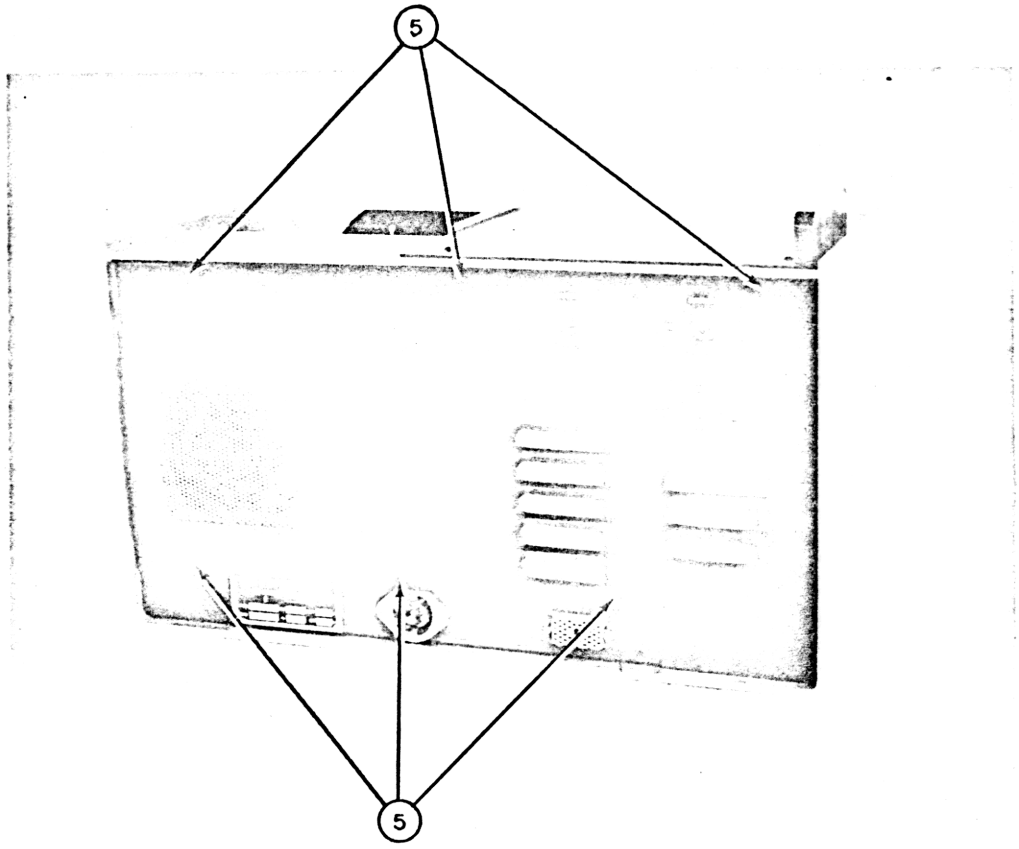


Figure 29. Three-Quarter Rear View

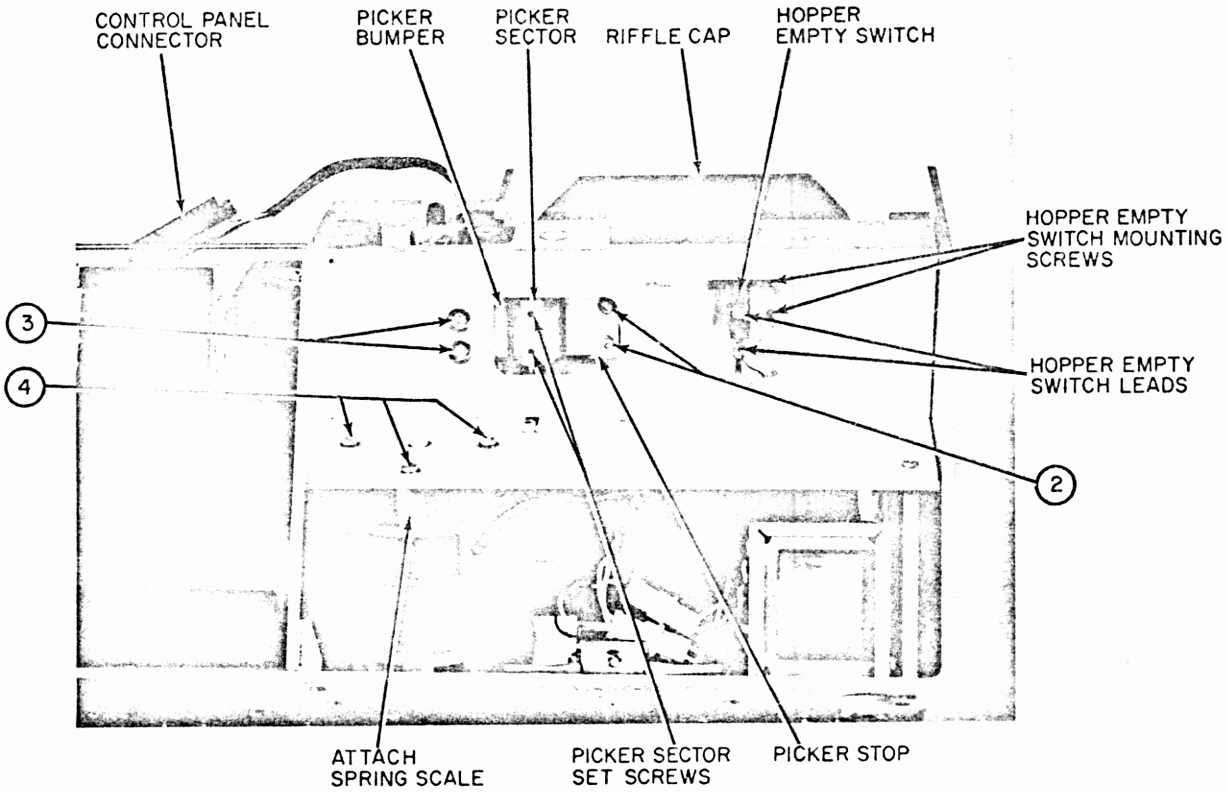


Figure 30. Partial Front View, Cover Removed

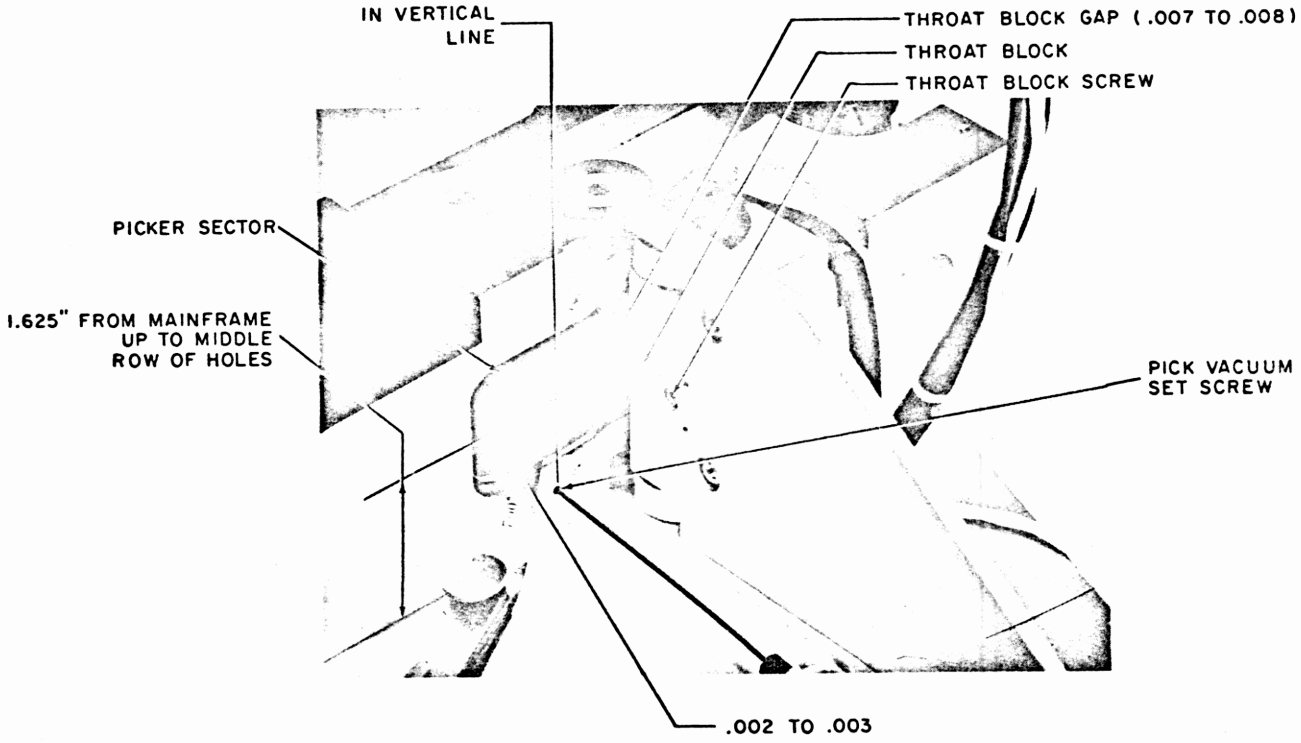


Figure 31. Picker Sector Adjustment

3. Attach a 32-ounce spring scale with a round hook end to the front main drive motor standoff, Figure 30.

4. Apply 24-ounces of force to the motor standoff. This will apply the correct tension to the main drive motor belt.

5. With this force applied, tighten the three main drive motor mounting screws.

CAUTION

BELT TENSION IS A CRITICAL ADJUSTMENT: EXERCISE CARE THAT TENSION IS CORRECT TO PREVENT EXCESSIVE BELT AND MOTOR SHAFT BEARING WEAR.

6. Re-adjust magnetic pickup using step 8 of Replacement and Adjustment of magnetic pickup.

7. Reassemble in reverse order of disassembly.

ADJUSTMENT OF STACKER TRAY SPRING

1. Perform steps 1 and 2 of Replacement Hopper Empty Switch Procedure.

2. Locate stacker tray spring behind left side of stacker tray-facing reader, Figure 32.

Use the following guidelines to adjust the stacker tray spring:

3. The six holes in the spring plate may be termed the stacker tray rate adjustment. Generally, if the cards being read are heavy (very few punches), the spring will be placed in one of the holes toward the front of the plate. If the cards being read are light (many punches), the spring will be placed in one of the holes toward the rear of the plate. The spring is adjusted at the factory (as illustrated in Figure 32) for about 20-25% punch density or about 3 punches per column.

4. The four holes in the spring bracket may be termed the stacker tray preload adjustment. The spring should be placed in the bracket in a position which will allow sufficient clearance for the card to drop into the stacker tray and the tray then continue to load evenly and smoothly.

STACKER SHAFT SUPPORT - BEARING REPLACEMENT

1. Perform steps 1 and 2 of Replacement of Hopper Empty Switch Procedure.

2. Remove six 6 x 32 buttonhead screws holding rear panel, Figure 29.

3. Disconnect fan motor connector and remove rear panel, Figure 33.

4. Remove three 6 x 32 Phillips pan head screws (6) from bottom plate holding rear connector panel, Figure 33.

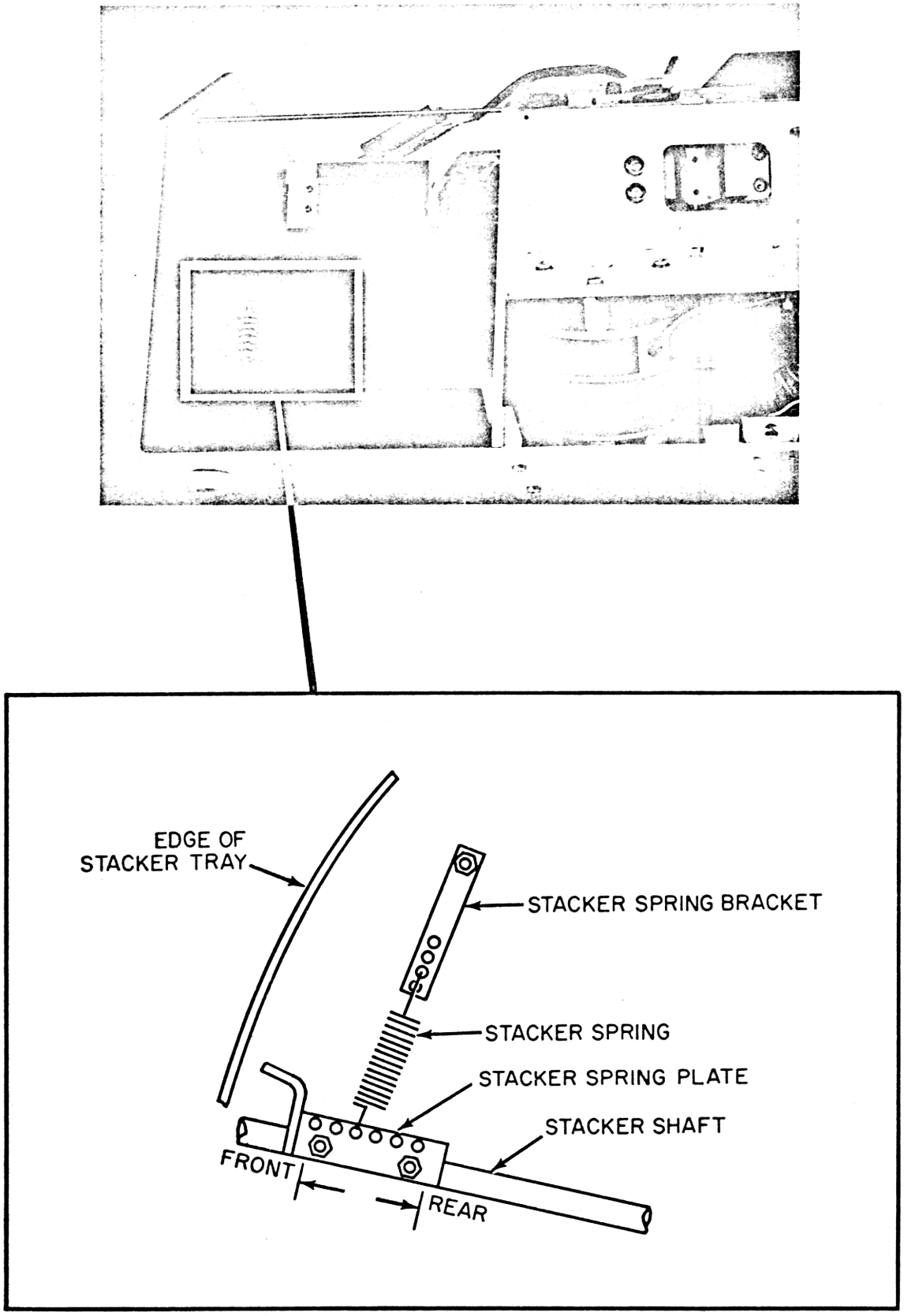


Figure 32. Partial Front View, Stacker Spring

5. Using a 5/16 Allen Wrench, LOOSEN stacker shaft collar set screw, Figure 34.

6. Remove two 8 x 32 pan head screws (7) from mainframe holding stacker shaft support casting, Figure 34.

7. Move stacker shaft support casting to the rear and slide off shaft to the left.

8. Using an arbor press, remove and replace the two bearings in the stacker shaft support casting.

9. Reassemble in reverse order of disassembly making sure to replace collar on shaft when replacing casting.

REPLACEMENT OF BELT ON VACUUM PUMP MOTOR ASSEMBLY

1. Perform steps 1 through 4 of Stacker Shaft Support - Bearing Replacement.

2. Disconnect motor AC connector - located off cable on mainframe, Figure 35.

3. Disconnect solenoid driver connector, Figure 35.

4. Disconnect yellow lead from relay, Figure 35.

5. Lift rubber protective cover from capacitor and remove red and blue leads from capacitor, Figure 35.

6. Remove hopper empty switch leads, Figure 30.

7. LOOSEN vacuum hose clamp screw and remove hose from main mounting plate, Figure 35.

8. LOOSEN vacuum adapter clamp screw and lift adapter out of pump, Figure 33.

9. Remove read head connector from card cage, Figure 42.

10. Remove three 8 x 32 Phillips pan head screws (8), one from main mounting plate, and two from under mainframe, Figure 36.

11. Remove two 8 x 32 flat head screws (9) from top of main mounting plate, Figure 36.

12. Remove the main mounting plate and lay to one side.

13. Remove screw holding ground strap to subframe, Figure 34.

14. Remove four Phillips head screws (10) located on underside of mainframe, Figure 34.

15. The vacuum pump motor assembly may now be removed from the card reader.

16. LOOSEN the three hex bolts (11) holding the vacuum pump in place. Figure 37.

17. Replace vacuum pump belt, Figure 37.

18. Using a spring scale, adjust vacuum pump for a belt tension of 4-6 ounces. This is about 3/64" belt deflection, Figure 37.

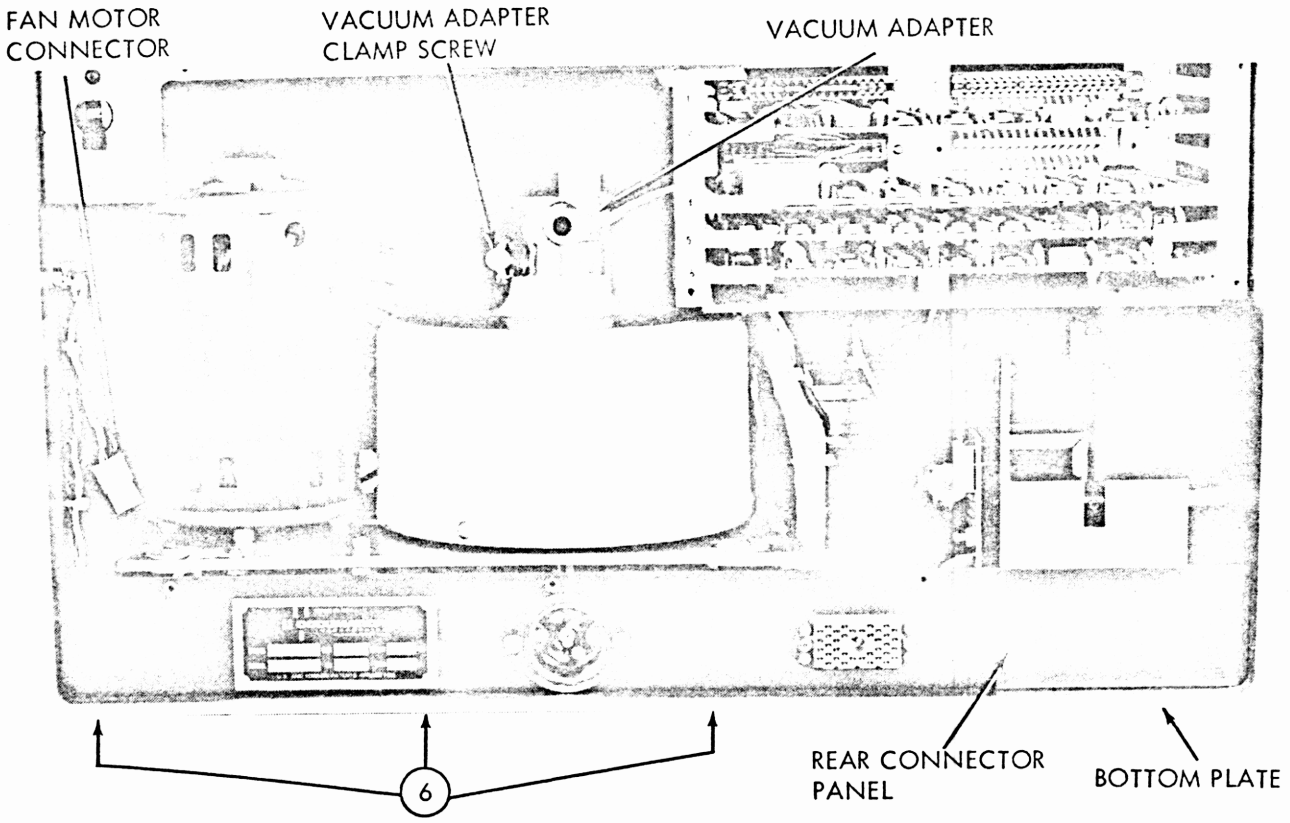


Figure 33. Rear View, Cover Removed

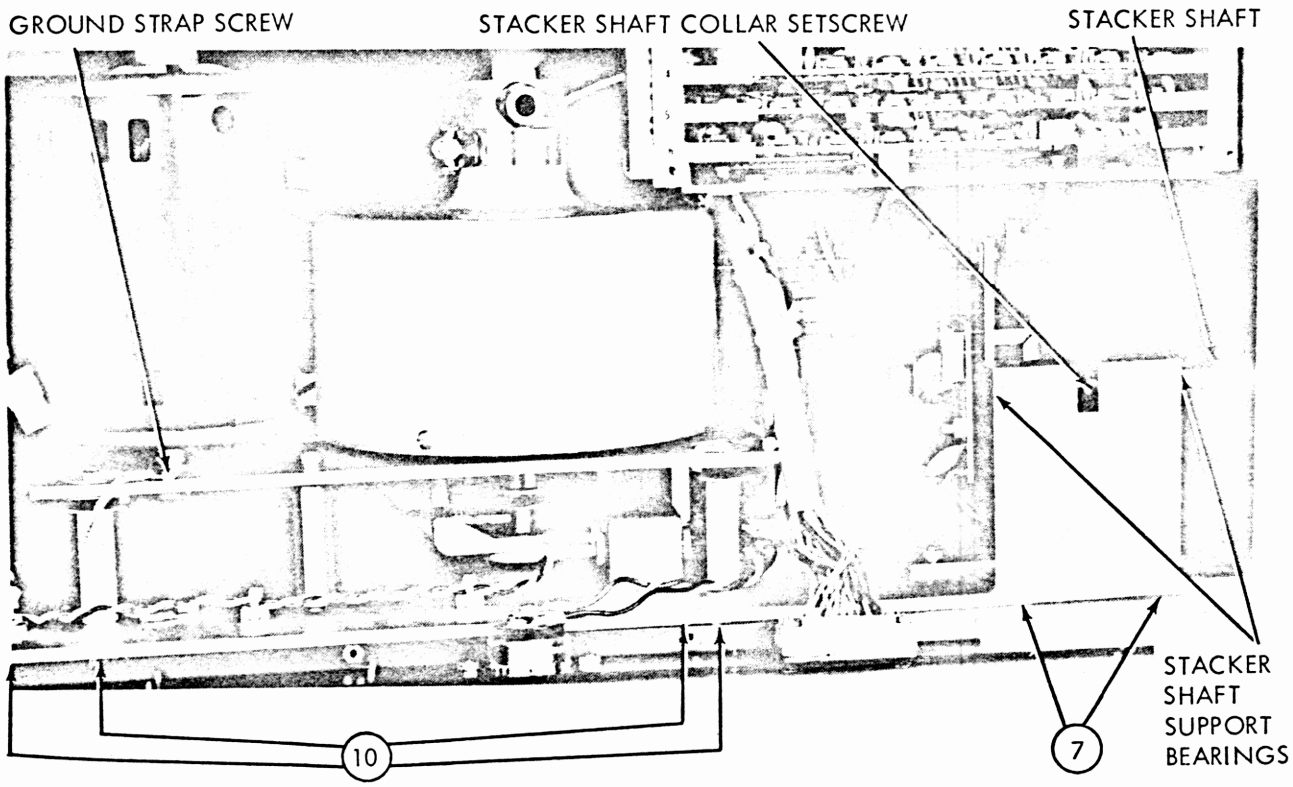


Figure 34. Rear View, Cover and Rear Connector Panel Removed

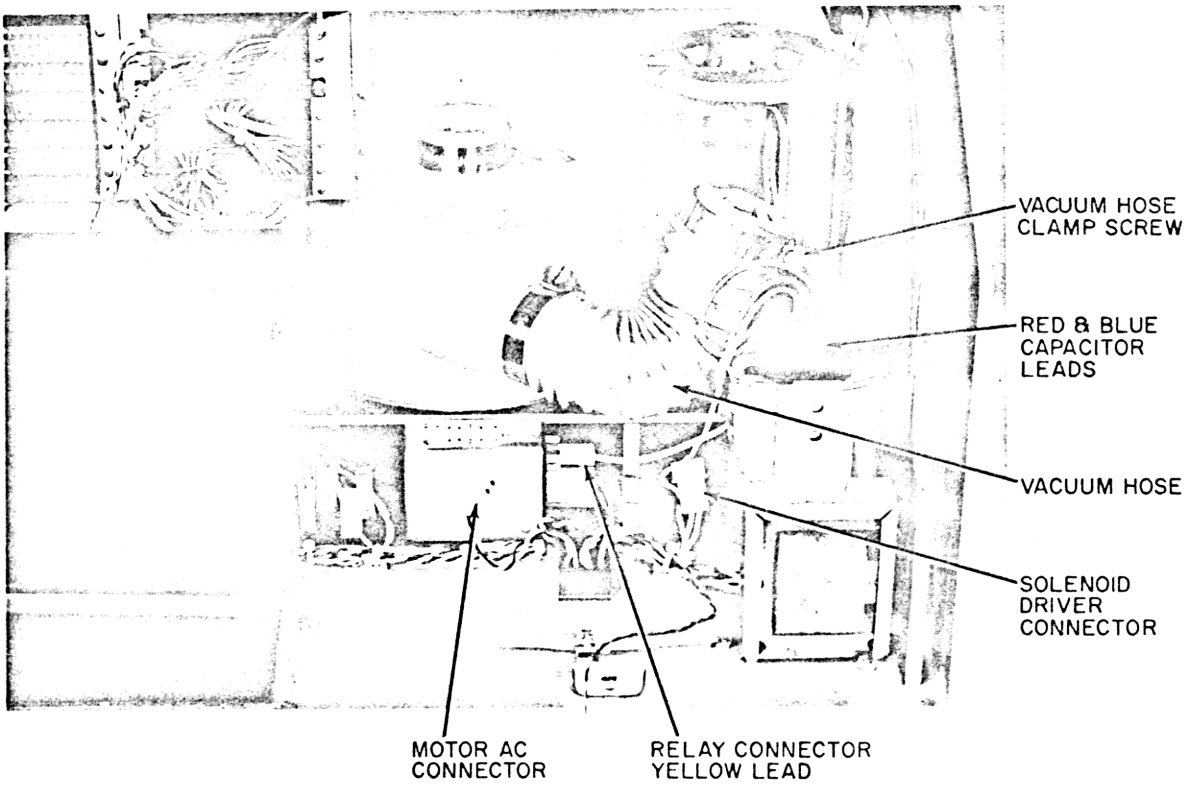


Figure 35. Front View, Main Wiring Connections

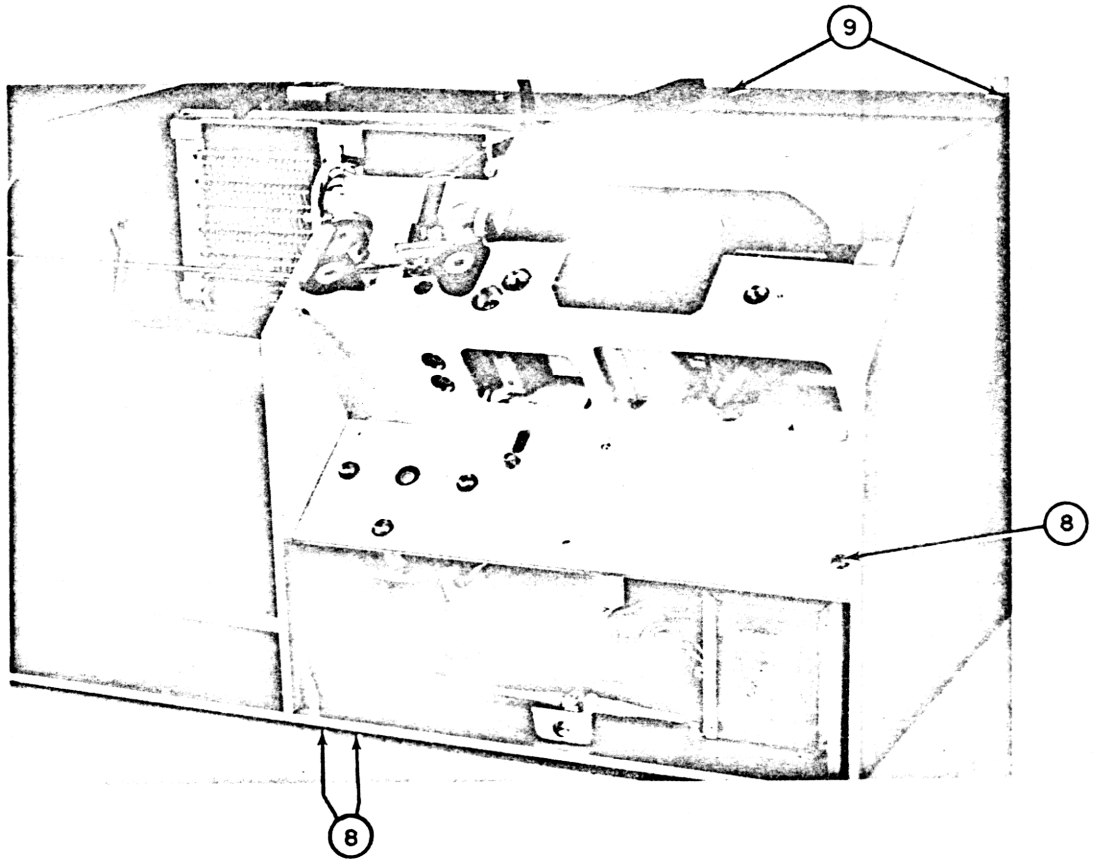


Figure 36. Front View, Main Mounting Plate Removal

19. With the appropriate belt tension applied, tighten the three hex vacuum pump mounting bolts, Figure 37.

20. Re-install the vacuum pump assembly into the card reader in reverse order of disassembly.

REPLACEMENT OF MAIN DRIVE MOTOR BELT

1. It is necessary to remove the main mounting plate for this repair. Perform steps 1 through 13 of Replacement of Belt on Vacuum Pump Motor Assembly.

2. Using a Phillips screwdriver, remove three main drive motor mounting screws (4), Figure 30. If the belt was not broken, there should now be sufficient slack to slip the belt over the motor pulley and remove the motor.

3. Using a 5/64 Allen wrench, LOOSEN one 8 x 32 set screw in timing disk, Figure 38.

CAUTION

REMOVE TIMING DISK USING EXTREME CARE NOT TO DAMAGE THE TEETH ON DISK. WRAP DISK IN SOFT TISSUE WHILE NOT IN THE READER.

4. Replace the main drive motor belt over the timing disk pulley and the roller pulley and motor shaft pulley in that order.

5. Replace the belt over the motor shaft pulley, replace the motor in its mounting position, and then replace the motor mounting screws but DO NOT tighten.

6. Perform steps 3 through 5 of Adjustment of Tension on Main Drive Motor Belt.

7. Replace timing disk on shaft and line up teeth on timing disk with tip on magnetic pickup. Using a feeler gauge, check for .007 to .008 clearance between timing disk teeth and magnetic pickup tip. If out of clearance, perform step 8 of Replacement and Adjustment of Magnetic Pickup, Figure 39.

NOTE

BEFORE TIGHTENING TIMING DISK SET SCREW, CHECK TO MAKE SURE TIMING DISK TEETH ARE PRECISELY IN A HORIZONTAL PLANE WITH THE MAGNETIC PICKUP TIP.

8. Reassemble card reader in reverse order of disassembly.

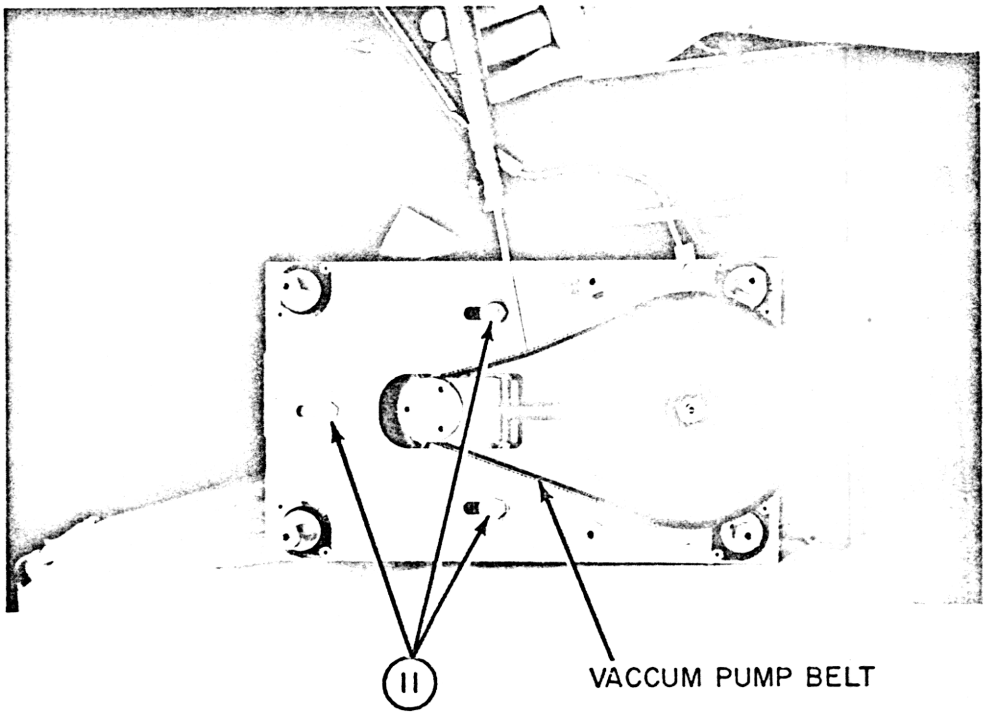


Figure 37. Vacuum Pump Belt Adjustment

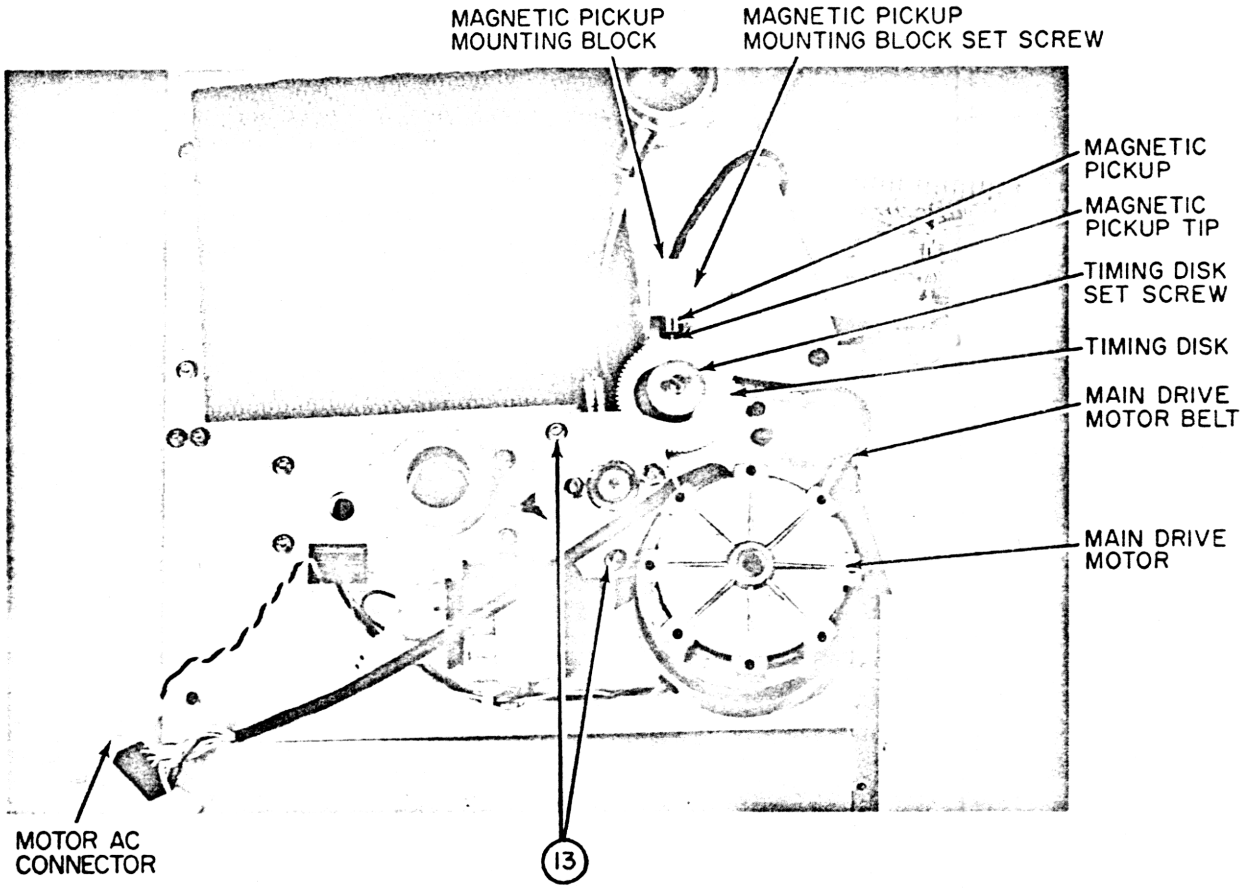


Figure 38. Bottom View, Main Mounting Plate

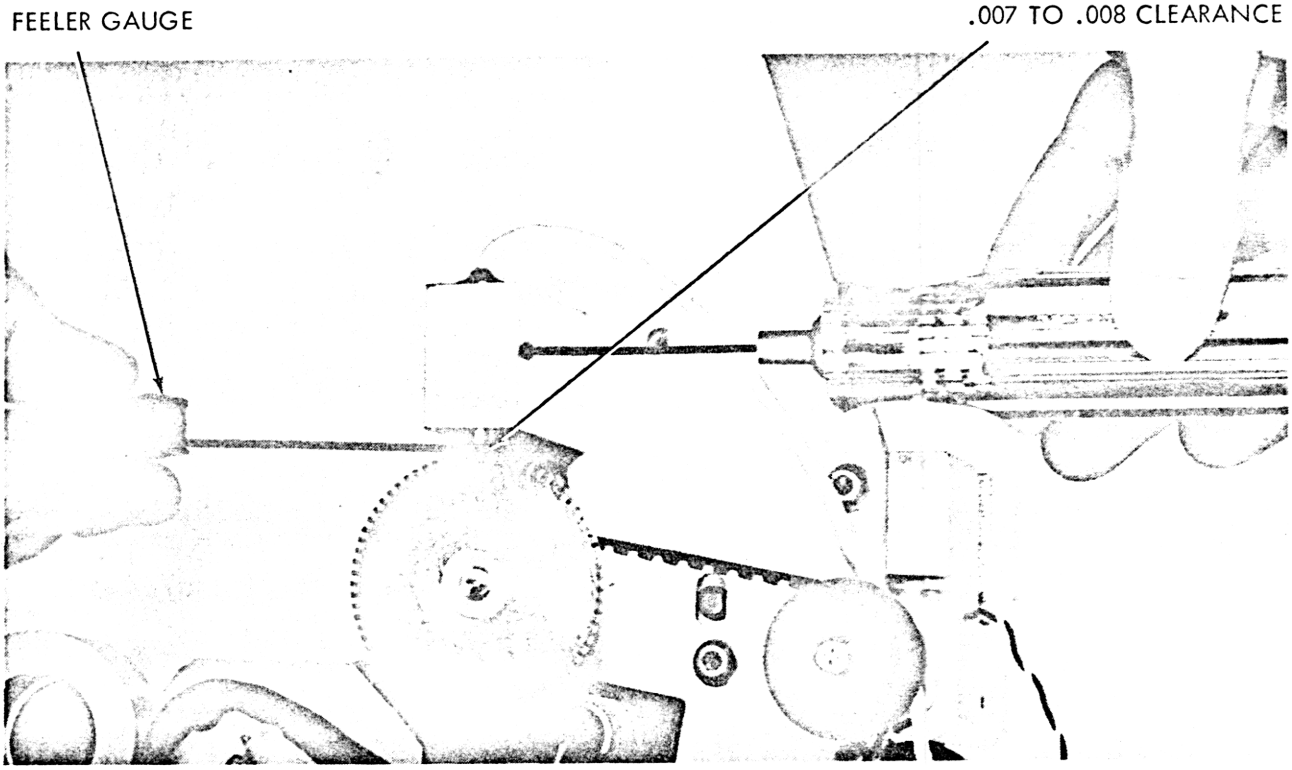


Figure 39. Timing Disc Air-gap Adjustment

REPLACEMENT AND ADJUSTMENT OF MAGNETIC PICKUP

1. It is necessary to remove the main mounting plate for this repair. Perform steps 1 through 13 of Replacement of Belt on Vacuum Pump Motor Assembly.

2. Using a 1/16 Allen wrench, LOOSEN set screw in magnetic pickup mounting block, Figure 38.

3. Remove magnetic pickup from mounting block, Figure 38.

4. Unwrap the read head connector cable to free the magnetic pickup cable.

5. Unsolder wires from Pins J, K and L on the read head connector, Figure 42.

6. Solder the new magnetic pickup wires to the read head connector and rewrap the read head connector cable.

7. Insert the new pickup unit into the mounting block.

8. Using a feeler gauge, adjust spacing between timing disk teeth and tip of pickup unit for .007 to .008, Figure 39.

9. Reassemble card reader in reverse order of disassembly.

REPLACEMENT OF SOLENOID

1. It will be necessary to remove the main mounting plate for this repair. Perform steps 1 through 13 of Replacement of Belt on Vacuum Pump Motor Assembly.

2. Remove solenoid spring from spring post and arm stud, Figures 40 and 41.

3. Using a .050 or 1/16 Allen Wrench, LOOSEN two set screws in the top solenoid coupling, Figure 41.

4. Using a 9/64 Allen Wrench, remove two 8 x 32 socket head screws (13) holding solenoid mounting plate, Figure 41. Remove solenoid.

5. Using an 11/32 hex wrench, remove two 8 x 32 mounting nuts (14), Figure 41.

6. Using a .050 or 1/16 Allen Wrench, LOOSEN two set screws retaining the coupling on the solenoid shaft. Remove coupling, Figure 41.

NOTE

REMOVE THE SET SCREWS FROM THE COUPLING AND REPLACE USING LOCKTITE GRADE C. ALL OPERATIONAL AND MOUNTING HARDWARE, WITH THE EXCEPTION OF PANEL SCREWS, SHOULD BE REPLACED USING LOCKTITE GRADE C.

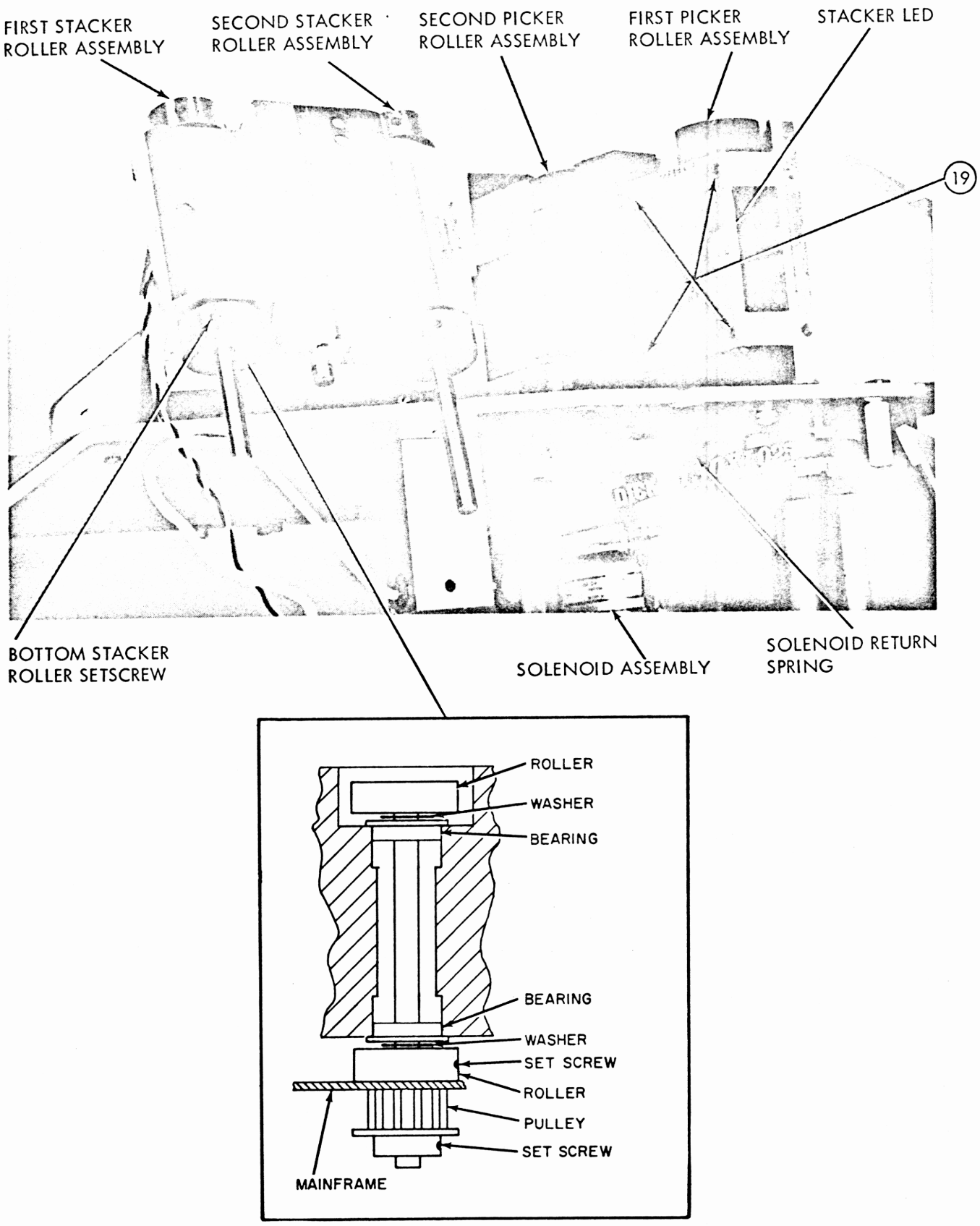


Figure 40. Stacker Casting Removal and Bearing Replacement

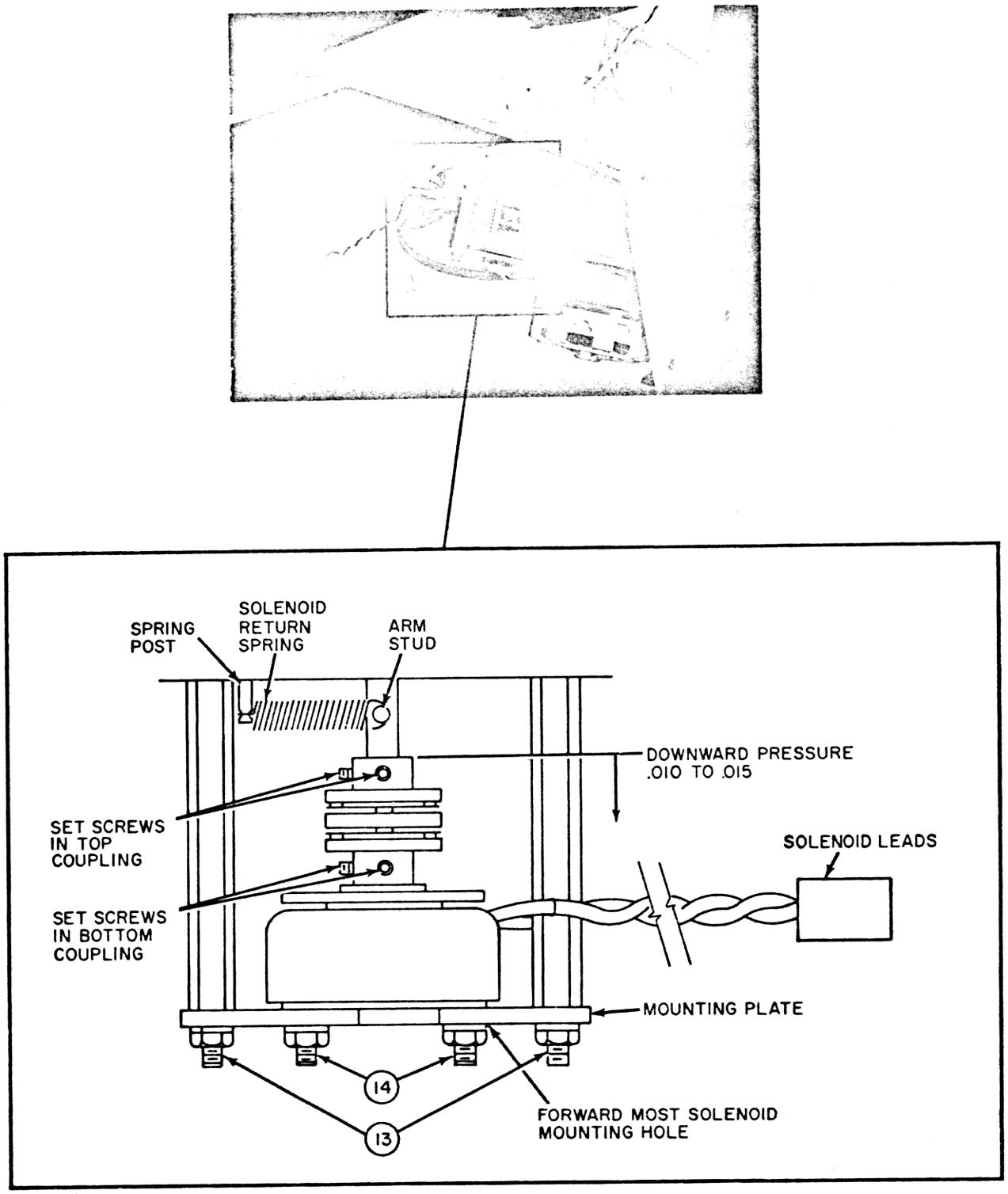


Figure 41. Solenoid Replacement and Adjustment

7. Replace the coupling locating the bottom coupling set screws on the two flat sides of the shaft, Figure 41.

8. Tighten the bottom coupling set screws and replace the solenoid on the mounting plate making sure holes are in the proper position, with wires extending from the LEFT side, as viewed from the bottom of the main mounting plate.

9. Replace solenoid on mounting posts.

10. Replace the solenoid return spring between the spring post and the arm stud, Figure 41.

11. Preload the solenoid coupling by pressing downward .010 to .015 and tighten the top coupling set screws, Figure 41.

NOTE

THE SOLENOID WILL TURN AS THE SET SCREWS ARE TIGHTENED TO THE FLAT SIDES OF THE SHAFT. THIS IS A NATURAL BUILT-IN ALIGNMENT. THIS ALIGNMENT PREVENTS THE SOLENOID FROM BOTTOMING-OUT DURING OPERATION

12. Reassemble reader in reverse order of disassembly.

REPLACEMENT OF ROLLER BEARINGS OR STACKER LED

NOTE

USE THE FOLLOWING TEN STEPS TO REMOVE THE STACKER CASTING. THIS CASTING MUST BE REMOVED TO ACCOMPLISH ANY OF THE ABOVE REPAIRS.

1. It will be necessary to remove the main mounting plate for these repairs. Perform steps 1 through 13 of Replacement of Belt on Vacuum Pump Motor Assembly.

2. Using a flat blade knife, remove stack guide plate, Figure 42.

3. Remove two 8 x 32 Phillips flat head screws (15) holding side support plate, Figure 43.

4. Remove two 8 x 32 Phillips screws (16) from input hopper wall, Figure 31.

5. LOOSEN three Phillips screws (4) holding main drive motor, Figure 30.

6. Using a 5/64 Allen Wrench, LOOSEN setscrew in timing disk. Remove timing disk, Figure 38.

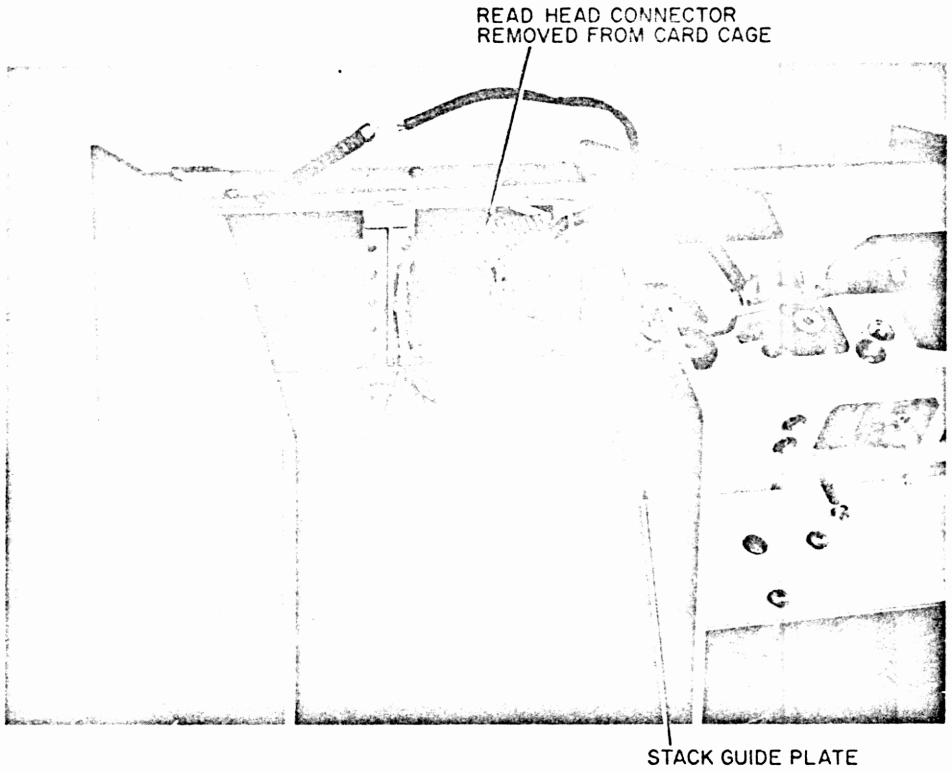


Figure 42. Top View Casting Assemblies

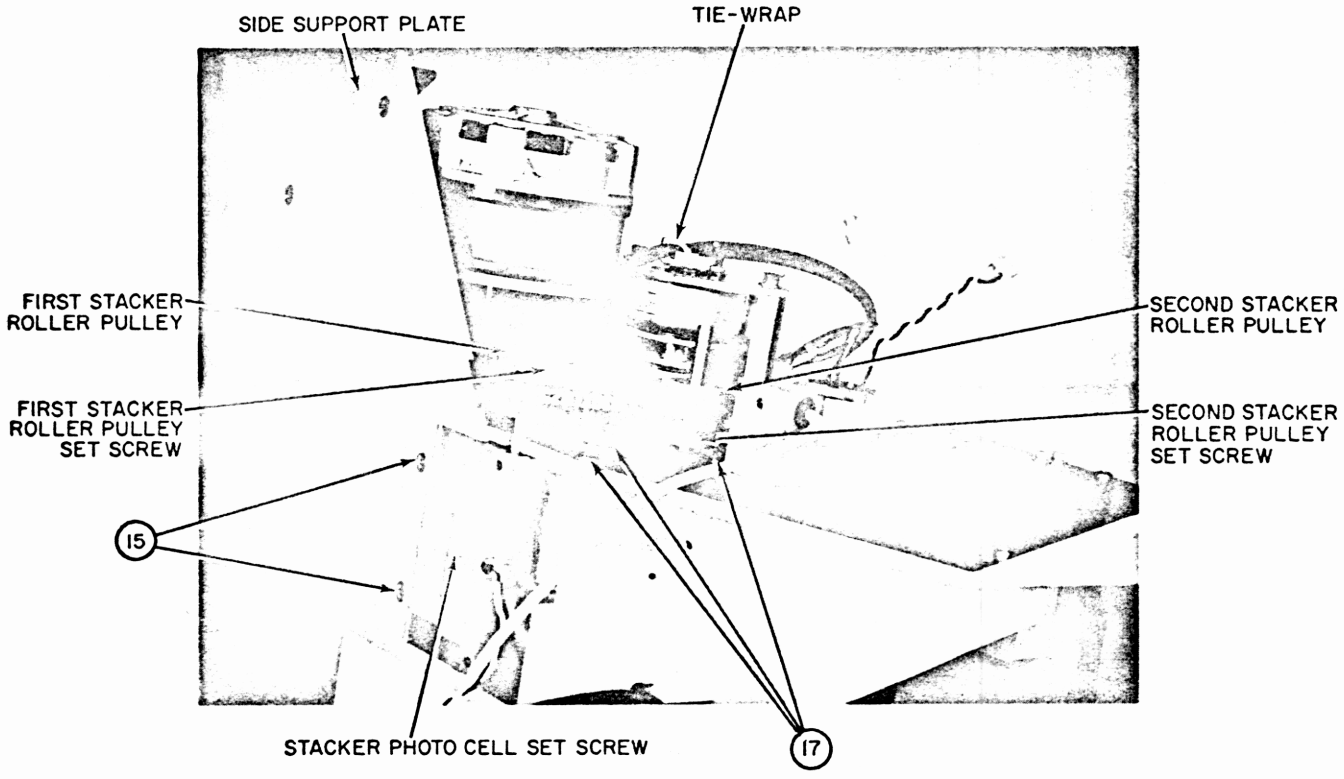


Figure 43. Bottom View Main Drive Motor Assembly

7. Remove main drive motor belt, Figure 38.

8. Using a 3/32 Allen Wrench, LOOSEN the set screws in the two stacker nylon pulleys, Figure 43. Remove pulleys.

9. Cut nylon tie-wrap on solenoid mounting plate, holding light station cable, Figure 43.

10. Using a 9/64 Allen Wrench, remove three 8 x 32 socket head screws (17) holding stacker casting, Figure 43. Lay stacker casting to one side.

TO REPLACE ROLLER ASSEMBLY BEARINGS

1. Using a 1/16 Allen Wrench, LOOSEN the set screw in the bottom roller of the assembly to be removed. Remove roller, Figure 40.

NOTE

THE SECOND PICKER ROLLER HAS A SPLIT SHAFT. LOOSEN THE SET SCREW IN THE TOP OR BOTTOM ROLLER. THE SHAFT OF EITHER MAY THEN BE REMOVED FROM THE CENTER OF THE CASTING, FIGURE 40.

2. Remove bottom bearing spacer washer from shaft, Figure 40.

3. Lift shaft straight up out of castig. Note there is another spacer washer between the top roller and the bearing seat, Figure 40.

4. Using a knife blade, pry out top or bottom bearing to be replaced.

NOTE

THE BEARINGS ARE A LOOSE PRESS FIT INTO THE CASTING. IF THE BEARINGS APPEAR DIFFICULT TO REMOVE, USE A SLENDER TOOL SUCH AS A SMALL ALLEN SCREWDRIVER AND TAP THE EDGE OF THE BEARING FROM THE INSIDE OF THE SHAFT HOLE.

5. Reassemble in reverse order of disassembly, making sure spacer washers are installed between top and bottom rollers and bearing seats.

6. Apply firm finger pressure between the top and bottom rollers and tighten set screw in the bottom roller.

CAUTION

IT IS IMPORTANT TO CHECK THAT THERE IS NO VERTICAL PLAY IN THE SHAFT AFTER TIGHTENING THE ROLLER SET SCREWS.

7. When replacing the nylon pulleys, make sure set screw is on the flat side of the shaft, and that the pulley flange is oriented correctly, Figure 43.

CAUTION

USING MODERATE TORQUE, TIGHTEN PULLEY SET SCREWS. DO NOT OVERTORQUE OR DAMAGE WILL RESULT TO PULLEY.

8. Re-install stacker casting onto main mounting plate. To insure pressure between the stacker and picker rollers, squeeze the stacker casting and picker casting together with hand pressure when tightening the three 8 x 32 socket head screws (17) holding the stacker casting, Figure 43. After tightening, check pinch between rollers. The steel roller should cause a slight depression onto the rubber rollers.

9. Using a feeler gauge, adjust spacing between timing disk teeth and tip of pickup unit for .007 to .008, Figure 39.

10. Using a Phillips screwdriver, LOOSEN the throat block screw and adjust throat block for .007 to .008" clearance between picker sector and throat block, Figure 31. Tighten throat block screw.

11. Reassemble reader leaving front cover off.

12. Perform Step 10 in Replacement of Read Station.

TO REPLACE STACKER LED

1. Remove four 2-56 x ¼ flat head Phillips screws (19) to remove light station Figure 40.

2. Remove nylon tie-wraps from solenoid mounting plate and disconnect STACKER LED connector.

3. Install new stacker LED, reconnect and replace tie-wraps on solenoid mounting plate.

4. Perform steps 8 through 12 of To Replace Roller Assembly Bearings.

REPLACEMENT OF PICKER

1. It is necessary to remove the main mounting plate for this repair. Perform steps 1 through 13 of Replacement of Belt on Vacuum Pump Motor Assembly.

2. Remove solenoid return spring from spring post and arm stud, Figure 41.

3. Using a .050 or 1/16 Allen Wrench, LOOSEN two set screws in the top solenoid coupling, Figure 41.

4. Using a 9/64 Allen Wrench, remove two 8 x 32 socket head screws (13) holding solenoid mounting plate, Figure 41.

5. Remove solenoid assembly.

6. Using a #2 retaining ring remover tool, remove the retaining ring from the top of the picker shaft, Figure 44.

7. Remove spacers located under the retaining ring, Figure 44.

CAUTION

ALL OF THE SPACERS MUST BE REPLACED IN REASSEMBLY.

8. Using a 5/64 Allen Wrench, LOOSEN two set screws holding picker sector, Figure 30.

9. Remove picker shaft from bottom of main mounting plate.

10. Using a Phillips screwdriver, remove throat block, Figure 31.

11. Remove picker sector from rear side of picker casting, Figure 31.

12. Replace picker sector, shaft, spacers and retaining ring.

13. Adjust shaft to place sector set screws on flat side of shaft.

14. Using a 6" metal ruler, measure 1.625" from the main mounting frame up to the center row of holes on the picker sector, Figure 31.

15. Retaining this measurement, tighten the two picker sector set screws, Figure 30.

16. Using a .050 Allen Wrench, LOOSEN the pick vacuum set screw, Figure 31.

17. Using a feeler gauge, adjust clearance between pick vacuum tube plate and picker sector for .002 or .003. Tighten pick vacuum set screw, Figure 31.

18. Check sector travel using procedure for adjustment of Picker Sector travel.

19. Replace solenoid and adjust top solenoid coupling using step 11 of Replacement of Solenoid. Replace return spring, Figure 41.

20. Replace throat block but do not tighten set screw, Figure 31.

21. Using a feeler gauge, adjust pick throat for a clearance of .007 to .008 between throat block and picker sector and tighten screw, Figure 31.

22. Reassemble reader in reverse order of disassembly.

REPLACEMENT OF STACKER FULL SWITCH

1. Perform steps 1 and 2 of Replacement of Hopper Empty Switch.

2. Remove two 6 x 32 Phillips screws (20) from bottom of mainframe holding stacker front panel, Figure 45.

3. Remove wires from switch, remove and replace switch, Figure 46.

4. Check to make sure switch is mechanically activated when stacker tray is almost full.

5. Reassemble reader in reverse order of disassembly.

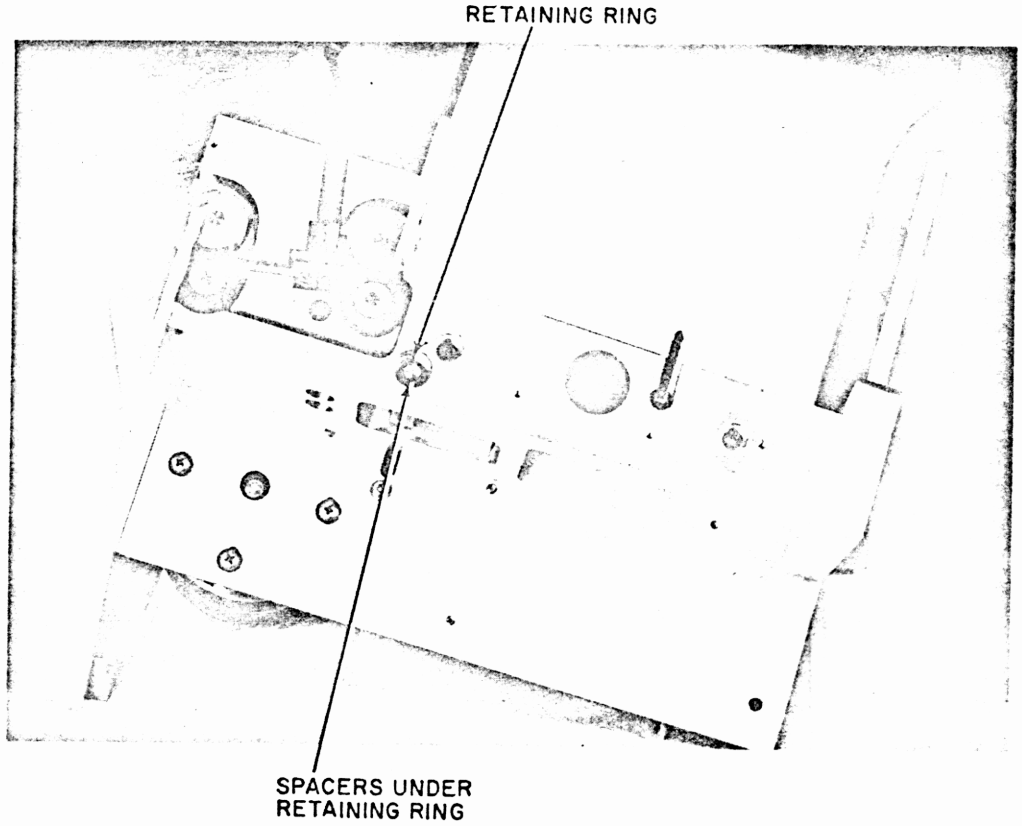


Figure 44. Top View Stacker Casting Assembly

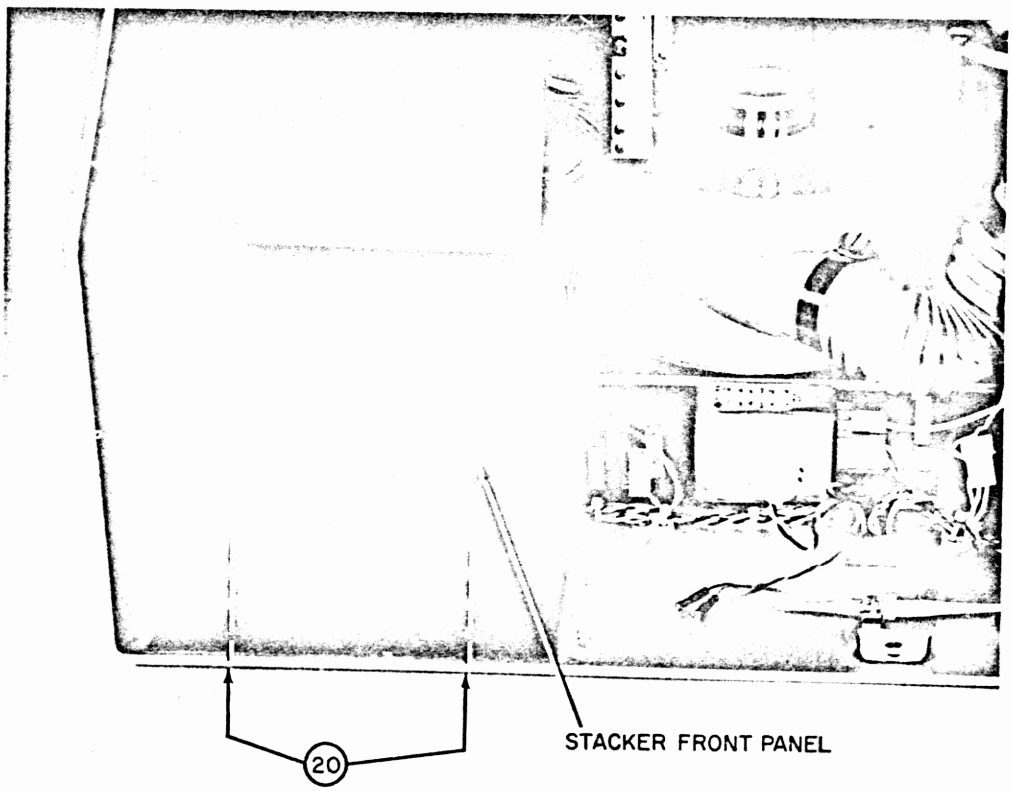


Figure 45. Stacker Panel Removal

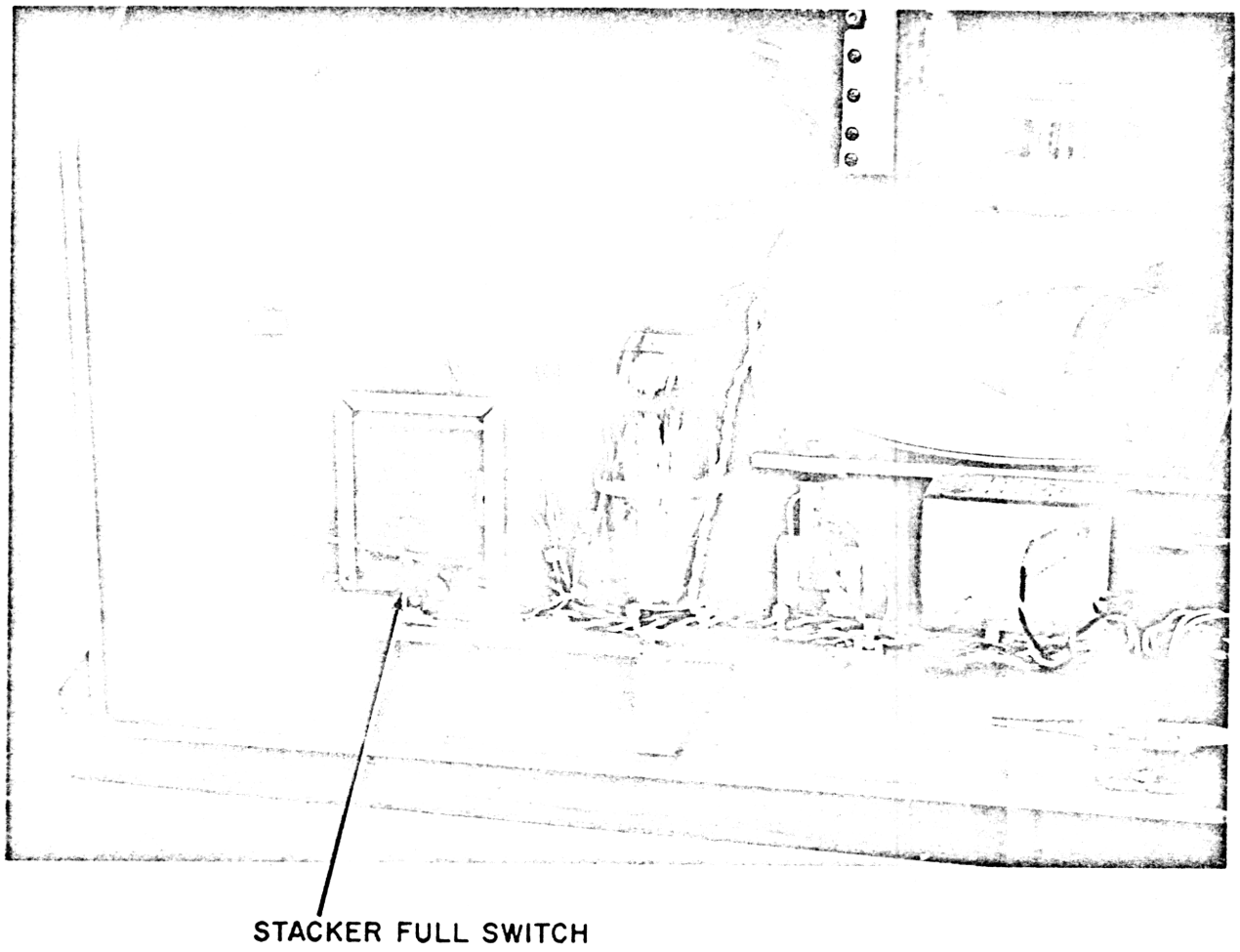


Figure 46. Stacker Full Switch Replacement

REPLACEMENT OF STACKER PHOTOCELL

1. Perform steps 1 and 2 of Replacement of Hopper Empty Switch.

2. Using a 1/16 Allen screwdriver, LOOSEN set screw in stacker casting holding stacker photocell, Figure 43.

3. Remove photocell from casting, Figure 43, and tag black and white wires from photocell.

4. Replace photocell, align photocell flush with stacker casting face-plate, and tighten photocell set screw, Figure 43. Replace leads.

5. Reassemble reader in reverse order of disassembly.

REPLACEMENT OF READ STATION

1. It is necessary to remove the main mounting plate for this repair. Perform steps 1 through 13 of Replacement of Belt on Vacuum Pump Motor Assembly.

2. Remove tie-wraps on solenoid mounting plate.

3. Remove four phillips head 4-40 screws (1), Figure 47, holding Read & Light Station Assembly in pick casting.

4. Using a 1/16" Allen wrench turn out the four adjustment set screws (2) 1/4 inch, Figure 47.

5. Slide Read and Light Station up and out of the pick casting.

6. Remove tie-wraps from cable assembly.

7. Remove four 4-40 flat head Phillips screws (1) holding the Read Station to the Light Station, Figure 48.

8. Unsolder Read Station wires from Read Station.

9. Replace Read Station and resolder wires to the new Read Station.

10. Reassemble in reverse order of disassembly leaving reader top cover off.

11. By adjusting socket head screws (2) and Phillips head screws (1), Figure 47, position the Read and Light Station assembly so two card thicknesses fit snugly between the Read and Light Station and the Stack Casting wall, Figure 47. To make sure both top and bottom are properly adjusted, adjust bottom first.

NOTE

Following Replacement of the Read Station, the Read Station's phototransistors must be checked for proper Light voltages with an oscilloscope or high impedance (1 meg ohm or greater) voltmeter.

12. Place Data Card, P/N 1540872, on extender board.

13. Remove power from the Reader's drive motor by disconnecting the motor's AC connector (Figure 38).

14. Turn the reader on and hand feed a mark sense card (blank surface forward) about half way through the Read Station. (Make sure card lying straight in the card track.)

15. Measure light voltages for all rows and record.

Row	Data Card I/O Pin	Data Card Resistor
12	H	R11
11	K	R28
0	5	R42
1	7	R63
2	M	R77
3	9	R91
4	3	R18
5	P	R35
6	16	R49
7	E	R70
8	15	R84
9	1	R98
CLOCK	C	R56

16. All rows should produce voltages from 1.3V to 4.0V with a maximum spread of 2 volts, i.e., if the lowest channel is 1.3 volts, the highest should be less than or equal to 3.3 volts.

17. If one or more rows are out of the voltage range, select-at-test (SAT) resistors should be used to replace the nominal 10K ohm resistors (see table under step 15). SAT resistor range is 4.7K ohm to 15K ohm. Increasing the resistors' value will increase the light voltage. Decreasing the resistors' value will decrease the light reading.

18. Place cover on Reader.

REPLACEMENT OF LIGHT STATION BULB

1. It is necessary to remove the main mounting plate for this repair. Perform steps 1 through 13 of Replacement of Belt on Vacuum Pump Motor Assembly.

2. Remove fastons from bulb, unscrew bulb and replace. Be sure rubber washer remains inside bulb housing, Figure 48.

3. Place fastons on new bulb and reassemble reader.

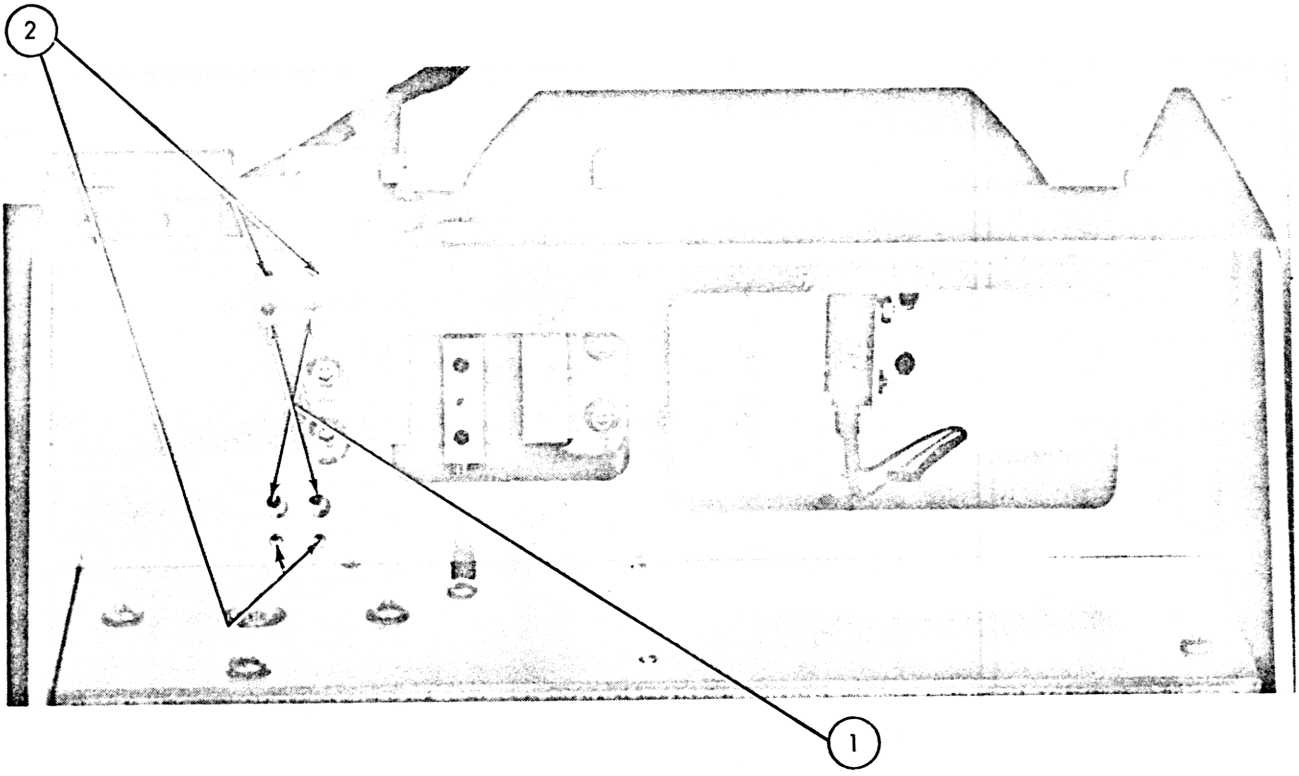


Figure 47. Read and Light Station Mounting and Adjustment Screws

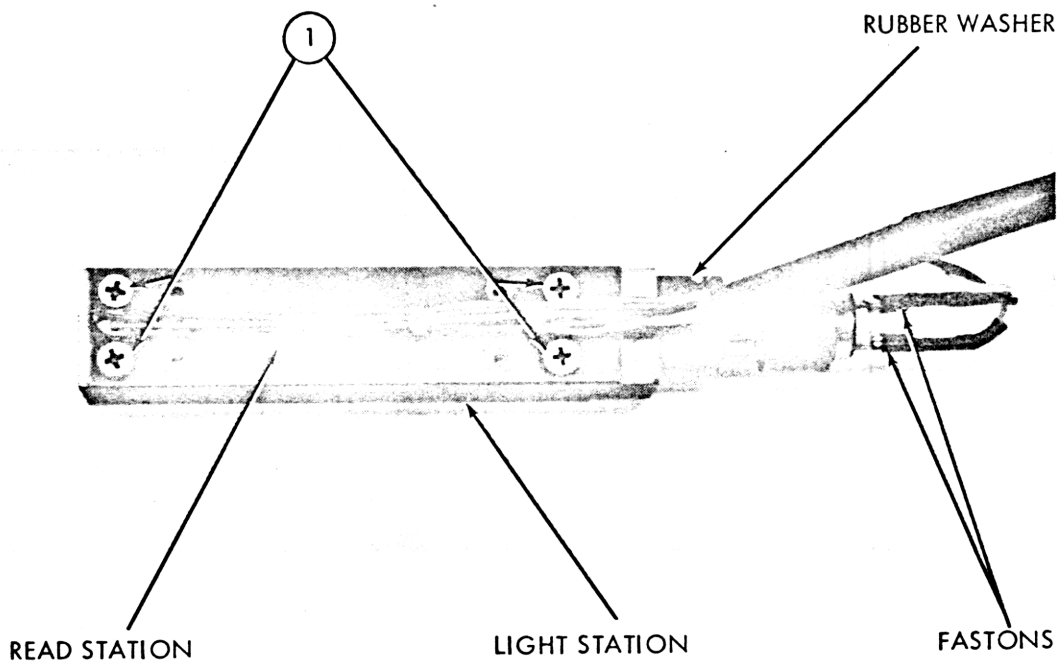


Figure 48. Read and Light Station Assembly

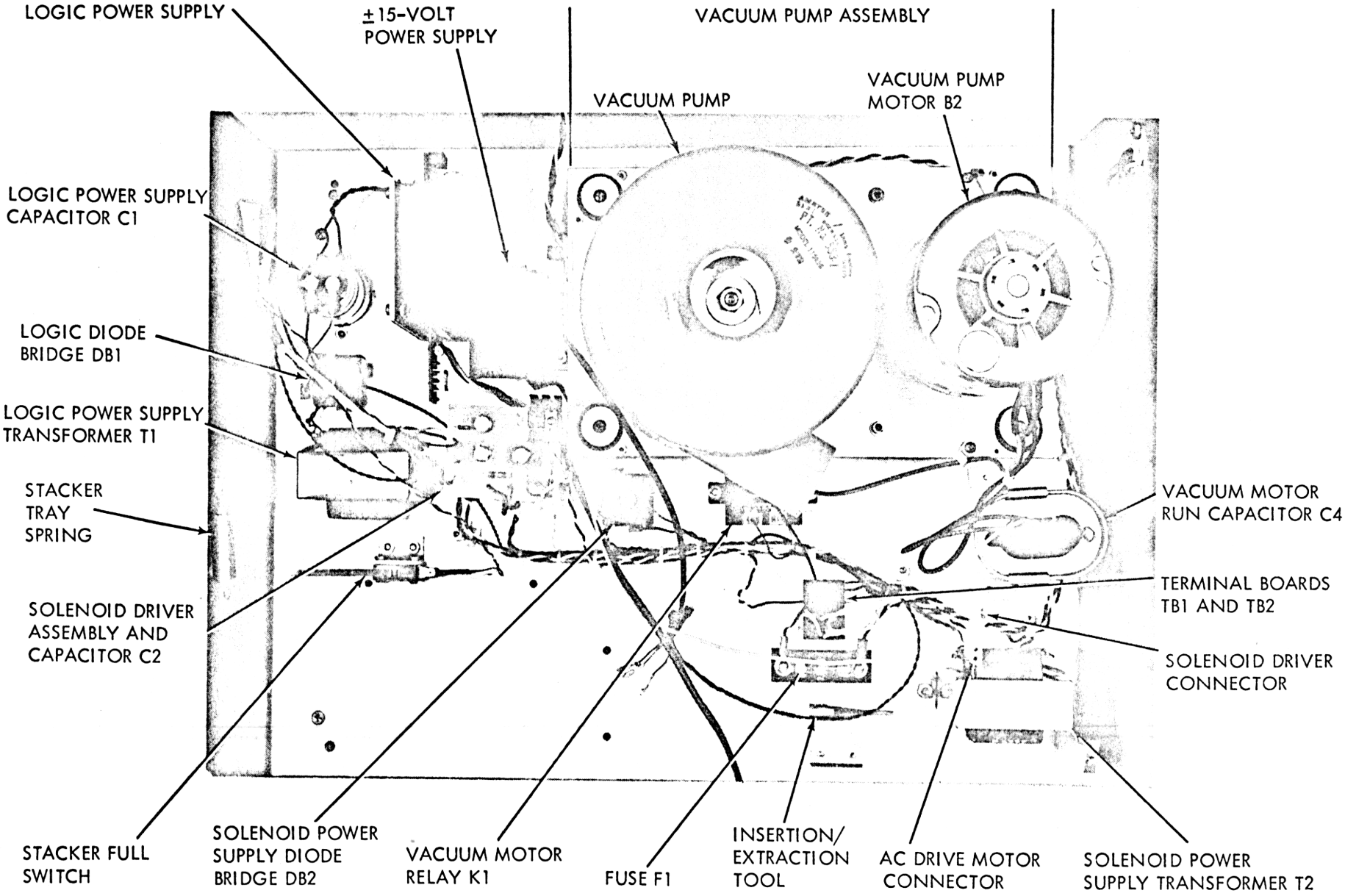


Figure 49. Main Frame Component Locations

APPENDIX A

ELECTRICAL DRAWINGS

The electrical drawings included as part of this manual represent the standard Documation card reader. If special electrical drawings are required, they will be included as reduced bluelines and will supersede the standard drawings.

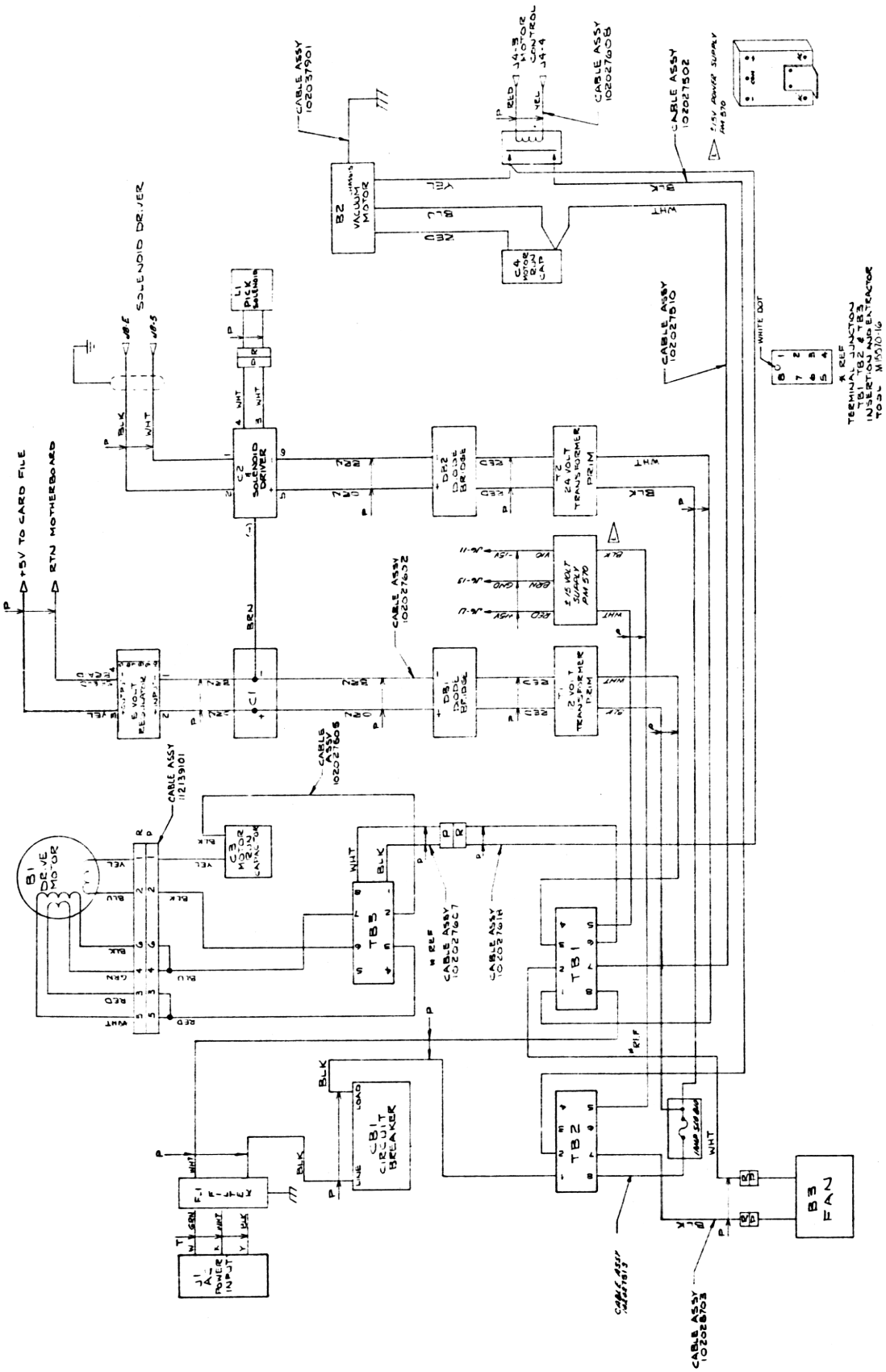


Figure A1. Wiring Diagram, AC Power Distribution, 115 VAC, 60 Hz
(Dwg. No. 1540910)

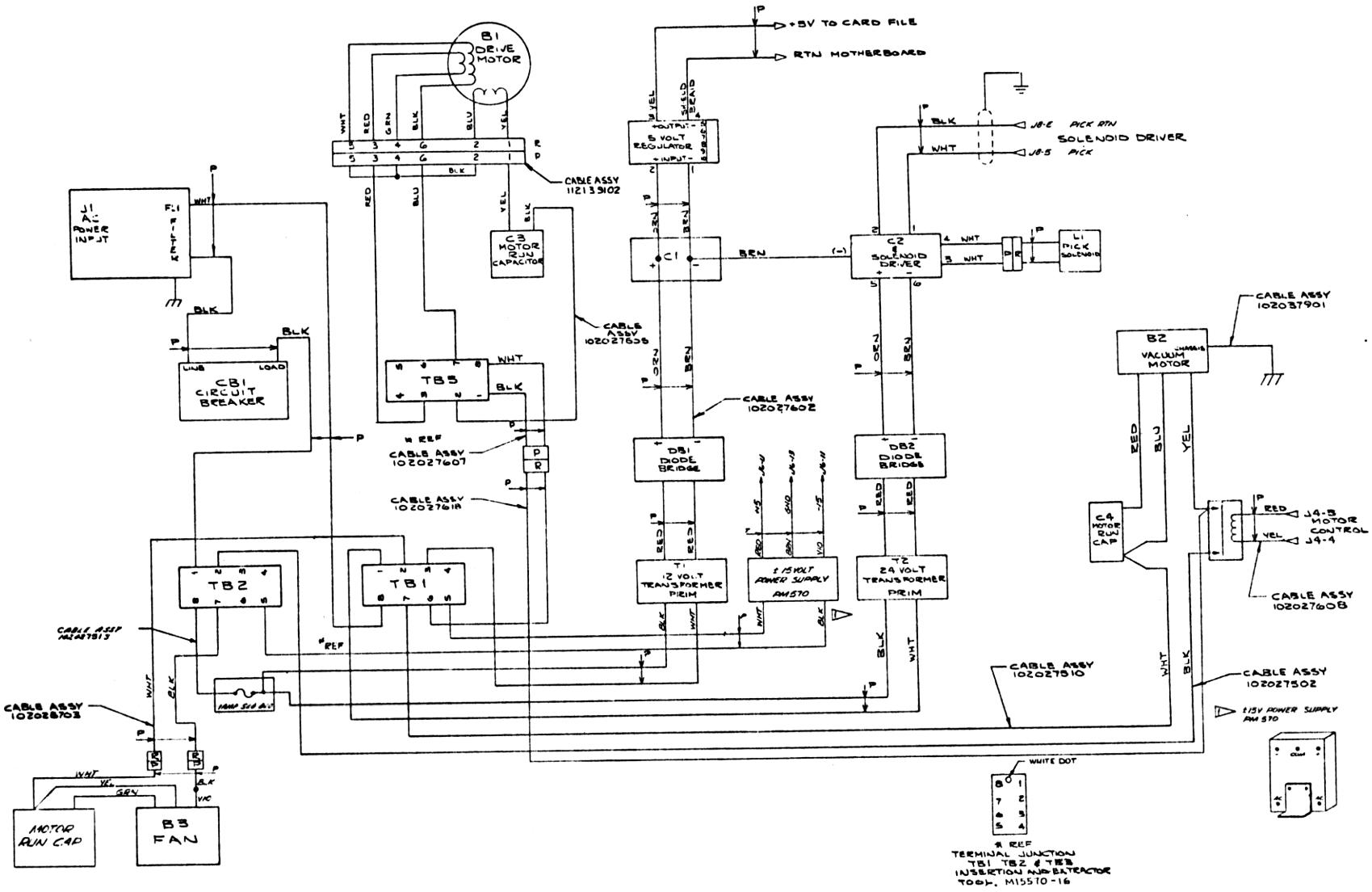
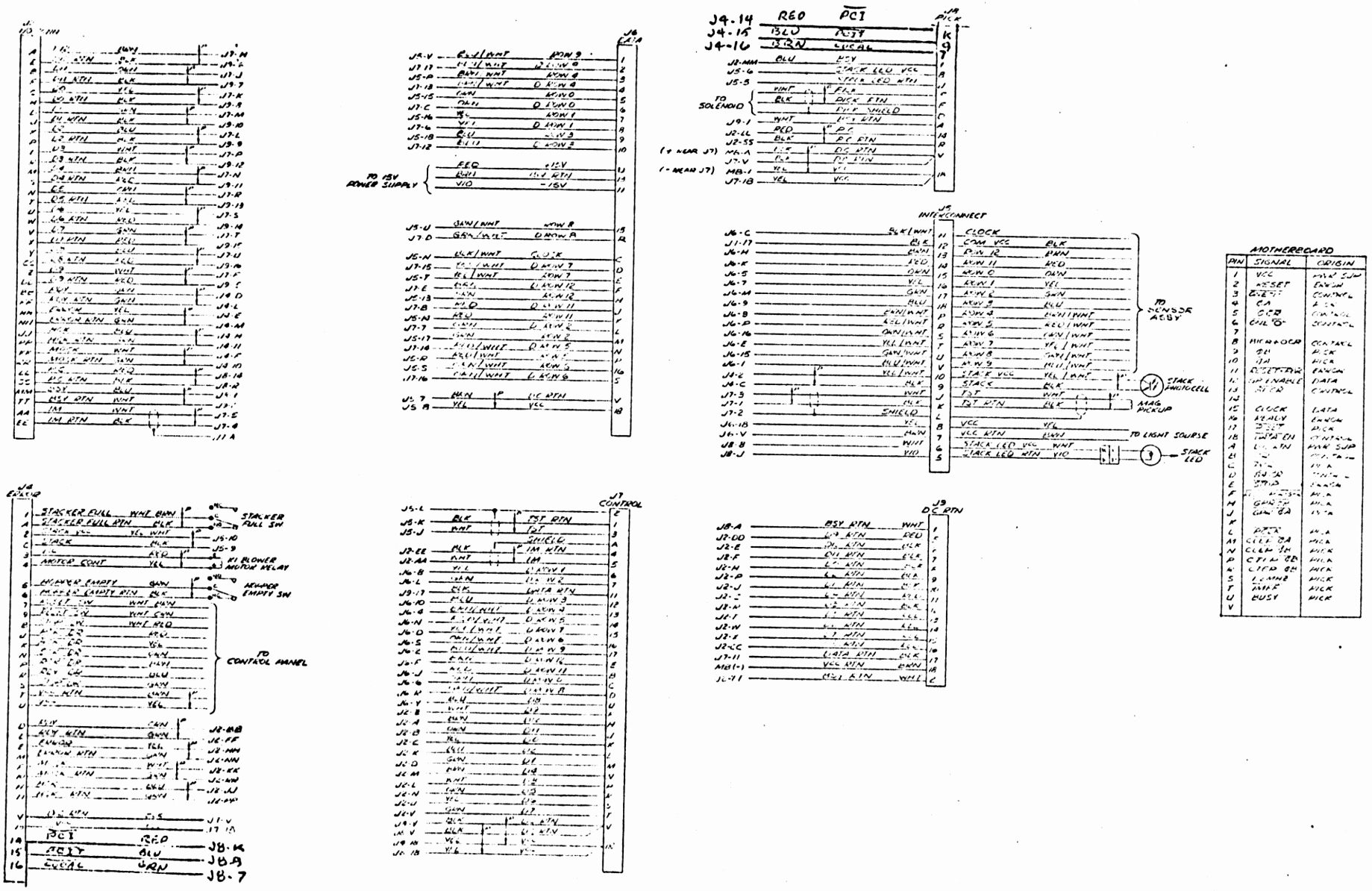


Figure A1A. Wiring Diagram, AC Power Distribution, 230 VAC, 50 Hz
(Dwg. No. 1540919)



A-2

Figure A1B. Wiring Diagram, Card Cage
(Dwg. No. 1542330) CS 190

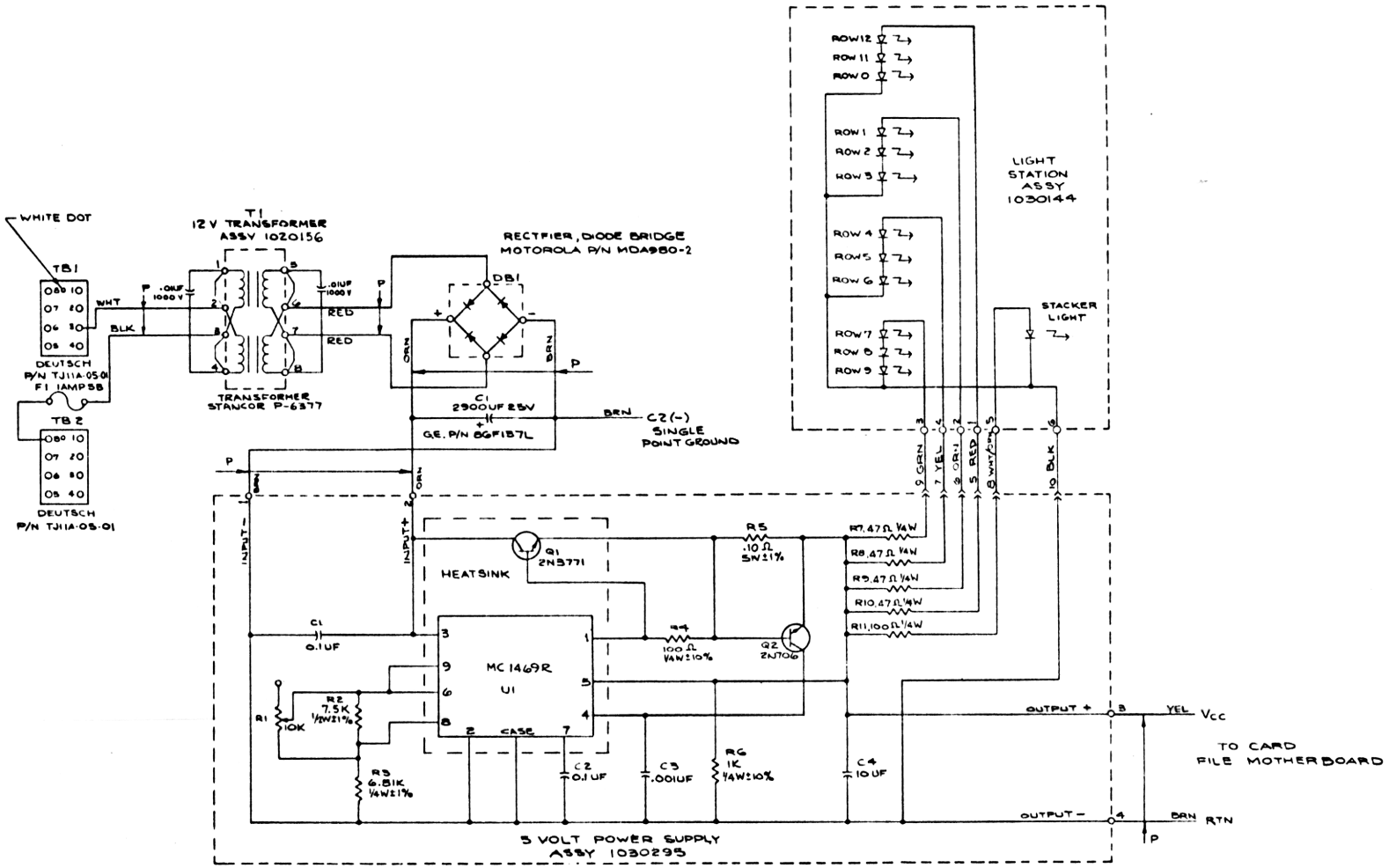


Figure A2. Schematic Diagram, 5V Power Supply, 115 VAC, 60 Hz
(Dwg. No. 1140637)

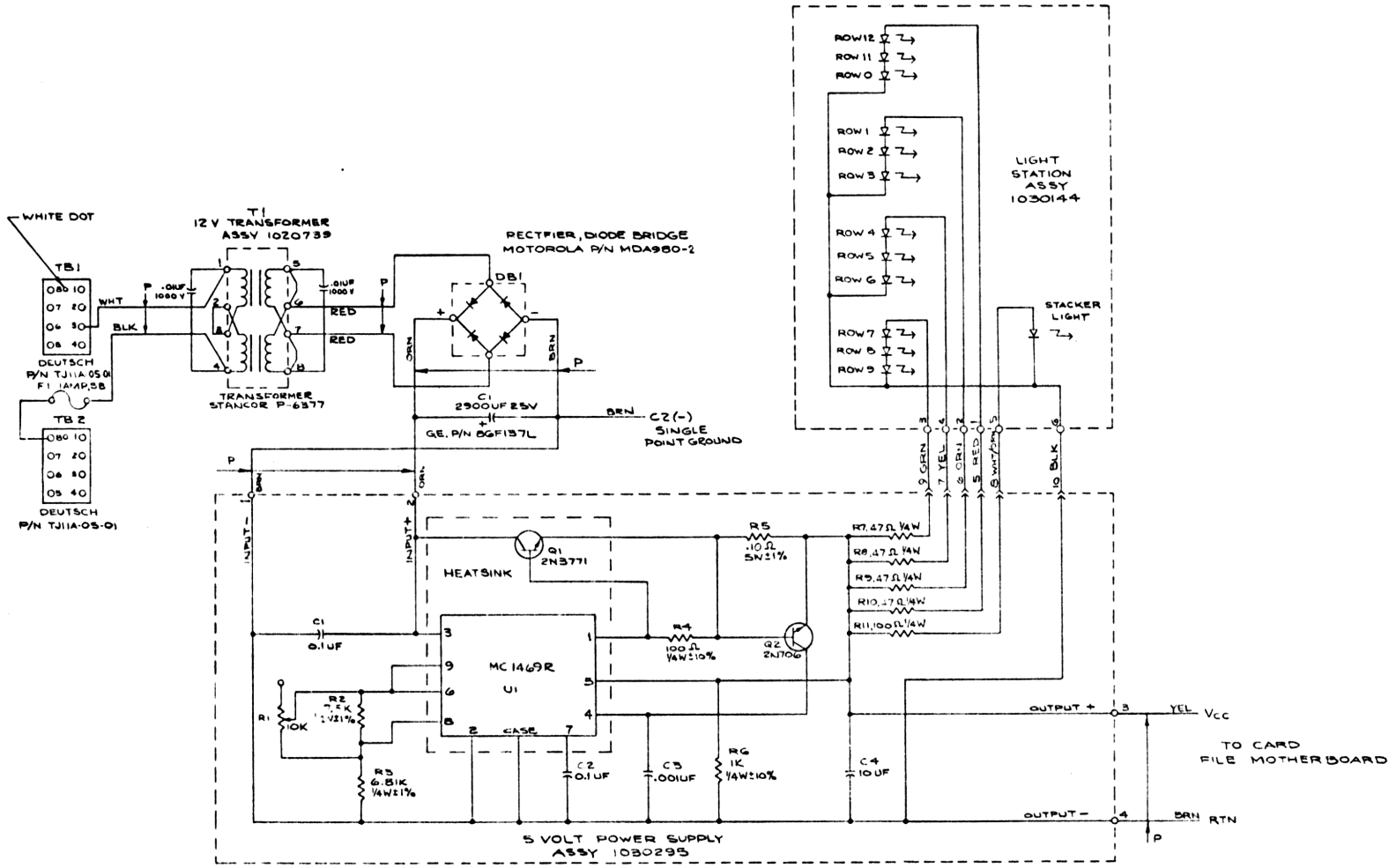


Figure A2A. Schematic Diagram, 5V Power Supply, 230 VAC, 50 Hz
(Dwg. No. 1140924)

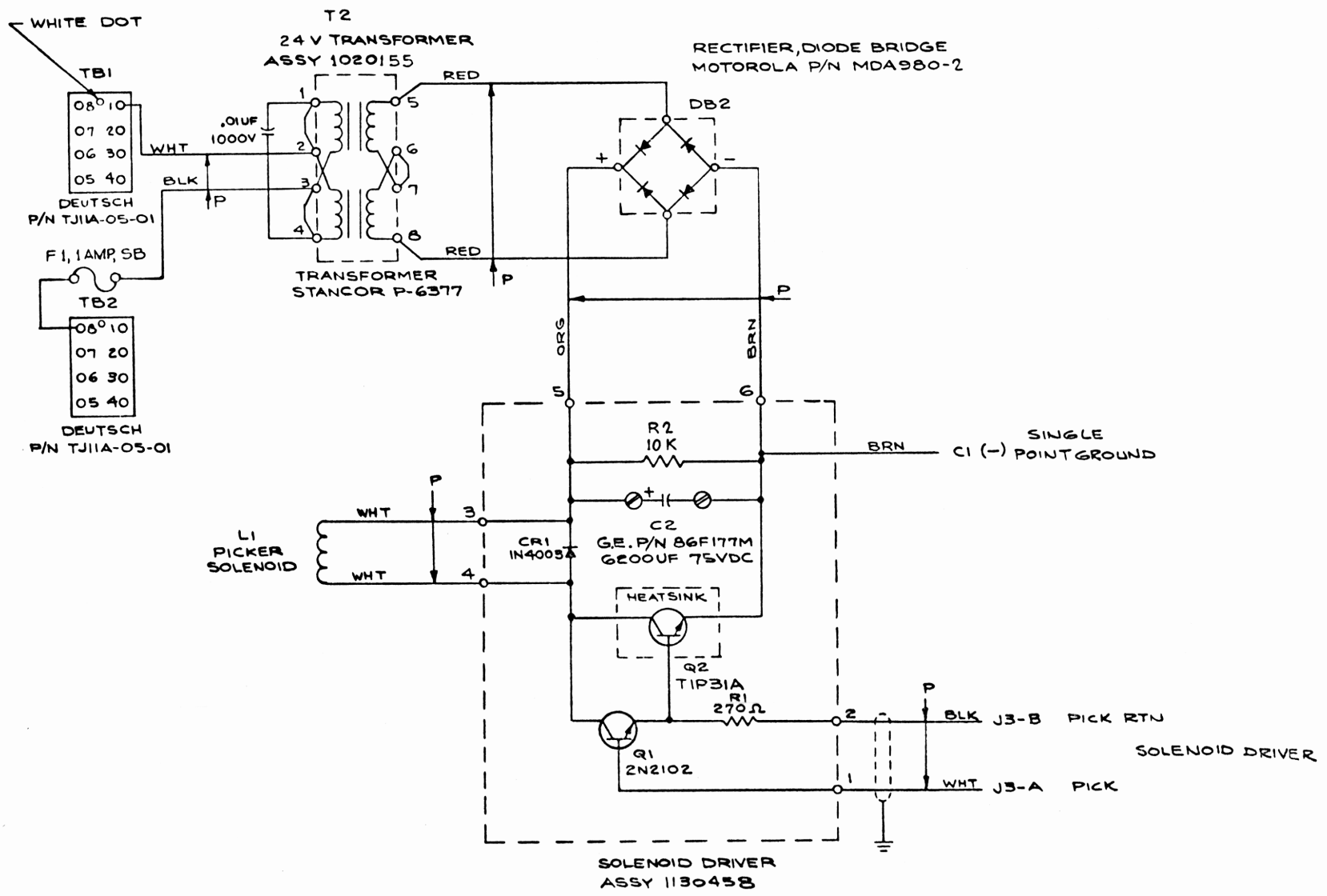


Figure A3. Schematic Diagram, Solenoid Driver, 115 VAC, 60 Hz
(Dwg. No. 1140632)

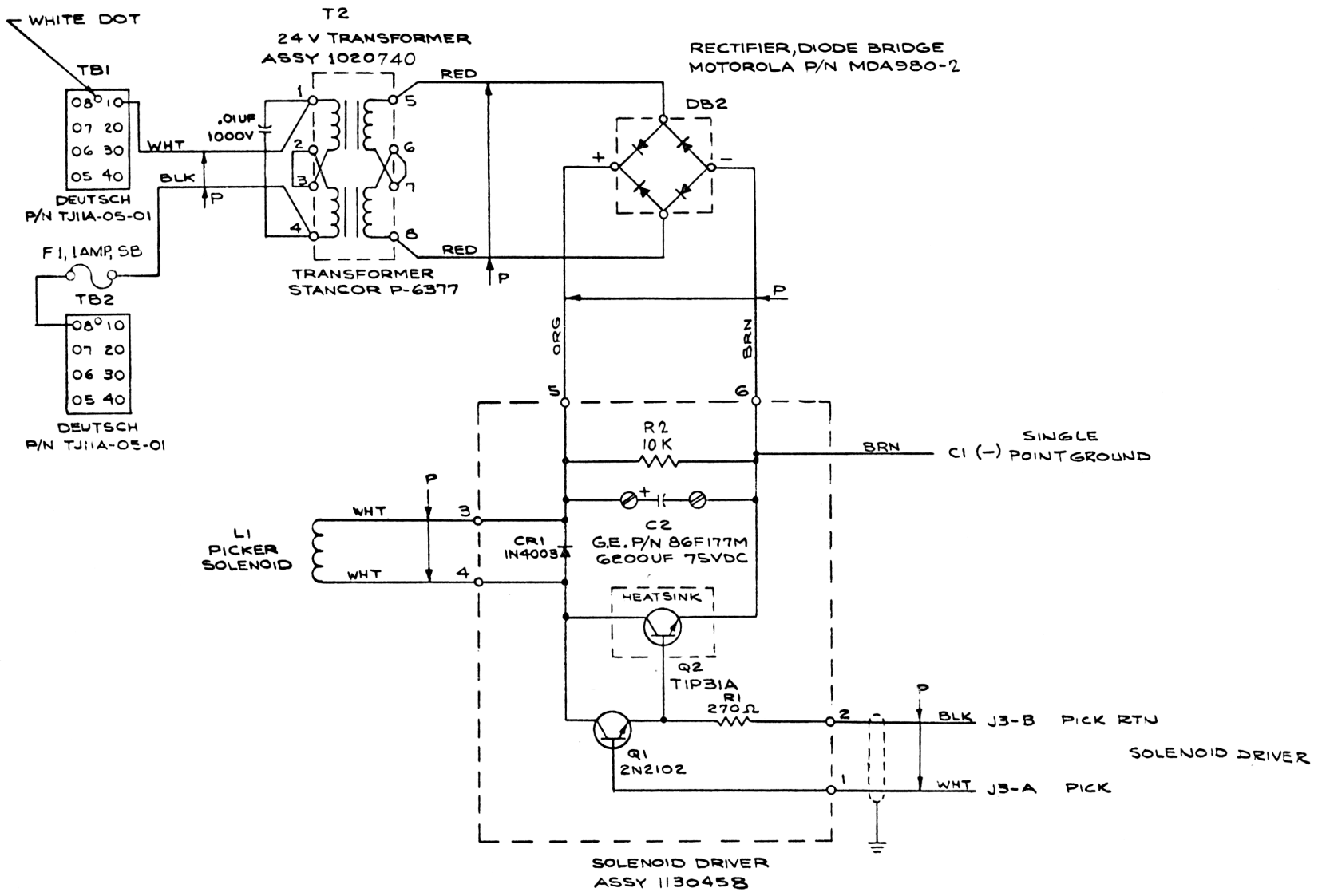
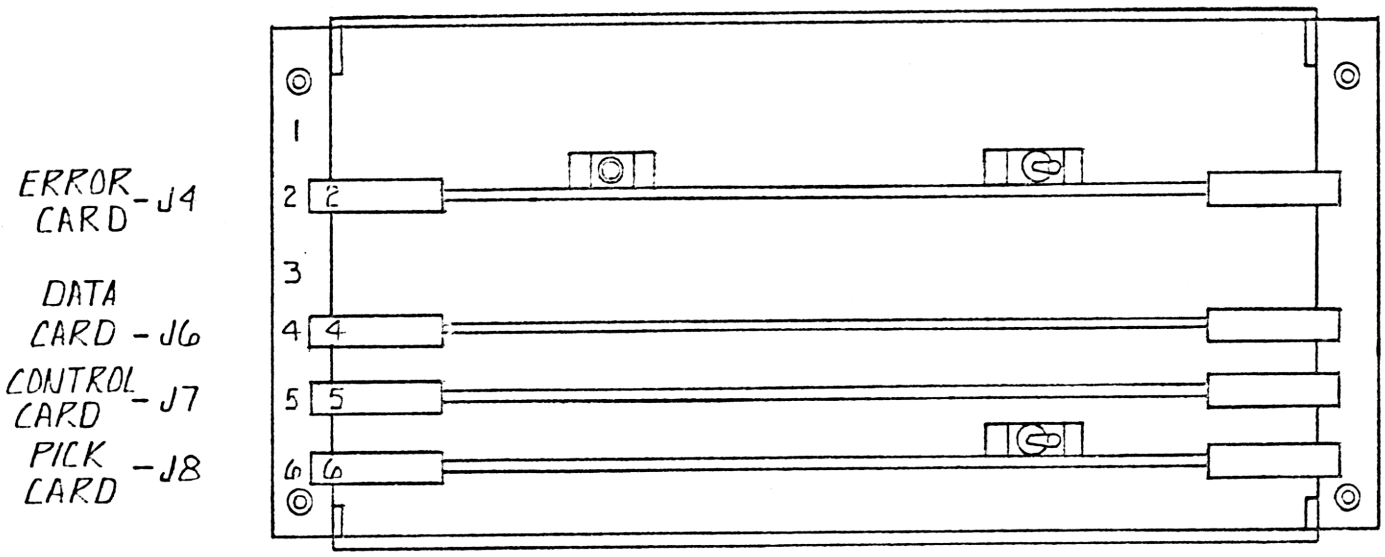
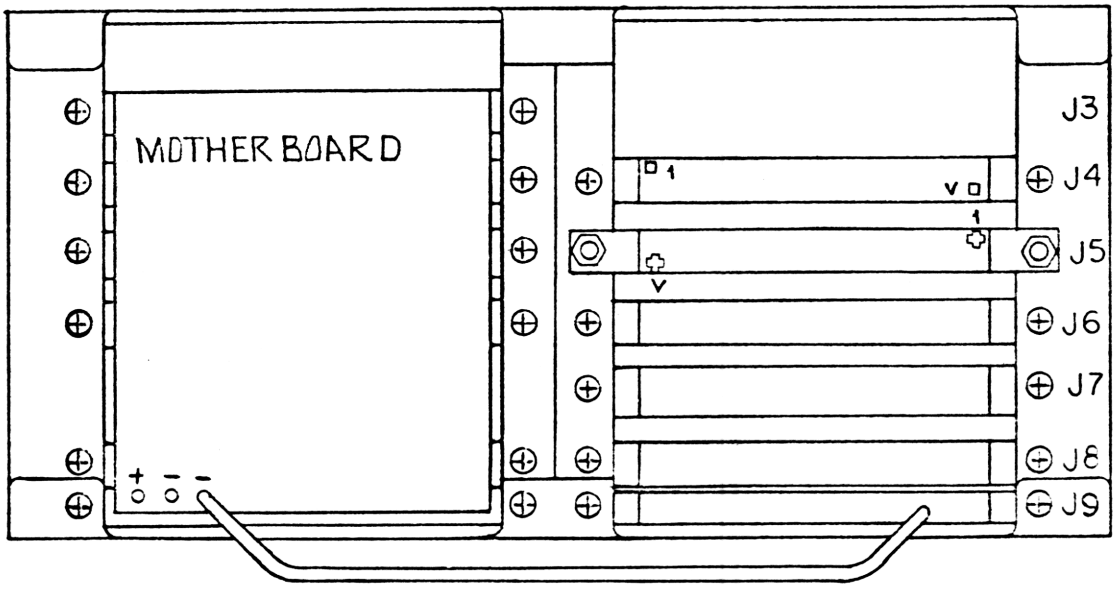


Figure A3A. Schematic Diagram, Solenoid Driver, 230 VAC, 50 Hz
(Dwg. No. 1140925)



CARD FILE, REAR VIEW
COVER REMOVED



CONNECTOR VIEW

Figure A4. Card File

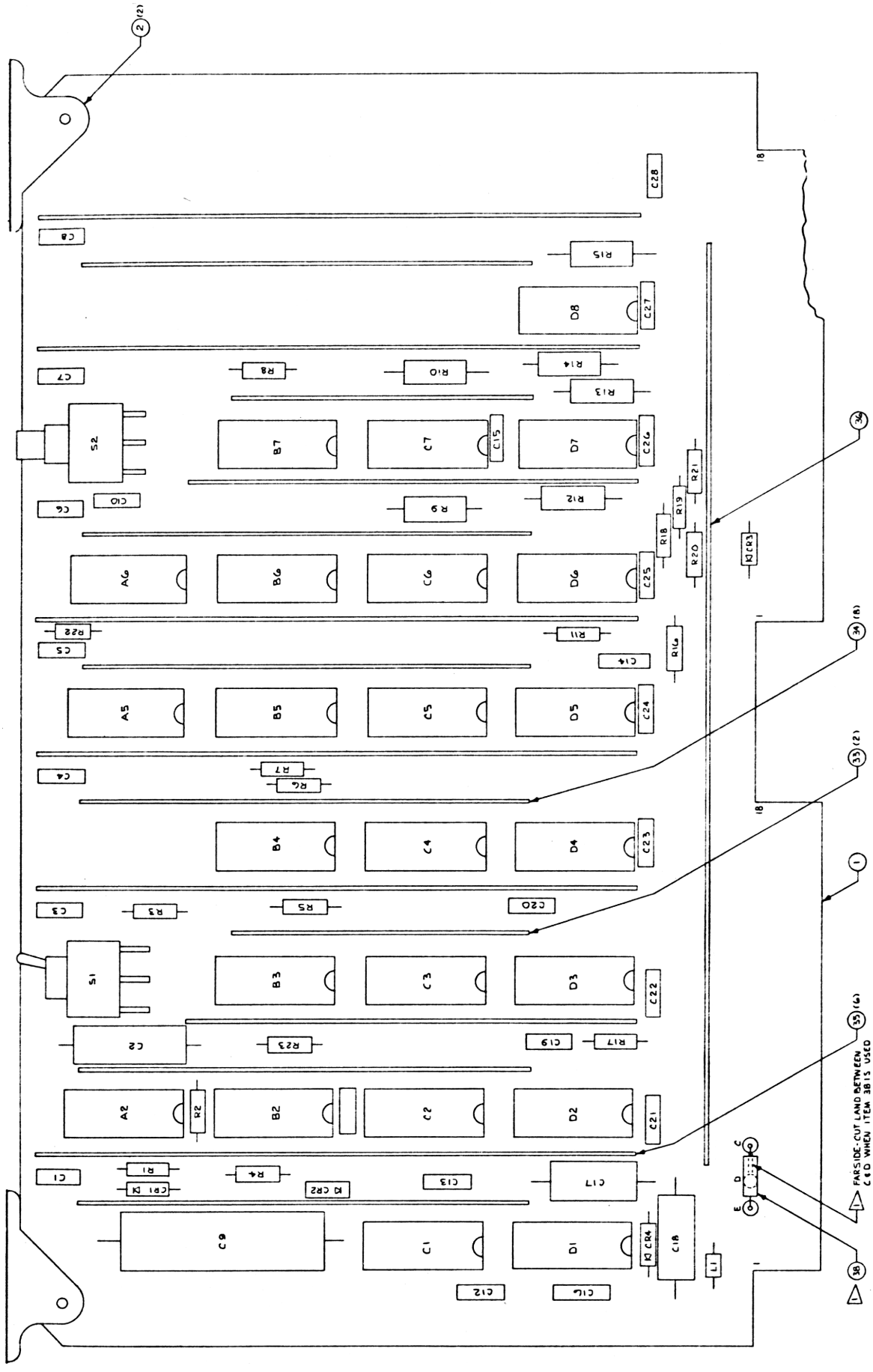


Figure A5. Error Card Assembly - Dwg. No. 1540899

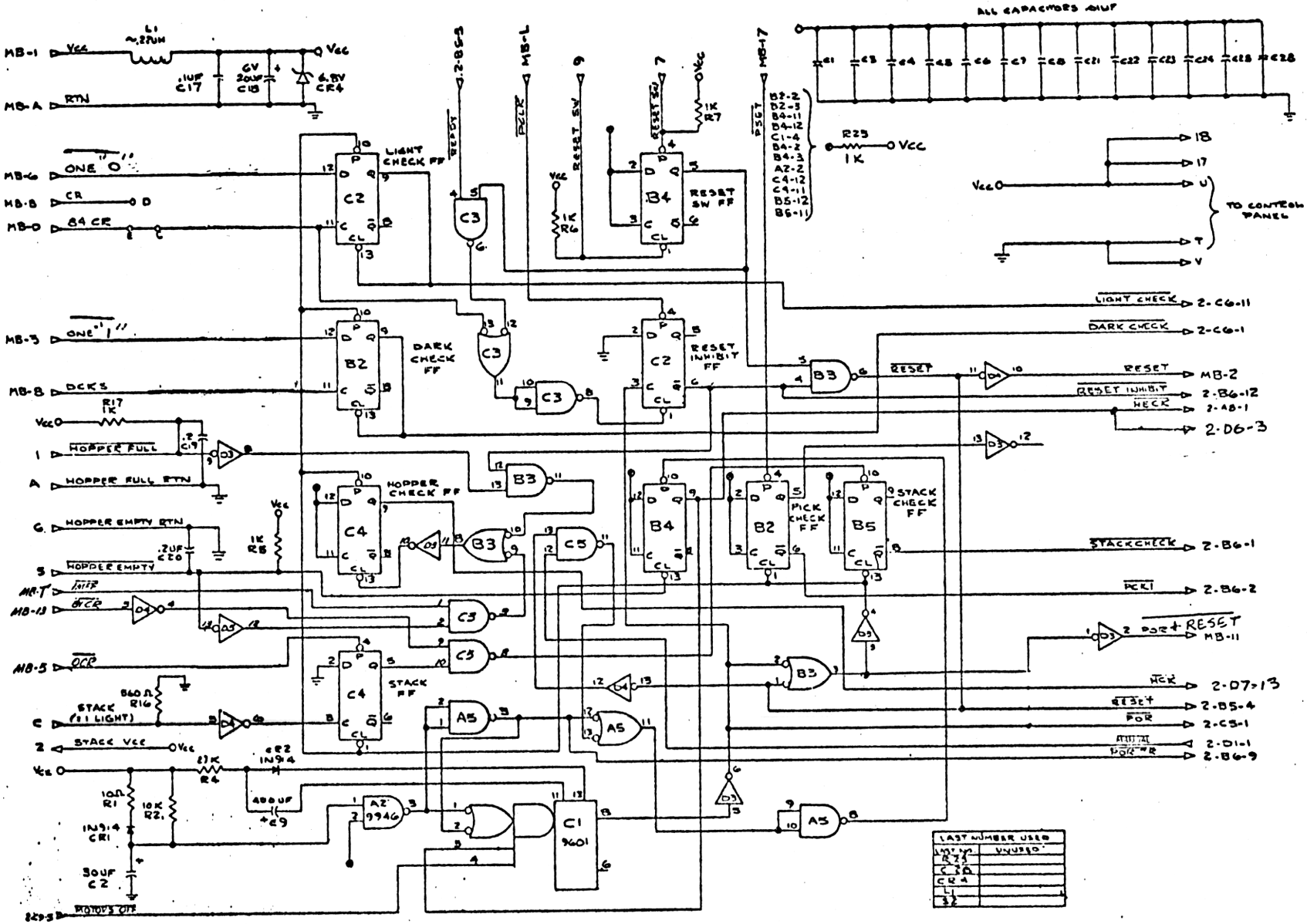


Figure A-6 Schematic Diagram, Error Card, (Sh. 1 of 2) CS 190
DWG # 1542328

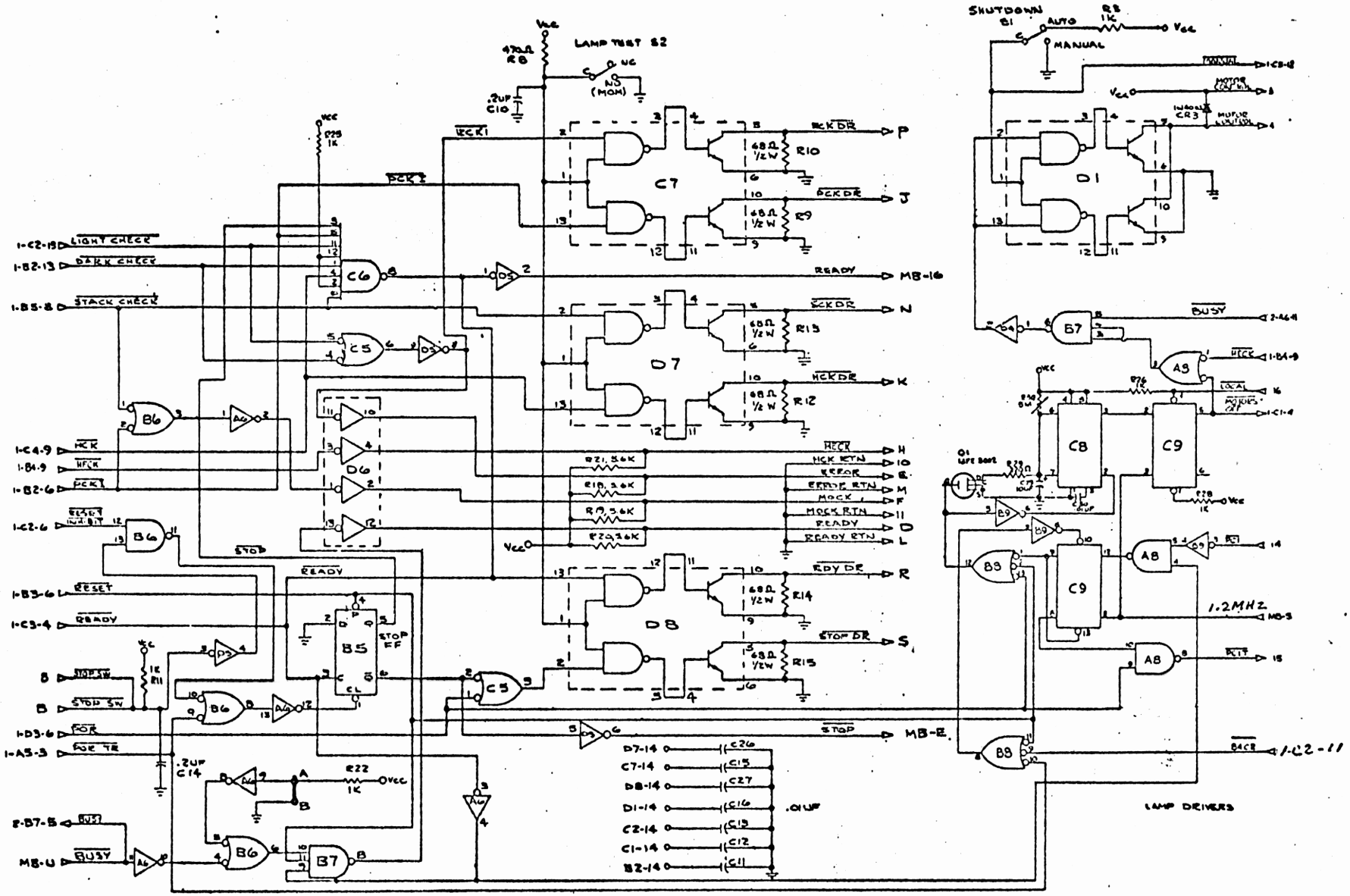


Figure A-6 Schematic Diagram, Error Card, (Sh. 2 of 2) CS 190

Modified per option 01

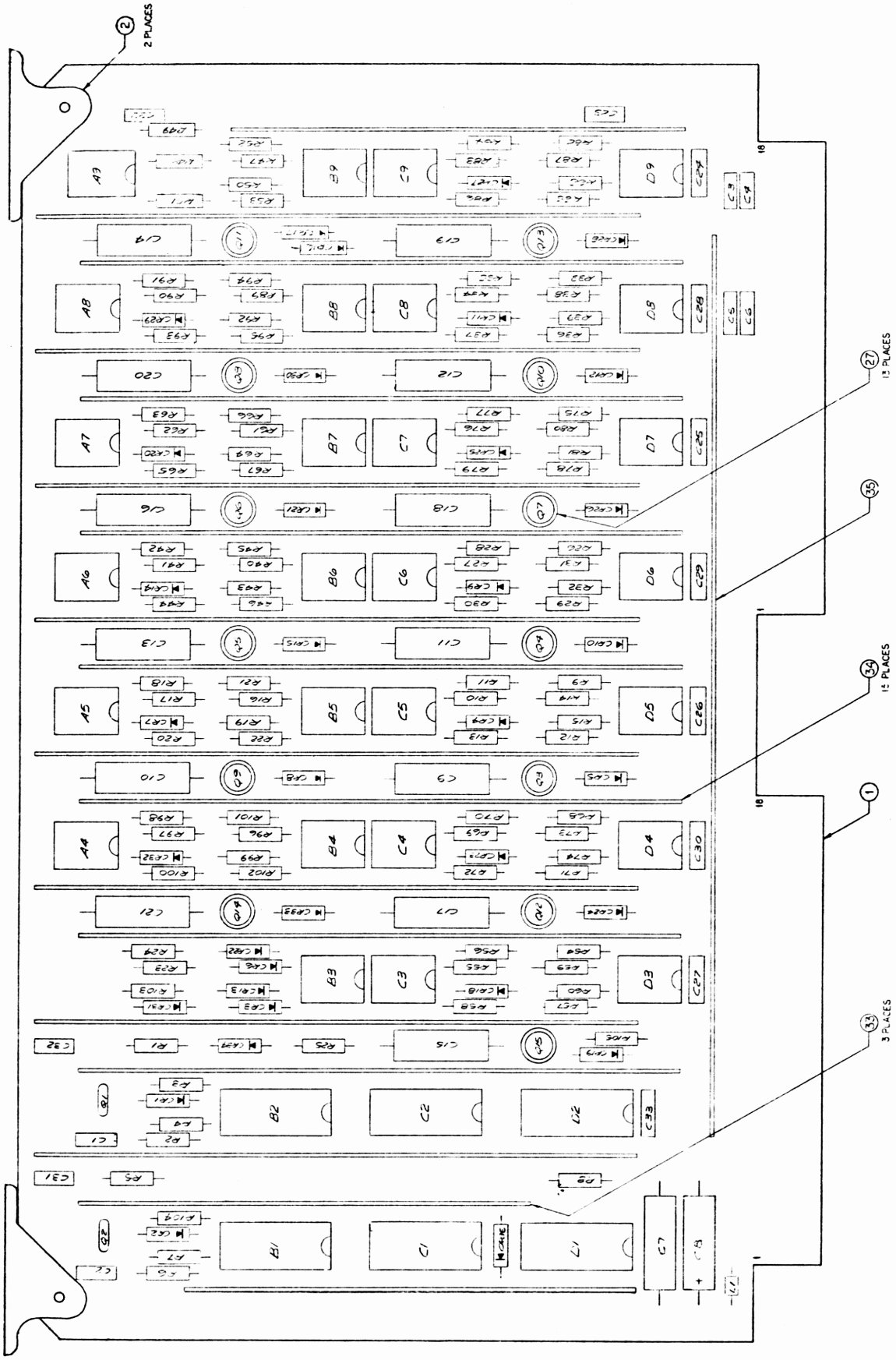
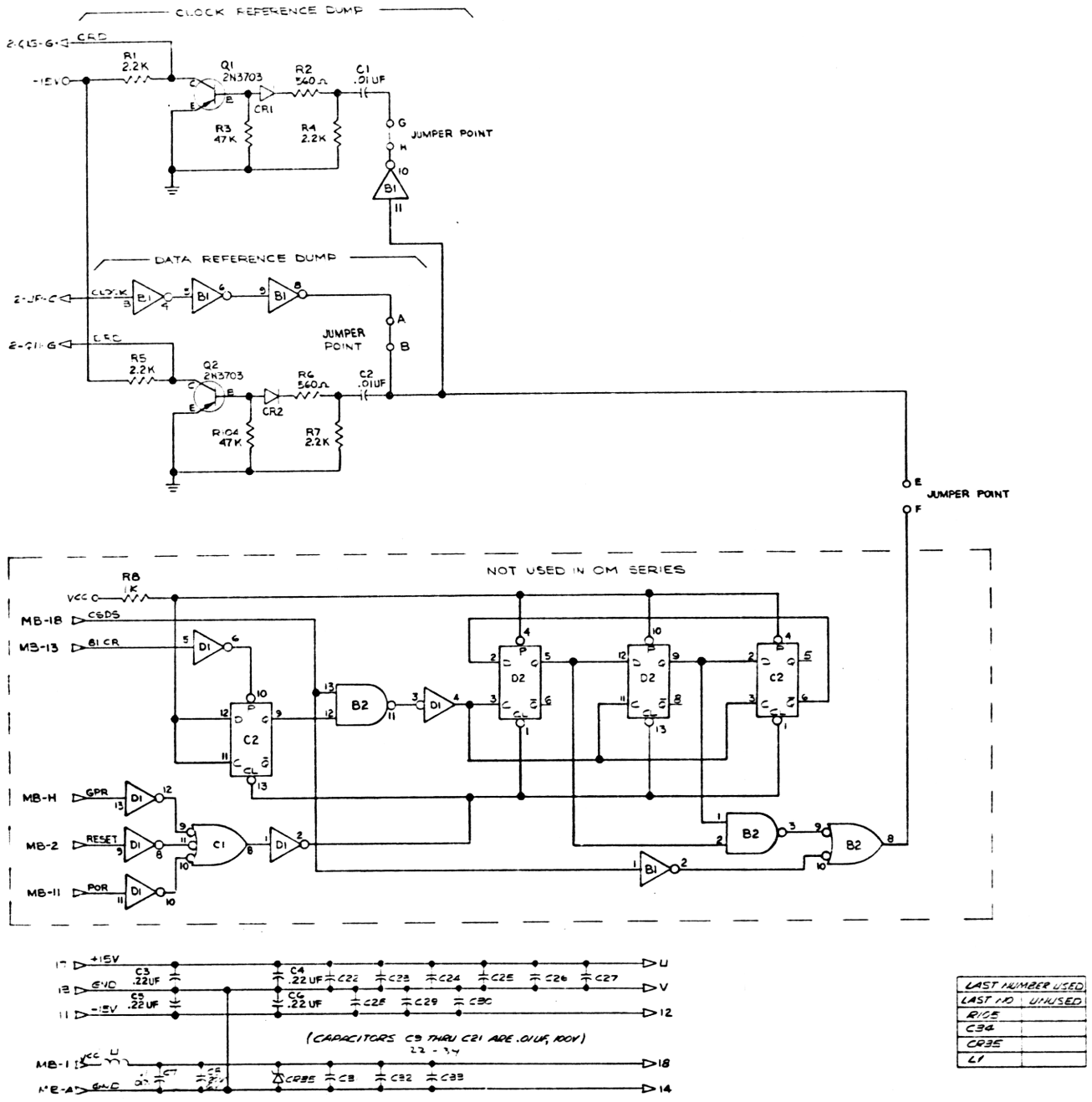


Figure A7. Data Card Assembly – Dwg. No. 1540872



LAST NUMBER USED	
LAST NO	UNUSED
R105	
C34	
CR35	
L1	

Figure A8. Data Card Schematic (Sheet 1 of 2) - Dwg. No. 1540873

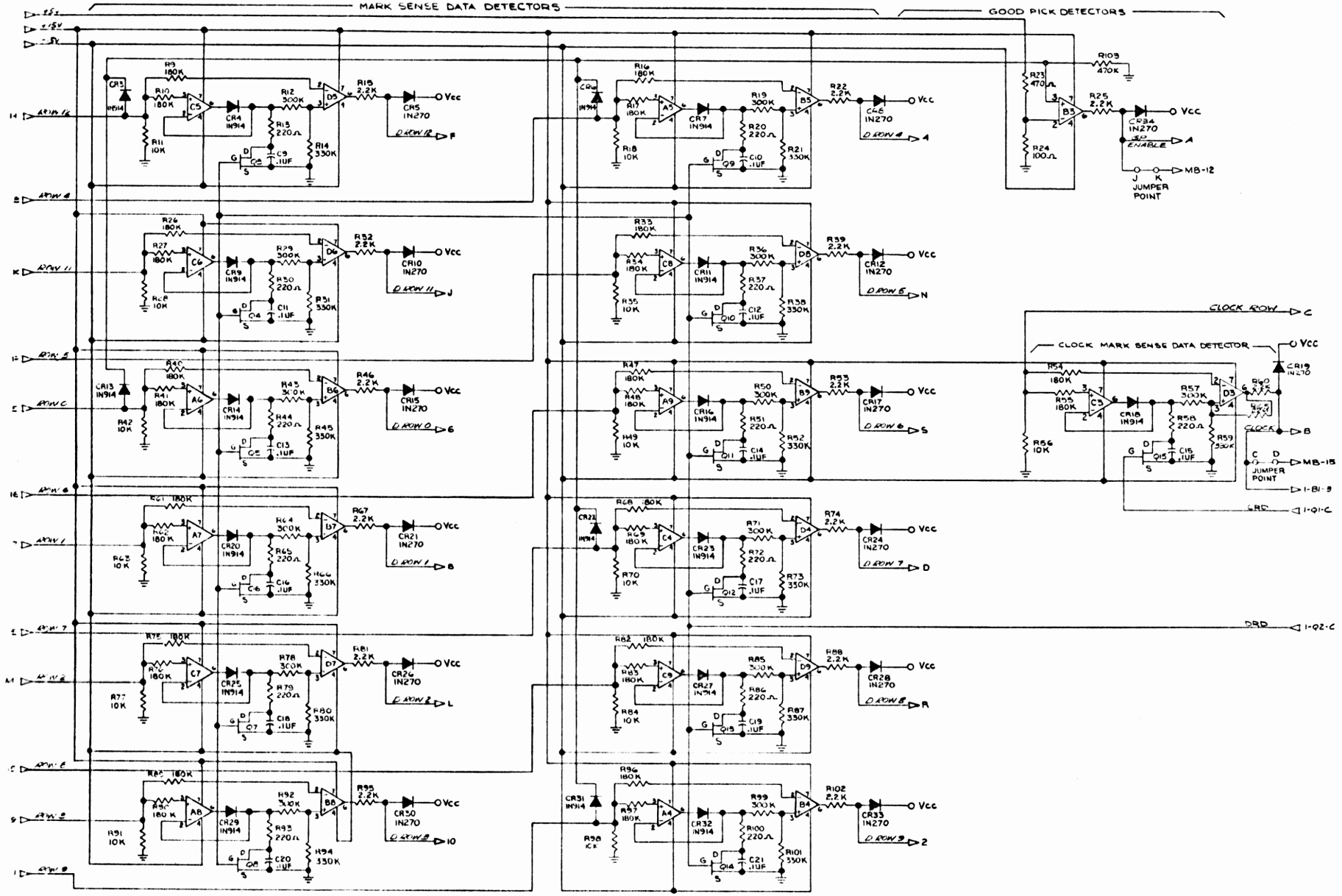


Figure A8. Data Card Schematic (Sheet 2 of 2)

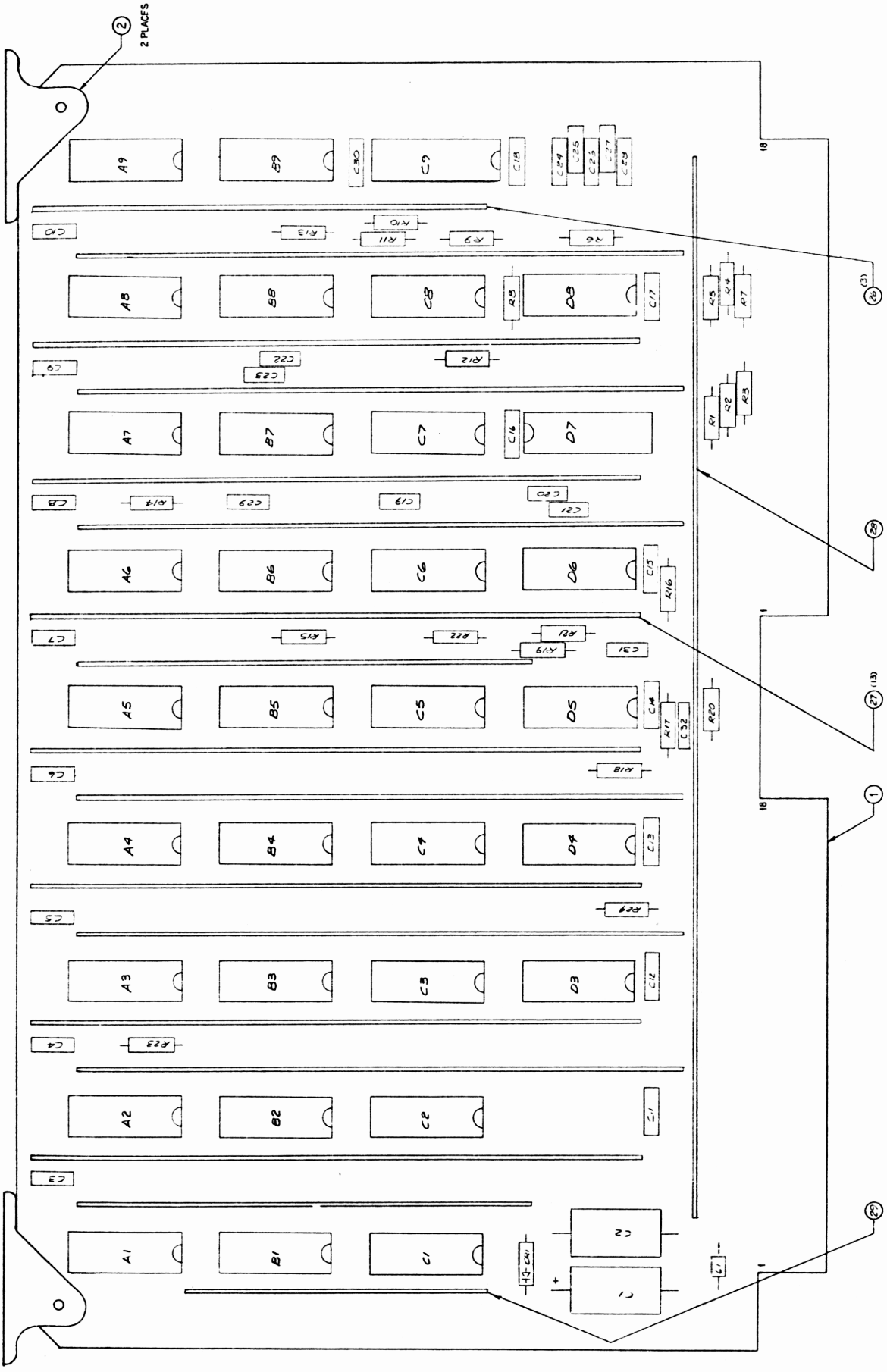


Figure A9. Control Card Assembly – Dwg. No. 1540889

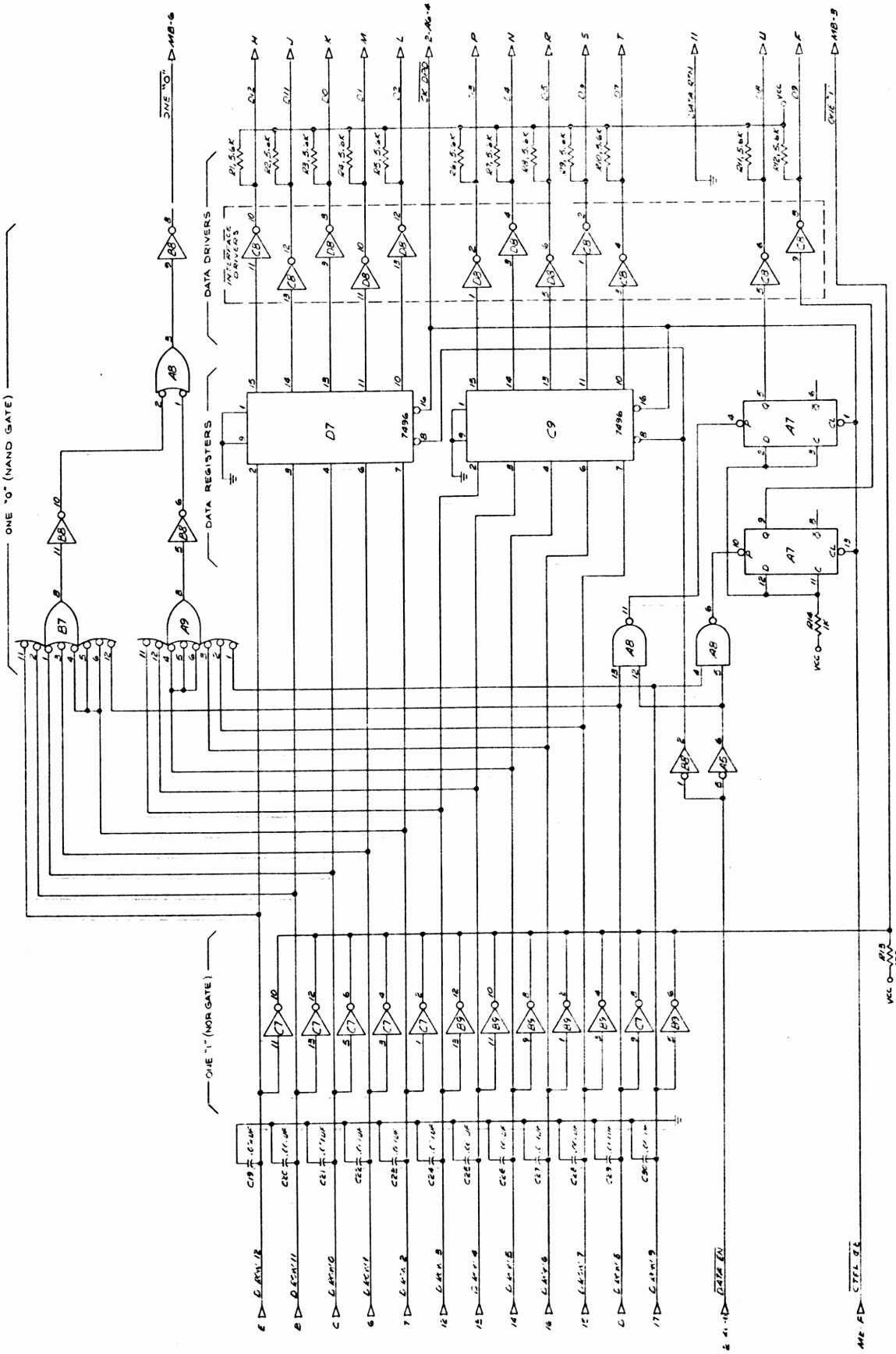


Figure A10. Control Card Schematic (Sheet 1 of3) - Dwg. No. 1540888

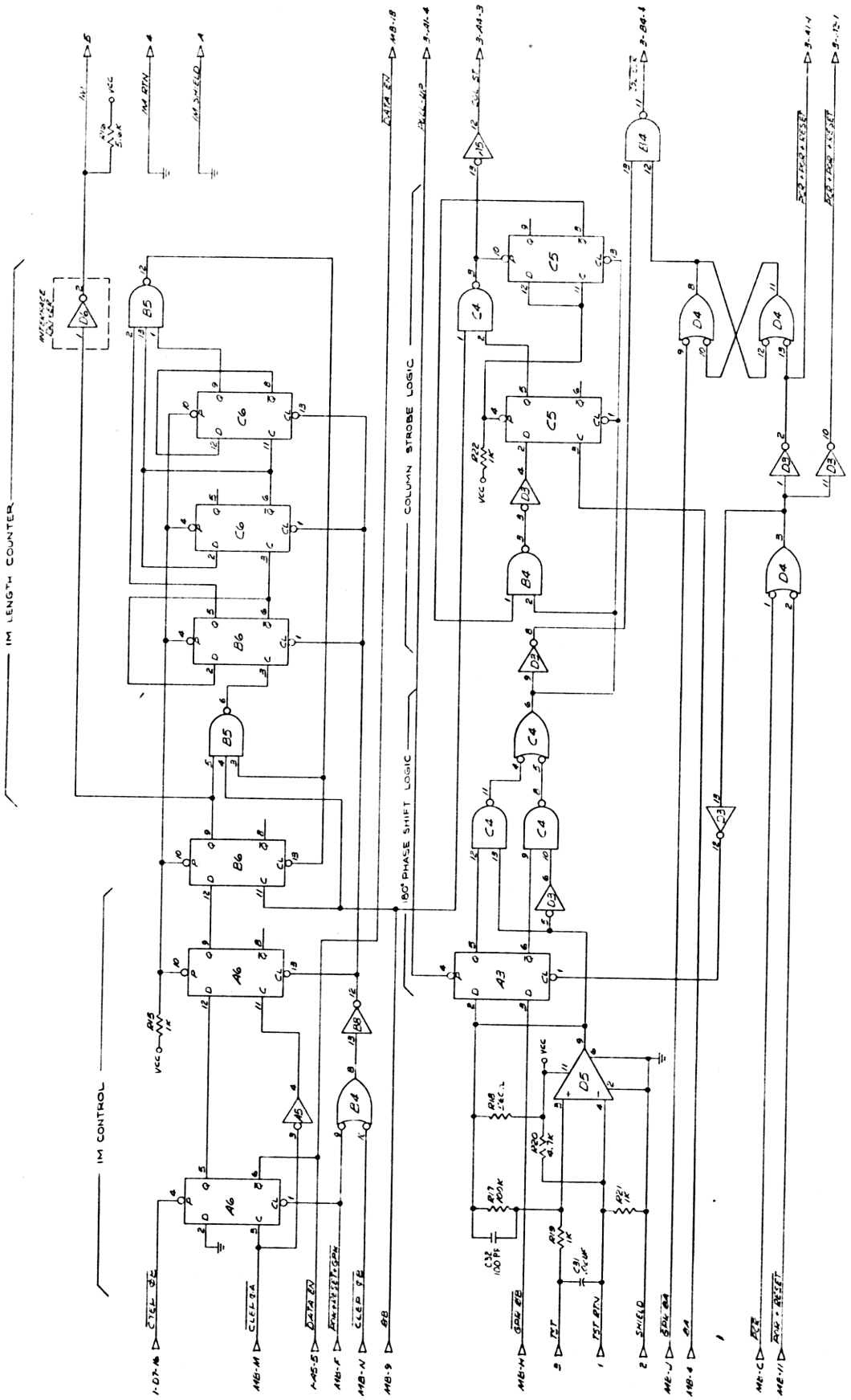


Figure A10. Control Card Schematic (Sheet 2 of 3)

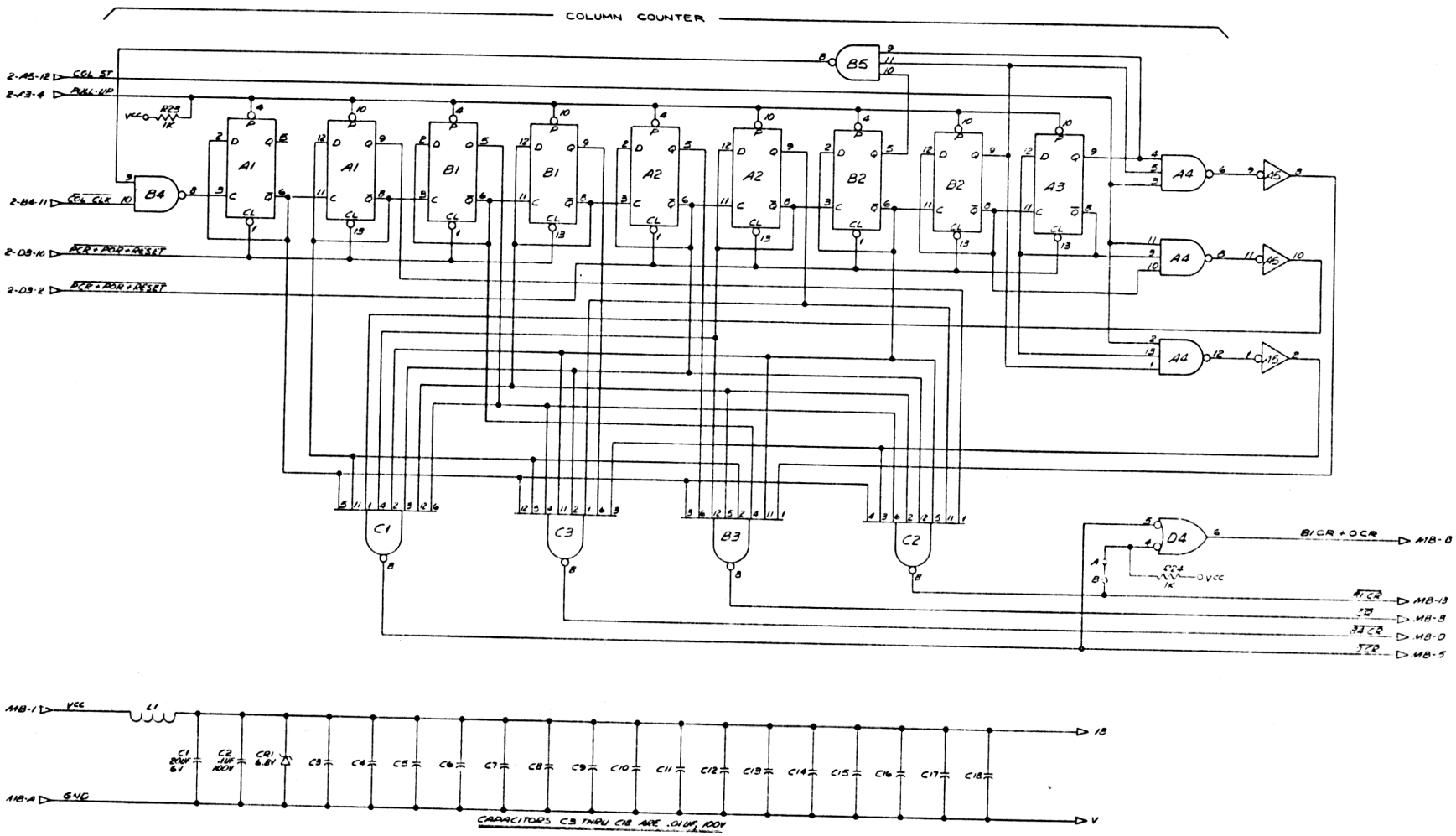


Figure A10. Control Card Schematic (Sheet 3 of 3)

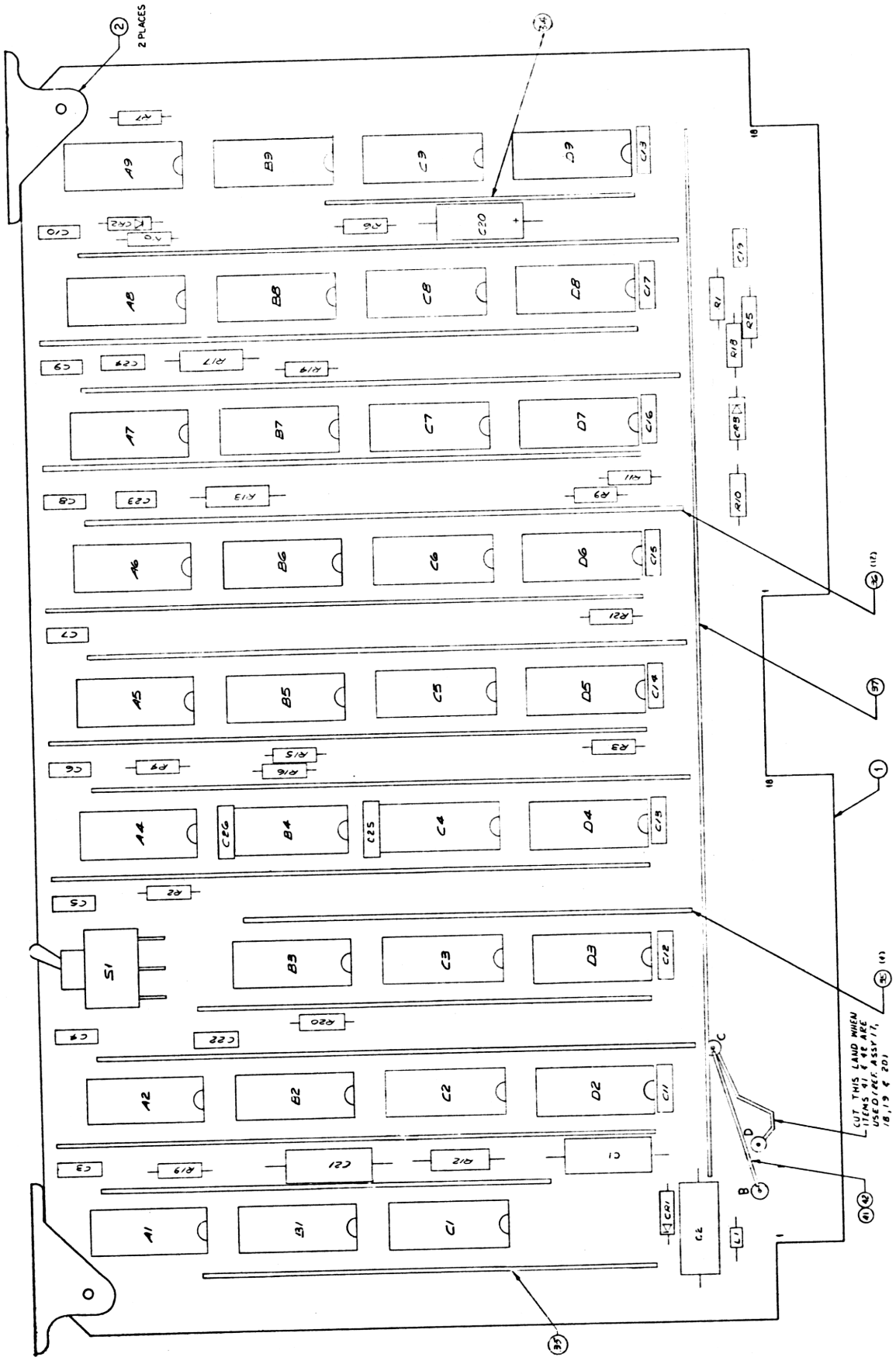


Figure A11. Pick Card Assembly - Dwg. No. 1540881

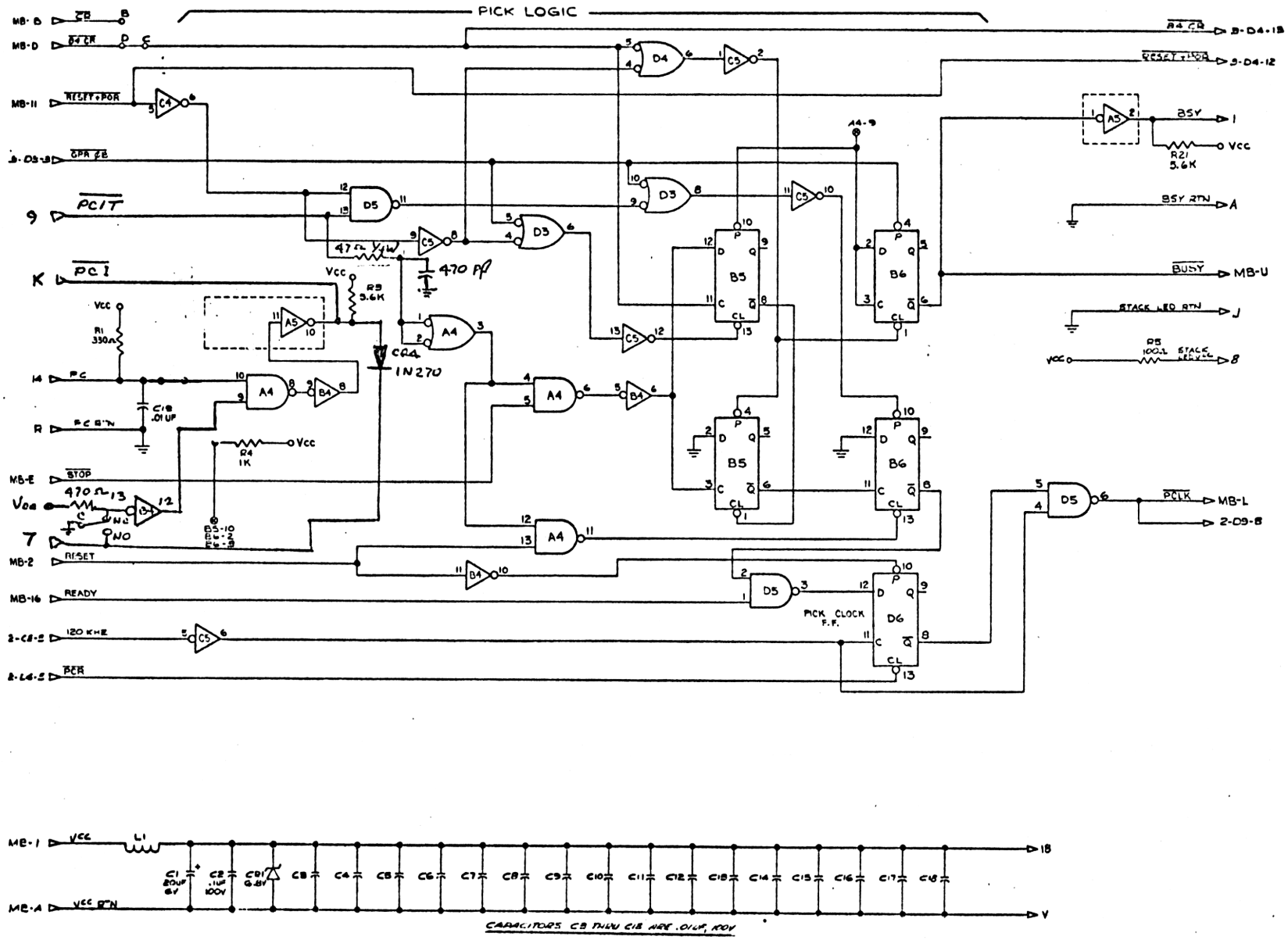


Figure A12. Pick Card Schematic (Sheet 1 of 3) - Dwg. No. 1542329 CS 190

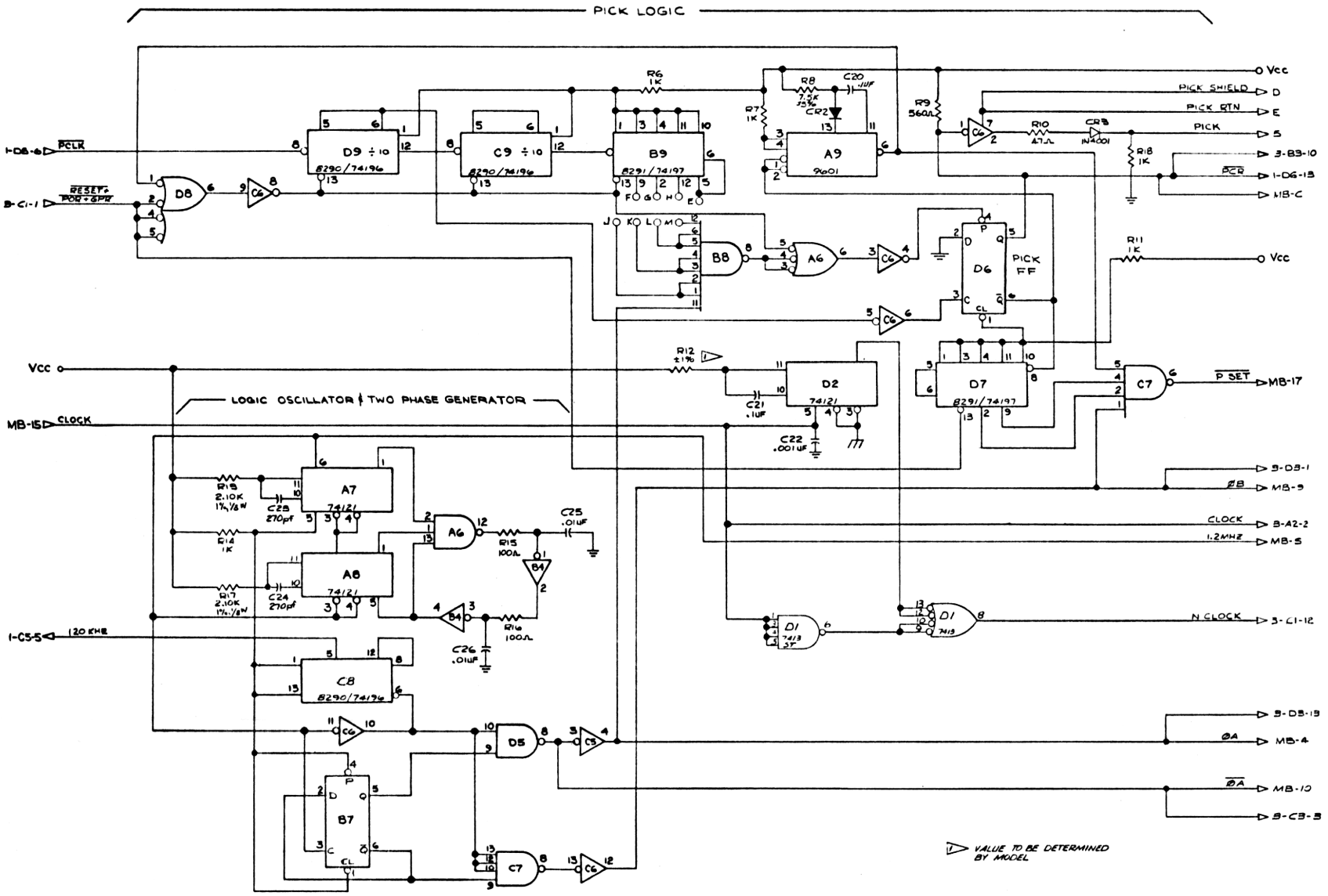


Figure A12. Pick Card Schematic (Sheet 2 of 3)

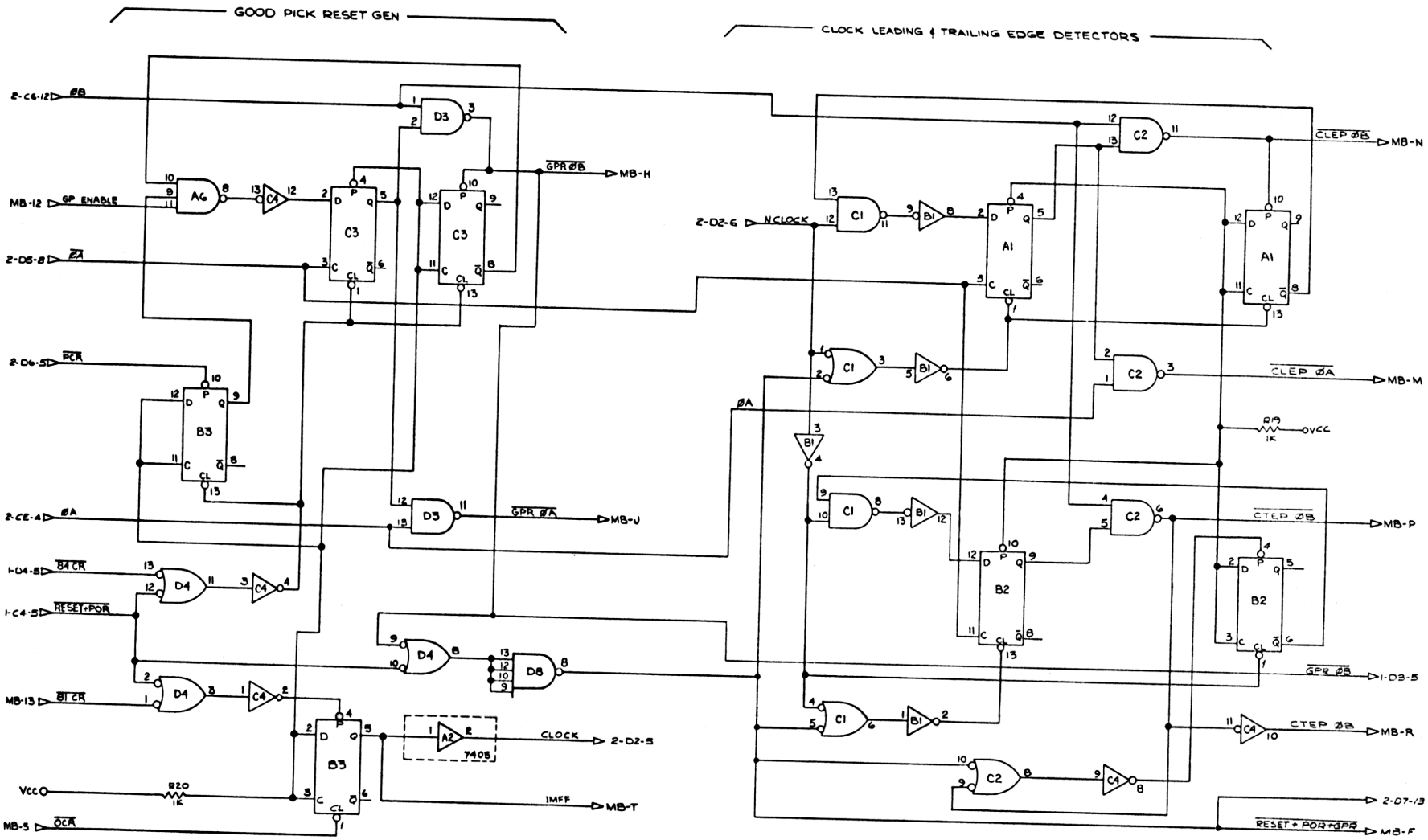


Figure A12. Pick Card Schematic (Sheet 3 of 3)

APPENDIX B

PARTS LIST

This appendix lists all items that are considered field replaceable. Should damage occur through excessive abuse to such items as picker castings, stacker castings, control panel assemblies, and card file assemblies, return the card reader to Documation Incorporated for repair.

To find the part number of a replaceable item, identify the item in one of the illustrations listed in Table B-1. Apply the index number in the illustration to the parts list to find the part number of that item.

To find the part number of the first picker roller assembly drive capstan, for example, identify the first picker roller assembly in figure B-3. Apply the associated index numbers - 18, 27, 51, and 53 - to the parts list to find the bearing, drive capstan, stack drive shaft, and bearing spacer part numbers.

Table B-1. Item Identification Illustrations

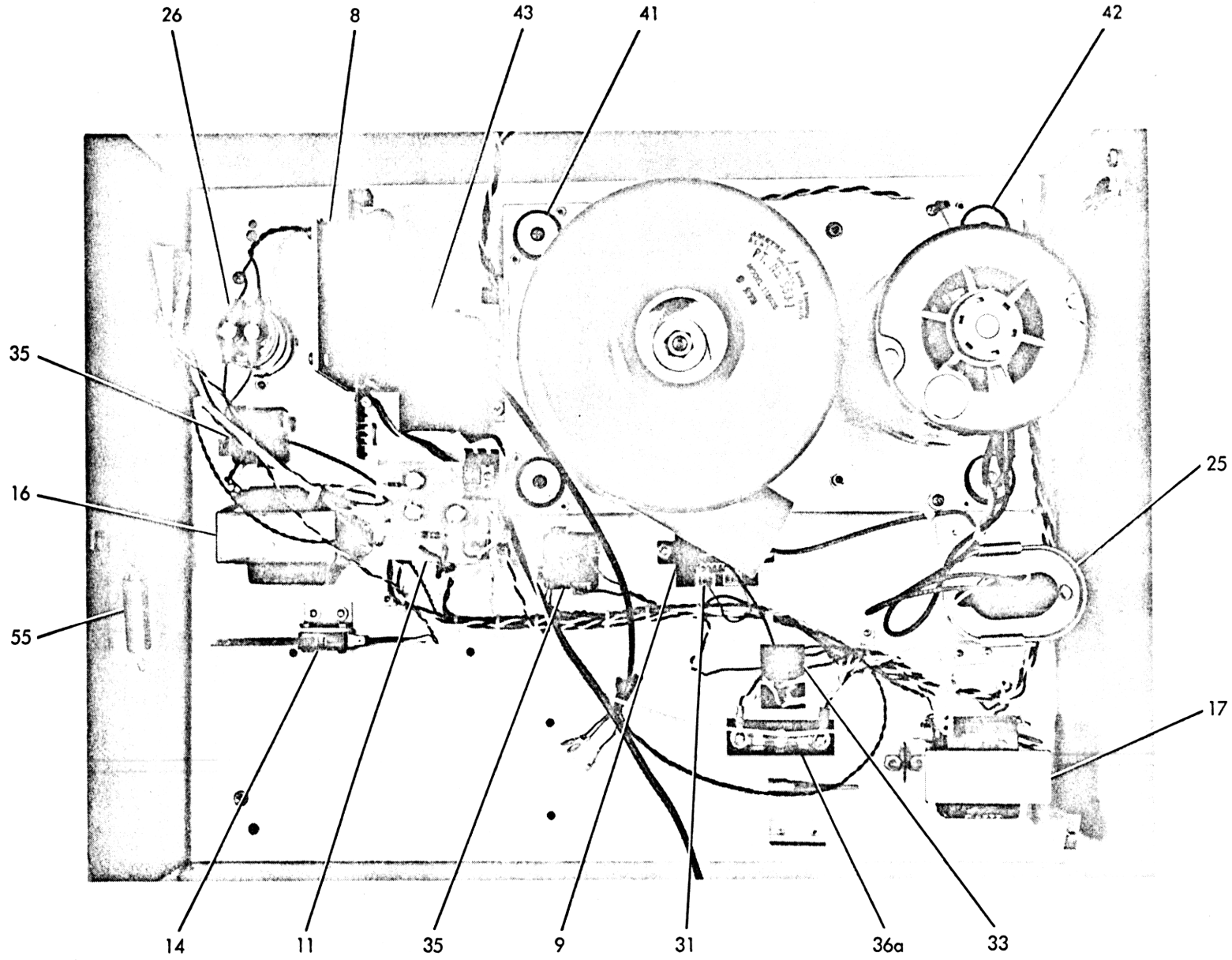


Figure B-1. Main Frame Assembly 1140752

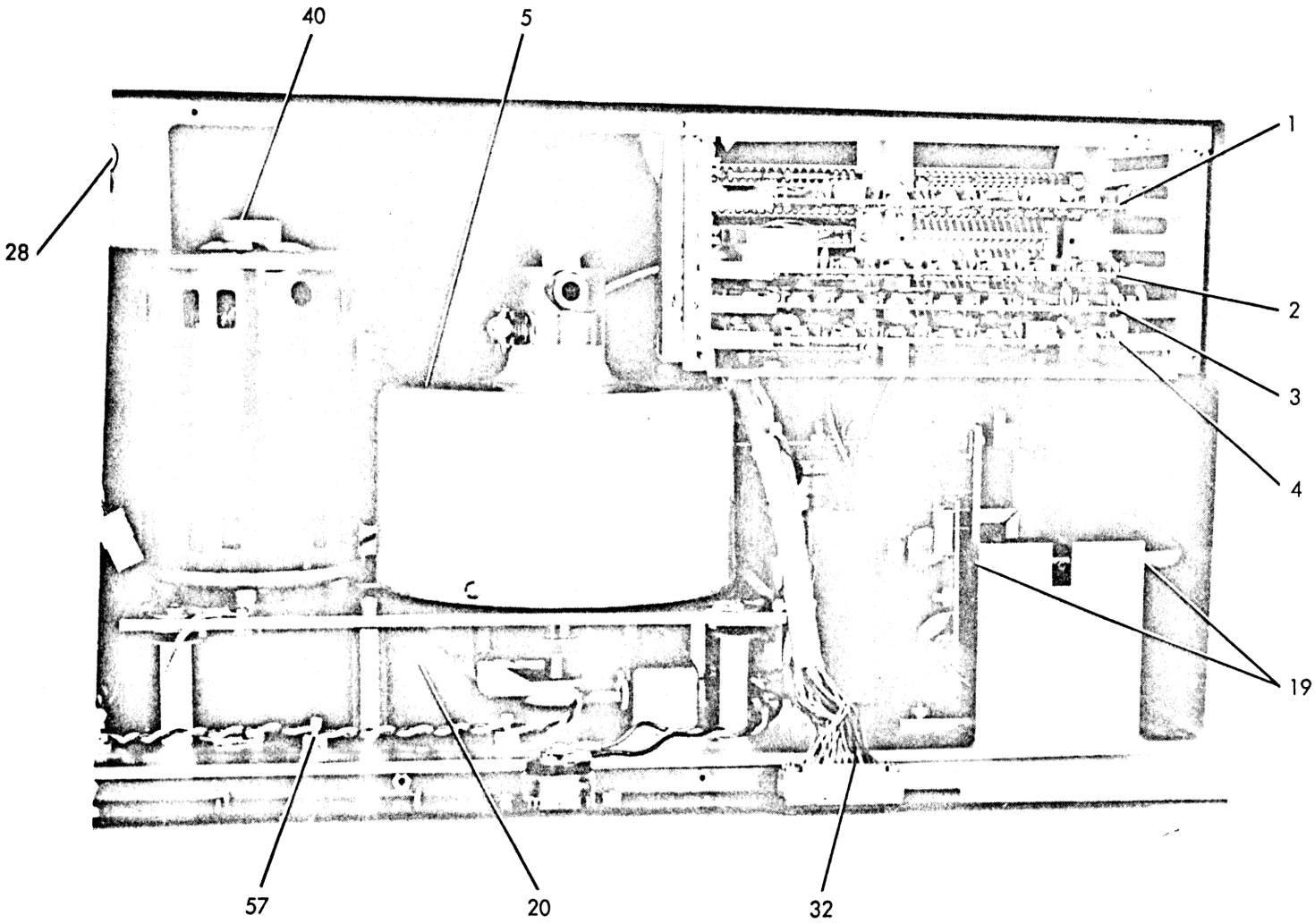


Figure B-2. OM 200 Card Reader, Rear View, Panels Removed

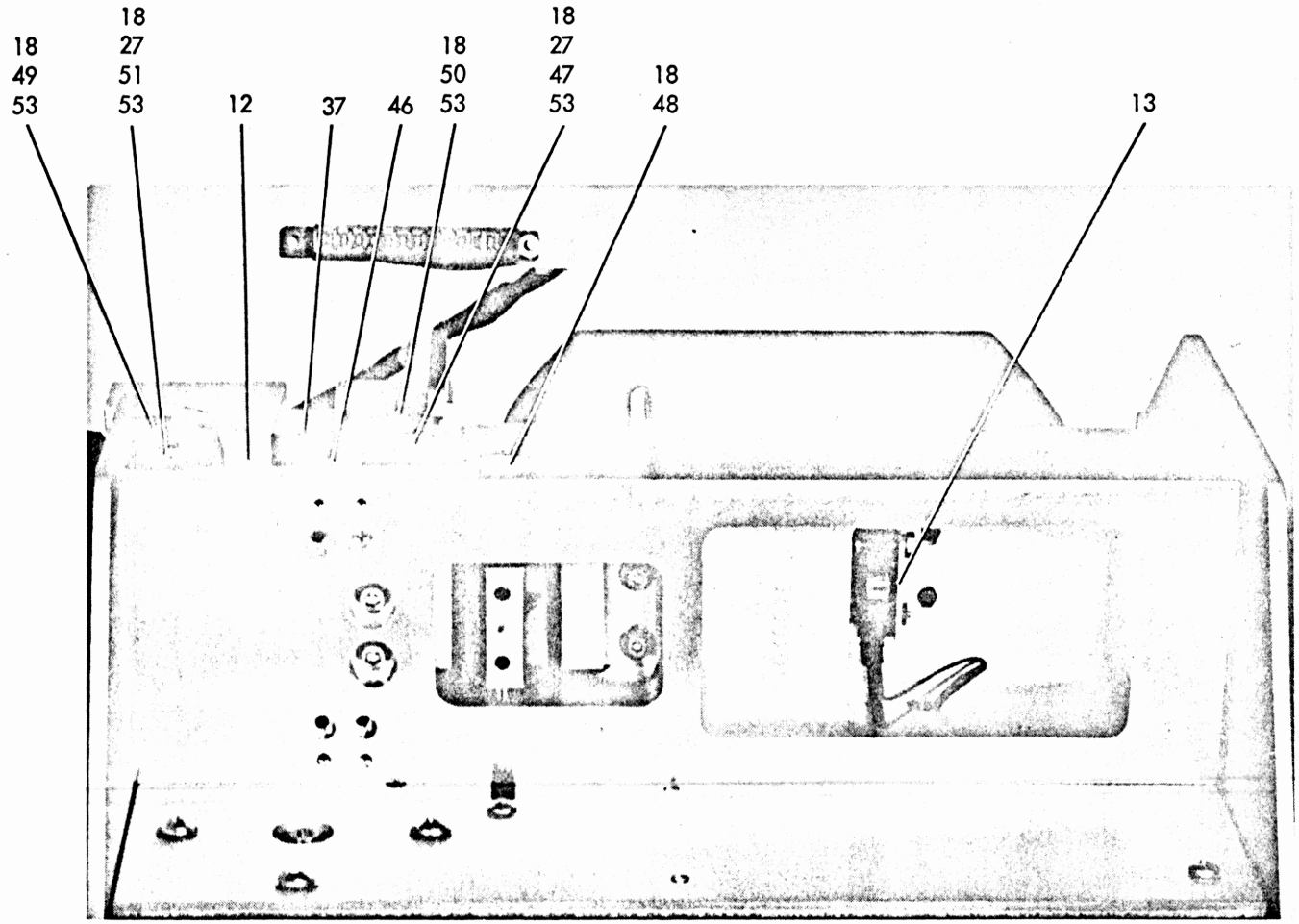


Figure B-3. Pick Support Assembly 1540927

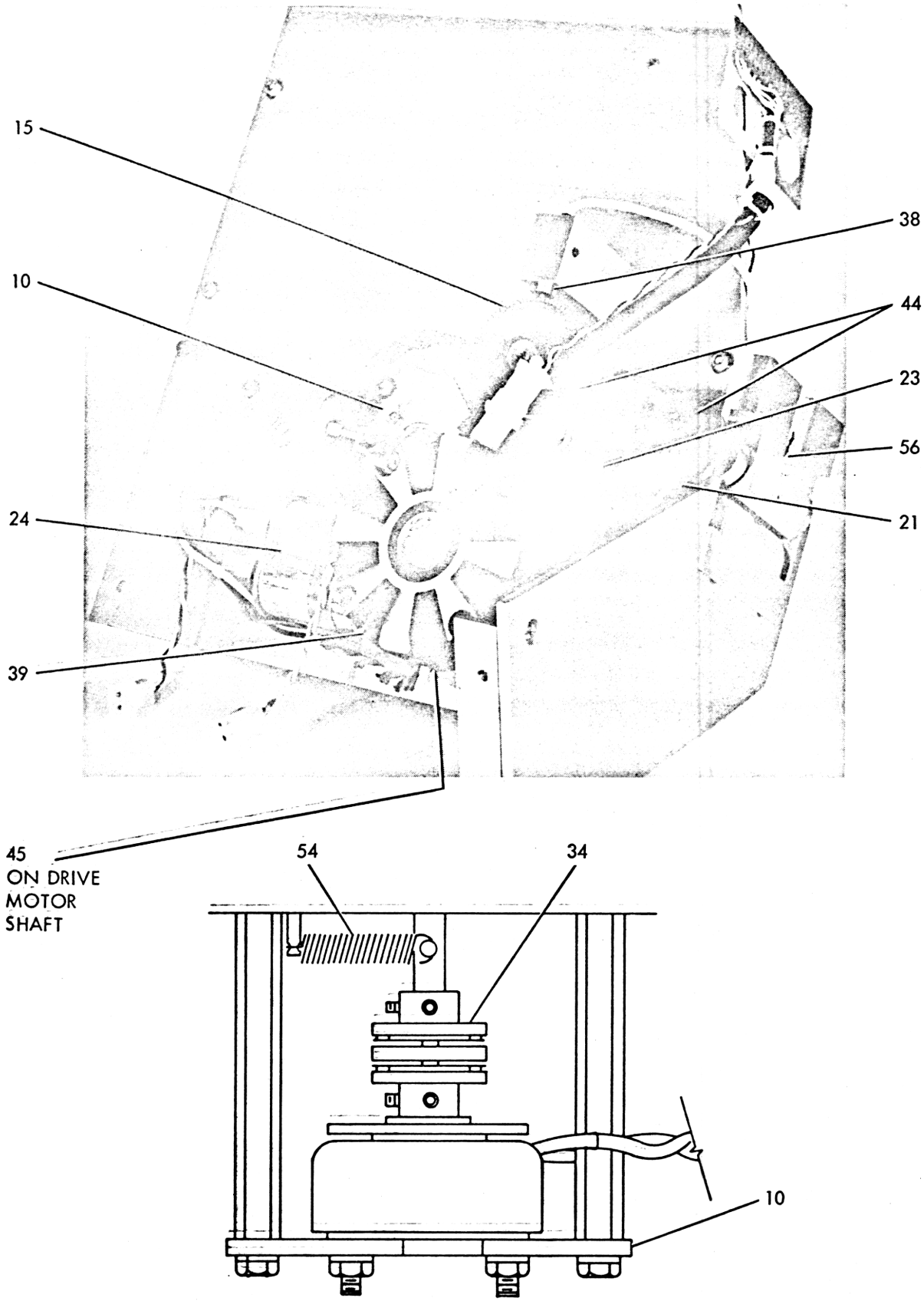


Figure B-4. Main Plate Assembly 1140516, Bottom View

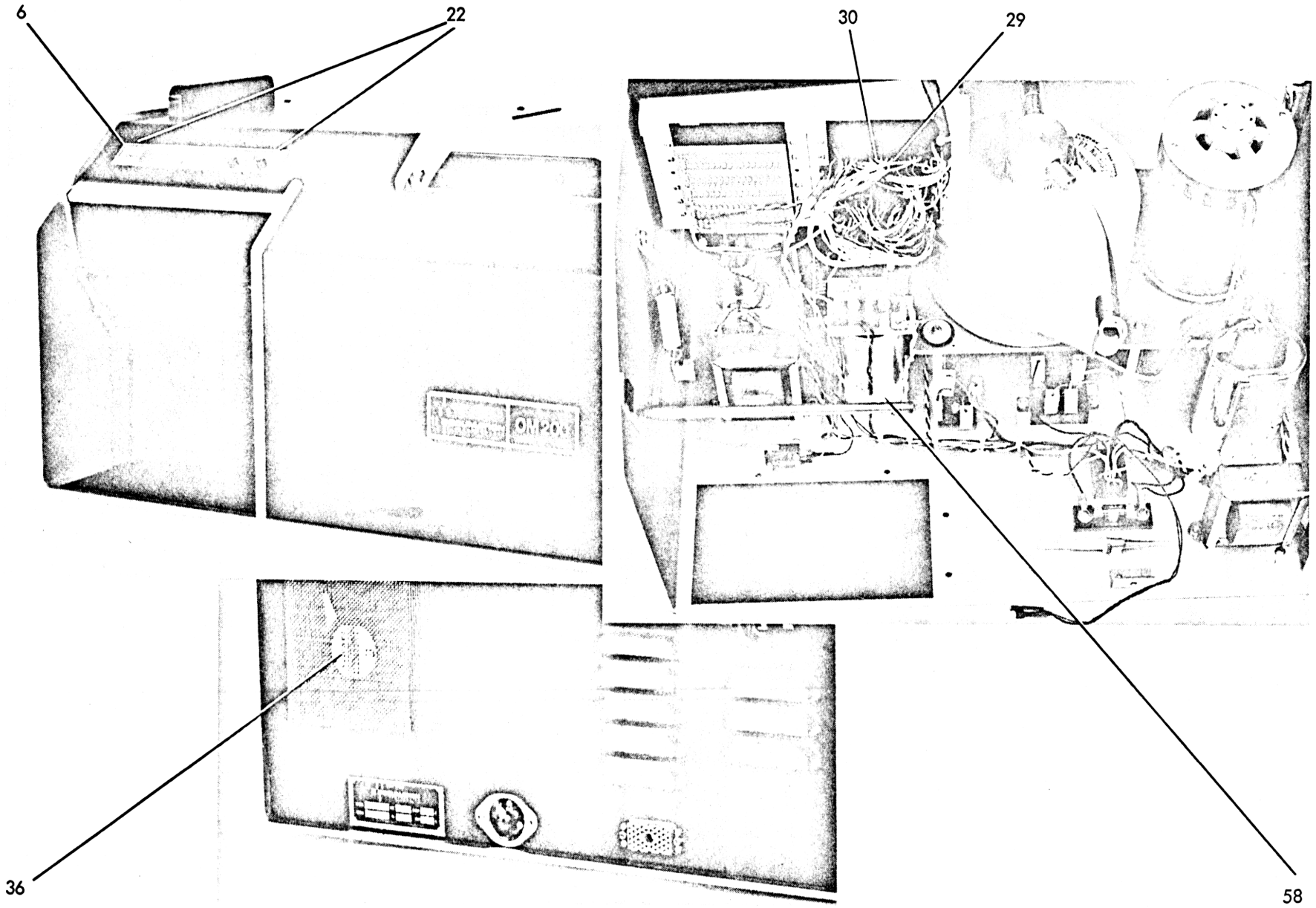


Figure B-5. Control Panel Assembly, Fan, Leaf Contacts, and Cable Tie SST-2S

PARTS LIST

FIG. & INDEX NO.	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY PER READER
B2-1	Assy., P.C. Card, Error	Documation	1540899-XX	1
B2-2	Assy., P.C. Card, Data	Documation	1540872-XX	1
B2-3	Assy., P.C. Card, Control	Documation	1540899-XX	1
B2-4	Assy., P.C. Card, Pick	Documation	1540881-XX	1
B2-5	Assy., Blower	Documation	1130559	1
B5-6	Assy., Control Panel	TEC	DPA-7164B	1
	Assy., Power Cord	Documation	1020148	1
B1-8	Assy., Power Supply, 5Volt	Documation	103029504	1
B1-9	Assy., Relay	Hamlin	733-11-150	1
B4-10	Assy., Solenoid	Documation	1120498	1
B1-11	Assy., Solenoid Driver	Documation	1130458	1
B3-12	Assy., Stacker LED	Documation	1520947	1
B3-13	Assy., Switch, Hopper Empty	Documation	1020277	1
B1-14	Assy., Switch, Stacker Full	Documation	1120551	1
B4-15	Assy., Timing Disc	Documation	1020223	1
B1-16	Assy., Transformer, 12 Volt	Documation	102015602	1
B1-17	Assy., Transformer, 24 Volt	Documation	102015502	1
B3-18	Bearing, Sealed Ball	Kubar	SFR188TTK25LG1	12
B2-19	Bearing, Stacker Shaft	Torrington	B-59-0H	2
B2-20	Belt, Blower	Gates	5M545	1
B4-21	Belt, Drive	Dick	130XL-025	1
B4-22	Bulb; 6V @ 0.20A	GE	#328	7
B4-23	Bulb; 5V @ .70A	Welch Allyn	999079-6	1
B4-24	Capacitor, Motor Run, 3uf @ 370 VAC	GE	45F271	1
B1-25	Capacitor, Motor Run, 17.5uf @ 370VAC	GE	45F279	1
B1-26	Capacitor, 4600 uf @ 15 VDC	GE	86F119M	1
B3-27	Capstan, Drive	Documation	1020059	4
B2-28	Circuit Breaker	Airpax	UPG1162802	1
B5-29	Contact, Amp Leaf, 18-22 ga.	Amp	42717-4LP	4
B5-30	Contact, Amp Leaf, 22-26 ga.	Amp	42702-4LP	59
B1-31	Contact, Amp Modified Fork	Amp	583259-2LP	14
B2-32	Contact, Elco	Elco	6080-170313	36
B1-33	Contact, Terminal Junction	Deutsch	1841-1-5616	14
B4-34	Coupling, Solenoid	Documation	1020106	1
B1-35	Diode Bridge	Motorola	MDA-980-1	2

PARTS LIST

FIG. & INDEX NO.	DESCRIPTION	MANUFACTURER	PART NUMBER	QTY. PER READER
B5-36	Fan	Pamotor	4600	1
B1-36a	Fuse, 1 Amp, Slo-Blo	Little Fuse	313001	1
B3-37	Light Station	Documation	1530848	1
B4-38	Magnetic Pickup	Airpax	086-311-0011	1
B4-39	Motor, Drive, 60 Hz, 1200 RPM	Motronics	34131-11-300-01	1
B2-40	Motor, Blower, 60 Hz, 3350 RPM	GE	KCP19PG	1
B1-41	Mount, Rubber	Lord	100 PD2	2
B1-42	Mount, Rubber	Lord	100 PD4	2
B1-43	Power Supply ± 15 Volts	Computer Products	PM 570	1
B4-44	Pulley, Drive, Roller	Dick	16X1037	2
B4-45	Pulley, Drive Motor	Documation	1120448	1
B3-46	Read Station	Documation	1530849	1
B3-47	Shaft, Drive Roller	Documation	1010022	
B3-48	Shaft, Pick	Documation	1010039	1
B3-49	Shaft, Stack Drive	Documation	101003001	1
B3-50	Shaft, Stack Drive	Documation	101003002	1
B3-51	Shaft, Stack Drive	Documation	101003003	1
	Solenoid, Lube No. 2	Ledex	124048-001	1
B3-53	Spacer, Bearing	W. Berg	SS2-28	8
B4-54	Spring, Solenoid	Lee Spring	LE-026-C2-J	1
B1-55	Spring, Stacker	Lee Spring	LE-041E-6(MW)	1
B4-56	Stacker Photocell	Spectronics	SS1443	1
B2-57	Tie, Cable	Panduit	SST-1M	20
B2-58	Tie, Cable	Panduit	SST-2S	2

APPENDIX C

SIGNAL MNEMONICS AND ABBREVIATIONS

Appendix C contains the description, location and originating source for the Signal Mnemonics and Abbreviations used in this manual.

SIGNAL MNEMONICS AND ABBREVIATIONS

MNEMONIC	DESCRIPTION	SOURCE
Vcc	+5 Volts	5 Volt Power Supply
RTN	+5 Volt Return	5 Volt Power Supply
PC	Pick Command	Controlling Device
PC RTN	Pick Command Return	Controlling Device
120 KHz	120 KHz	Pick Card
PCR	Pick Control Reset	Pick Card
BSY	Busy	Pick Card
BSY RTN	Busy Return	Pick Card
BUSY	Busy	Pick Card
STACK LED Vcc	Stack Light Emitting Diode +5 Volts	Pick Card
STACK LED RTN	Stack Light Emitting Diode +5 Volts Return	Pick Card
PCLK	Pick Clock	Pick Card
CLOCK	Detected Clock	Data Card
N CLOCK	Buffered Clock	Pick Card
1.2 MHz	1.2 MHz (oscillator)	Pick Card
ØA	Clock Phase A	Pick Card
ØB	Clock Phase B	Pick Card
P SET	Pick Error Set	Pick Card
PICK	Pick Pulse to Solenoid Driver	Pick Card
PICK RTN	Pick Pulse Return	Pick Card
PICK SHIELD	Pick Pulse Shield	Pick Card
CLEP ØB	N Clock Leading Edge Pulse ØB	Pick Card
CLEP ØA	N Clock Leading Edge Pulse ØA	Pick Card
CTEP ØB	N Clock Leading Edge Pulse ØB	Pick Card
IMFF	Index Mark Flip Flop	Pick Card
GPR ØB	Good Pick Reset ØB	Pick Card
GPR ØA	Good Pick Reset ØA	Pick Card
ONE "0"	One "0"	Control Card
ONE "1"	One "1"	Control Card
D12	Row 12 Output	Control Card
D11	Row 11 Output	Control Card
D0	Row 0 Output	Control Card
D1	Row 1 Output	Control Card
D2	Row 2 Output	Control Card

SIGNAL MNEMONICS AND ABBREVIATIONS

MNEMONIC	DESCRIPTION	SOURCE
D3	Row 3 Output	Control Card
D4	Row 4 Output	Control Card
D5	Row 5 Output	Control Card
D6	Row 6 Output	Control Card
D7	Row 7 Output	Control Card
D8	Row 8 Output	Control Card
D9	Row 9 Output	Control Card
DATA RTN	Row 12-9 Output Return	Control Card
TST	Timing Strobe	Magnetic Pickup
TST RTN	Timing Strobe Return	Magnetic Pickup
SHIELD	Timing Strobe Shield	Magnetic Pickup
IM	Index Mark	Control Card
IM RTN	Index Mark Return	Control Card
IM SHIELD	Index Mark Shield	Control Card
DATA EN	Data Enable	Control Card
COL ST	Column Strobe	Control Card
COL CLK	Column Counter Clock	Control Card
OCR	0 Column Reset	Control Card
81 CR	81 Column Reset	Control Card
84 CR	84 Column Reset	Control Card
CR	Column Reset	Control Card
HOPPER FULL	Hopper Full Switch	Error Card
HOPPER FULL RTN	Hopper Full Switch Return	Error Card
HOPPER EMPTY RTN	Hopper Empty Switch Return	Error Card
HOPPER EMPTY	Hopper Empty Switch	Error Card
STACK	Stack Sensor Input	Error Card
STACK Vcc	Stack Sensor +5 Volts	Error Card
RESET SW	Reset Switch Normally Open	Error Card
$\overline{\text{RESET SW}}$	Reset Switch Normally Closed	Error Card
HECK	Hopper Empty Check	Error Card
PCK	Pick Check	Error Card
STACK CHECK	Output Stacker Check	Error Card
PCKI	Pick Check Indicator	Error Card
HCK	Input or Output Hopper Check	Error Card
SHUTDOWN STATUS	Mode Switch Input	Error Card

SIGNAL MNEMONICS AND ABBREVIATIONS

MNEMONIC	DESCRIPTION	SOURCE
POR TR	Power On Reset Trigger	Error Card
STOP SW	Stop Switch Input	Error Card
RCK DR	Read Check Lamp Driver	Error Card
PCK DR	Pick Check Lamp Driver	Error Card
SCK DR	Stack Check Lamp Driver	Error Card
HCK DR	Hopper Check Lamp Driver	Error Card
HCK RTN	Hopper Check Output Return	Error Card
ERROR	Error Output	Error Card
ERROR RTN	Error Output Return	Error Card
MOCK	Motion Check Output	Error Card
MOCK RTN	Motion Check Output Return	Error Card
READY	Ready Output	Error Card
READY RTN	Ready Output Return	Error Card
RDY DR	Ready Lamp Driver	Error Card
STOP DR	Stop Lam Driver	Error Card
ALL ONES CHECK	All Ones Check	Error Card
ALL ZEROS CHECK	All Zeros Check	Error Card
POR	Power On Reset	Error Card
RESET	Reset	Error Card
ROW 12	Row 12 From Read Station	Read Station
ROW 11	Row 11 From Read Station	Read Station
ROW 0	Row 0 From Read Station	Read Station
ROW 1	Row 1 From Read Station	Read Station
ROW 2	Row 2 From Read Station	Read Station
ROW 3	Row 3 From Read Station	Read Station
ROW 4	Row 4 From Read Station	Read Station
ROW 5	Row 5 From Read Station	Read Station
ROW 6	Row 6 From Read Station	Read Station
ROW 7	Row 7 From Read Station	Read Station
ROW 8	Row 8 From Read Station	Read Station
ROW 9	Row 9 From Read Station	Read Station
D ROW 12	Row 12 From Data Detector	Data Card
D ROW 11	Row 11 From Data Detector	Data Card
D ROW 0	Row 0 From Data Detector	Data Card
D ROW 1	Row 1 From Data Detector	Data Card

SIGNAL MNEMONICS AND ABBREVIATIONS

MNEMONIC	DESCRIPTION	SOURCE
D ROW 2	Row 2 From Data Detector	Data Card
D ROW 3	Row 3 From Data Detector	Data Card
D ROW 4	Row 4 From Data Detector	Data Card
D ROW 5	Row 5 From Data Detector	Data Card
D ROW 6	Row 6 From Data Detector	Data Card
D ROW 7	Row 7 From Data Detector	Data Card
D ROW 8	Row 8 From Data Detector	Data Card
D ROW 9	Row 9 From Data Detector	Data Card
CLOCK ROW	Clock Row From Read Station	Read Station
CLOCK	Clock From Clock Detector	Data Card
GP ENABLE	Good Pick Enable	Data Card
CRD	Clock Reference Dump	Data Card
DRD	Data Reference Dump	Data Card