## TECHNICAL MANUAL

##  <br>  <br> ||||||||1||||||||1||1 <br> 222222222222222222220 <br> 33333333333333'••• <br> 44441.. <br> D-15 "' CARD READER <br> 1.

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## IMPORTANT NOTICE

THIS TECHNICAL MANUAL IS SUPPLIED WITH DOCUMATION CARD READER SERIAL NUMBER

THIS MANUAL SHOULD REMAIN WITH THAT CARD READER.
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Figure 1-1 Card Reader, D-150 Series

## SECTION I <br> DESCRIPTION

1.1 INTRODUCTION
This manual contains interface, operational and maintenance instructions for the Documation Incorporated Series D-150 Card Readers. (Figure 1-1). In addition to these instructions there is an identification table of parts replaceable by the operator/user.
1.2 SCOPE
1.2.1 The material contained in this instruction manual is directed primarily toward an equipment operator with limited electro-mechanical skill.
1.2.2 This manual consists of seven sections as follows:
a) Section I. Introductory information, electrical description, optional features, and technical characteristics.
b) Section II. Servicing and installation, operating instructions.
c) Section III. Preventive maintenance, lubrication, adjustments and trouble analysis.
d) Section IV. Principles of operation.
e) Section V. Maintenance.
f) Section VI. Schematics.
g) Section VII. Parts list.

### 1.3 DESCRIPTION AND DATA

### 1.3.1 Purpose and Use

The Series D-150 Documation Incorporated card readers are designed to convert information from punched data cards to an electronic signal, which may then be used as an input to electronic data processing equipment. The D-150 family of low speed card equipment is tailored to the needs of the low volumn card user. Applications include program loading, warehousing, office use and data communications.

### 1.3.2 General Operation

The Basic Card Reader is designed to read standard ANSI 12-row, 80 column punched cards. Up to 400 punched cards are loaded in the input hopper. The cards are separated from the stack sequentially, using a side friction picking technique, and moved past a phototransistor read station, where the data is recognized in a serial column-by-column manner. The cards are then deposited in the output stacker 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.

### 1.3.3 Description

The D-150 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 reliable performance, with minimum maintenance. The side friction picking technique will allow end damaged and warped cards to be handled smoothly and quietly. The electronic controls are implemented by standard integrated TTL logic modules on a single printed circuit card to minimize service problems. Infra-red lightemitting diodes and phototransistors are used at the read station to insure longterm reliability in the basic model.

The two models described in this manual are:
a) D 150 Punched Card Reader 12-bit parallel output.
b) DC 150 Punched Card Reader with serial RS-232C output.

## $1.4 \quad \mathrm{C}-150$ OPTION

The EIA standard RS-232C output, on Model DC-150 is provided by the addition of another printed circuit card incorporating the necessary logic circuit elements to convert the data from a parallel to a serial format and provide the required features to permit the D-150 to be used as a terminal device. The C-150 board contains the most up-to-date TTL and MOS circuitry on a standard 150 series sized card. The DC- 150 may interface with any 103 or 202 Series Modem for telephone line communication. The reader may be equipped with the appropriate interface to communicate over lines, up to one-half mile of twisted pair.

The following features are either hardwired or switch selectable. See appendix A for the features incorporated in this unit.
a) Converts Hollerith to one of the following:

1) ASCII
2) EBCDIC
3) Compressed Hollerith
b) Complete record (card) storage for retransmit capability.
c) Transmits data in a record format.
d) Customer selected codes for the following control functions:
4) Start of record (SOR)
5) End of record (EOR)
6) Reader ready
7) Hopper empty
8) Pick one card
9) Resend last record
10) Start auto run mode
11) Stop auto run mode

Note: Any of the above eifht (8) codes must be specified upon order placement.
e) Six standard switch selectable baud rates:

1) $110 \mathrm{Bits} /$ Second
2) $150 \mathrm{Bits} /$ Second
3) 300 Bits/Second
4) $600 \mathrm{Bits} /$ Second
5) $1200 \mathrm{Bits} /$ Second
6) $2400 \mathrm{Bits} /$ Second
f) Switch selectable data format:
7) Parity or no parity
8) Odd or even parity
9) One or two stop bits
10) 5-8 Data Bits/data character
g) Four different signal interface driver/receiver configurations: *
11) EIA. RS232-C (for modem use)
12) Differential (for long distance twisted pair up to 2500 feet)
13) Positive True (for short distance and non-modem)
14) Ground True (for short distance and non-modem)

* Must be specified upon order placement.


### 1.4.1 Record Format

The record format for punched 80 column cards is fixed at 80 data characters per record. Each record is "framed" by special characters referred to as START OF RECORD (SOR) and END OF RECORD (EOR). These two special characters are customer assigned prior to assembly since they are hand-wired into the character generator. However, these character codes may be field changed. Most common of framing characters are: Line Feed (LF) for start of record, and carriage return (CR) for end of record.


80 Column Punch Card Record (82 Character)
The record format for optical mark cards is the same as that of punched cards, except that the data portion is variable in length. * The number of clock marks existing on the edge of this type of card is the number of data characters in the record. The SOR and EOR are the same as described in 1.5.2.


Optical Card Record
*Most cards of this type will have 40 data characters.

### 1.4.2 Data Format

Each character, whether it be a data character, a framing character, or any other special characters, will have the following general format when serially being transmitted.


Each character transmitted always begins with a sync (or start) bit. Immediately following the sync bit is the data character. This character may be five, six, seven or eight bits in length, depending upon the type of coding used. The data length is switch selectable. For example, if ASCII were used, the data character would be seven bits in length.

### 1.4.3 Parity Bit

The parity bit is the bit which follows the data character. The purpose for this bit is error detection. The parity bit may have any of the following forms:
a) Odd Parity: The parity generator inserts a bit (either A " 1 " or A " 0 ") to make the sum of the " 1 "'s in the data bits AND parity bit an odd number. In other words; if the number of " 1 "'s in the data character is even, then the parity bit will also be a " 1 ", causing the sum to be odd.
b) Even Parity: The same as odd, only the sum of the bits will be even.
c) Mark: The parity bit will always be an "1". (For 7 bit codes or less).
d) Space: The parity bit will always be a " 0 ". (For 7 bit codes or less).
e) No Parity: There is no parity bit, and the stop bit (s) immediately follow the data character.

### 1.4.4 Stop Bit (s)

The stop bit (s) are the last two bits or last bit, depending upon how many stop bits are desired.

### 1.4.5 Data Format Option Selection

The number of data bits, the status of the parity bit, and the number of stop bits are all switch selectable on the C150 communications board. To control these functions there is a miniature cluster switch with eight (8) sections (S3). Each section is a separate switch and the sections are all numbered.

Sections 1-5 have the following functional control:

| Section | Position | Function |
| :---: | :---: | :---: |
| S3-5 | ON | Parity check and generator ON |
| S3-5 | OFF | Parity check and generator $\overline{\mathrm{OFF}}$ |
| S3-1 | ON | ODD Parity |
| S3-1 | OFF | EVEN Parity |
| S3-4 | ON | ONE stop bit |
| S3-4 | OFF | TWO stop bit |

The on position is selected by depressing the black dot on the side of the rocker switch.

| S3-2 | $\underline{S} 3-3$ | Bits/Character |
| :--- | :---: | :---: |
| ON | ON | Five |
| OFF | ON | Six |
| ON | OFF | Seven |
| OFF | OFF | Eight |

Note 1
If odd, even, or no parity is selected, then the receiver also checks the same parameters as the transmitter generates. The same is true with the number of data and stop bits.

Note 2
To generate a mark or space for the parity bit, a jumper wire must be added and the parity generator turned off. When this is done, the receiver does not check any parity, but the transmitter will always generate the mark or space (Whichever is selected) for the parity bit.

### 1.4.6 Control Characters

There are two types of control characters used in this system. The first type is those characters which are transmitted to the receiving end device from the card reader in indicate some condition other than data. Two of these "special" characters have already been mentioned, (SOR and EOR). The other two special characters of this first type are also customer selected (coded) and they indicate the following conditions:
a) Ready

When the reader "START" pushbutton is depressed indicating that the reader is ready to transmit, a special character is sent to the end device to indicate this condition.
b) Hopper Empty

Immediately after the last card in a deck has been transmitted, there will be another special character generated and transmitted to the end device to indicate the hopper empiy and the end of transmission this character is also customer coded.

;The second type of control signal is those which are sent to the card reader from the end device. There are four different commands which perform the following functions and are all customer coded:
a) Pick

Each time a coded character assigned to be decoded as pick it is received by the reader, the reader will pick, read, and transmit ONE complete card.
b) Resend

Since the reader stores the entire record of a card which is being transmitted, there exists the capability of Retransmitting the transmitted record between Pick commands.
c) Auto Run (or Auto Start)

If the user does not care to issue a pick command to initiate each record, a coded character may be sent to the reader to automatically send record after record. The reader will not stop until the hopper goes empty or the reader receives an AUTO STOP command. A motion check or read check will also stop the auto read.
d) Auto Stop

A coded character sent to the reader to take it our of the Auto Run mode.

### 1.4.7 Data Rate

The rates at which data is transmitted are all universally accepted baud rates. There are presently six standard baud rates, all switch selectable, incorporated into the communication board. These are 110, 150, 300, 600, 1200 and 2400 bits per second. There is an 8 -section cluster (S2) switch used to select the desired baud rate. Each section is a separate numbered switch selecting a unique baud rate. There are two spare sections which may be used to select customer special customer special baud rates. ONLY one section inúst be oñ at one tinie.

| $\mathrm{S} 2-4-110 \mathrm{~B} / \mathrm{S}$ | $\mathrm{S} 2-2-1200 \mathrm{~B} / \mathrm{S}$ |
| :--- | :--- |
| $\mathrm{S} 2-6-150 \mathrm{~B} / \mathrm{S}$ | $\mathrm{S} 2-1-2400 \mathrm{~B} / \mathrm{S}$ |
| $\mathrm{S} 2-5-300 \mathrm{~B} / \mathrm{S}$ | $\mathrm{S} 2-7-$ Spare |
| S2-3-600 B/S | S2-8 - Spare |

### 1.4.8 Interface Signal and Connector

The serial interface is composed of three types of signal lines:
a) Data Lines
b) Communications control lines
c) Signal and protective common return lines

All these lines are as outlined in the EIA-RS232-C Specification and are as listed below.
a) Transmitted data (data out) (BA)
b) Received data (data in) (BB)
c) Request to send (control) (CA)
d) Clear to send (control) (CD)
e) Data Terminal ready (control) (CD)
f) Data set ready (control) (CC)
g) Signal ground (common return) (AB)
h) Protective ground (AA)
() - RS232-C circuit reference
The connector used by Documation for the serial interface is a universallyaccepted 25 -pin female connector. The pin assignments are again as perthe EIA RS232-C specification and are as follows:
Pin No.
1 - Protective Ground2 - Transmitted Data3 - Received Data4 - Réquest to Send
Pin No.
5 - Clear to send
6 - Data Set Ready
7 - Signal Ground20 - Data Terminal Ready

### 1.5 TECHNICAL CHARACTERISTICS

Table 1-1 lists the technical characteristics of the D-150 series Card Reader.

## Table 1-1 Technical Characteristics

## CARD CAPACITY

CARD RATE

CARD TYPE

## CONTROL

## INPUT

Pick Command (PC)

## OUTPUT

Data Lines and
Interface Signal

POWER

## SIZE:

Height
Width
Depth
Stacker

SHIPPING WEIGHT
OPERATING ENVIRONMENT
Dry Bulb Temperature
Relative Humidity
Wet Bulb Temperature
Thermal Shock
Altitude

STORAGE ENVIRONMENT:
Dry Bulb Temperature Relative Humidity
Altitude

Hopper/Stacker 400 cards

220 cards per minute
Standard ANSI 80 column card or Mark Sense card or specified in para. 1.4

Demand feed, one card at a time under external program control. Continous run if Pick Command remains true.

Logic True 1 microsecond -15 MaDC @ 0.8 VDC Max.

TTL Type 7417
I Source 2.2 MaDC
I Sink -15 MaDC @ 0.40 VDC Max. (see para. 1.5 for $D C-150$ output)
103.5 to $126.5,57$ to $63 \mathrm{~Hz}, 165 \mathrm{VA}$
8.5 inches

11 inches (w/o stacker)
18.25 inches

8 inches

45 pounds

50 to $100^{\circ} \mathrm{F}$.
30 to $90 \%$ non-condensing
$80^{\circ} \mathrm{F}$. max.
$15^{\circ} \mathrm{F}$. per hour
1000 feet below to 6000 feet abcve sea level
-25 to $+135^{\circ} \mathrm{F}$.
5 to $95 \%$ non-condensing
1000 feet below to 12,000 feet above sea level

## Table 1-1 Technical Characteristics (Cont.)

## CARD STOCK

The card must meet American National Standard's Specification ANSI X3.11-1969, Specification for General Purpose Paper Cards for Information Processing.

PUNCH DATA

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

## SECTION II INSTALLATION AND OPERATING INSTRUCTIONS

### 2.1 INTRODUCTION

This section contains procedures for unpacking, inspecting, installing and operating the Series D-150 card readers. Upon receipt of the unit, inspect the outside of the container and report any damage to the carrier immediately.

### 2.2 UNPACKING PROCEDURES (Figure 2-1)

Unpack the D-150 card reader as follows:
a) Remove tape and bands from cartons and open flaps.
b) Remove upper half of styrofoam inner container to expose card reader and assessories.
c) Remove power cord, hopper follower weight and operator's manual from container.
d) Lift unit out of the container.
e) Unpack and attach stacker and card depressor to unit. (Attaching hardware in plastic bag.)

After unpacking, inspect the exterior of the unit for any surface damage which may indicate probable damage to the internal electronic or electromechanical components. Report any damage to Documation Incorporated, P. O. Box 1240, Melbourne, Florida. Verify contents against shipping document.

### 2.3 INSTALLATION

Figure 2-2 illustrates the physical dimensions of the D-150 card reader which govern the placement of the unit. Place the unit as close as possible to the associated data processing equipment. Six inches minimum space should be provided at the rear of the unit for proper ventilation.

### 2.4 INTERFACE AND POWER CONNECTORS

2.4.1 A 38-pin output connector provides access for all control, data and alarm signal lines. 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. With insert pins \#60-8017-0513. This connector is available from Documation Inc., and is shipped unassembled, as a kit, with connector base, cover and 38 solder-


Figure 2-1 Unpacking the D-150 Card Reader


Figure 2-2 Installation Requirements
type pins. A multiconductor cable must be prepared for the interface of the Card Reader and the Control Equipment. Figure 2-3 illustrates the interface cable and table 2-1 lists the pin function assignments. Twisted pairs AWG \#22 color coded wires should be used for the cable fabrication. P2 for the interface cable should be a matching connector for the existing equipment. Refer to the table of technical characteristics for logic interface requirements.
2.4.2 The power connector is CORCOM part No. 6EFl. The mating connector is part of the (supplied) standard accessory power cord BELDEN part No. 17250-C.

### 2.5 CONTROLS AND INDICATORS

Figure 2-4 and Table 2-2 illustrate and list all the controls and indicators of the $\mathrm{D}-150$. The operator should become familiar with their location and function prior to placing the unit in operation.
2.6 PRE-OPERATIONAL PROCEDURES

Table 2-3 lists the necessary steps that should be performed prior to operating the reader to insure that all controls and monitors are functioning pronerly: The steps constitute a complete pre-operational check of the unit. If your unit is equipped with the $\mathbf{C}-150$ option, see Appendix A for proper setting of Data Format selection switches and Data Rate switches.
2.7 NORMAL OPERATING PROCEDURES

The normal operating procedures listed in Table 2-4 are to be used as a guide for daily operation of the equipment.

### 2.8 MINOR MALFUNCTIONS

;
During operation of the Card Reader, minor troubles may develop which can be remedied by the operator. The unit will automatically stop if a card fails to feed, or be read, correctly, or the input hopper is empty. Procedures for correcting a minor malfunction are presented in Table 2-5.

CAUTION
SOME OF THE MOST COMMON CAUSES
OF MALFUNCTION ARE PAPER CLIPS
OR STAPLES ATTACHED TO CARDS.
MAKE SURE THAT NO FOREIGN ITEMS
ARE ATTACHED TO THE CARDS OR
PICKED UP WITH THE CARDS AND
ALLOWED TO ENTER THE FEED AND
READ AREAS OR DAMAGE TO THE READ
STATION MIGHT RESULT.


FIGURE 2-3 INTERFACE CABLE

Table 2-1 Interface Connector Pin Assignment

| 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)/GND | Signal Ground |
| K | D2 | Row 2 Data | FF | RDY (RET) |  |
| L | D3 | Row 3 Data | HH | ERROR | Error |
| M |  | 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) |  |



FIGURE 2-4 CONTROLS AND INDICATORS (See Table 2-2)

Table 2-2 Controls and Indicators (See Figure 2-4)

| REF. | NAME | DESCRIPTION | FUNCTION |
| :---: | :---: | :---: | :---: |
| 1 | POWER | White - Alternate action switch/indicator | When lighted energizes drive motor and power supply |
| 2 | START | Green - Momentary action switch/indicator | When lighted indicates reader ready to receive pick command. |
| 3 | STOP | Red - Momentary action switch/indicator | When lighted, will override the pick command. Card reader will stop operation after card currently in track is read completely. |
| 4 | HOPPER CHECK | Amber - Alarm indicator | When illuminated, indicates that the input hopper is empty. Pick motor will stop. |
| 5 | READ CHECK | Amber = Alarm indicator | When illuminated, indicates that the card just read may be torn on the leading edge or have punches in the 0 column. Will cause the reader to stop. |
| 6 | MOTION CHECK | Amber - Alarm indicator | When lighted, indicates the last card has not cleared the card track or a card has not passed the throat knife. |
| 7 | AC RECEPTABLE | Polarized AC | AC power input |
| 8 | CIRCUIT BREAKER | 3A Main Power Breaker | Circuit protection when tripped a red band is exposed. Wait on minute, push to reset. |
| 9 | FUSE | 1A Buss Fuse | DC Power Fuse |
| 10 | RECEPTABLE | Interface Connector | Provides for input/output signal interconnect. |


| STEP | ACTION | NORMAL INDICATIONS |
| :---: | :---: | :---: |
| 1 | Verify that the input hopper and output stacker are free of foreign matter. |  |
| 2 | Remove hopper card follower weight. |  |
| 3 | Wipe interior of input hopper and output stacker with soft, lint-free cloth. |  |
|  | CAUTION <br> DO NOT USE ANY CLEANING FLU WHICH MAY DAMAGE PLASTIC OR RUBBER LIKE MATERIALS. ONL MILD SOAP SOLUTION SHALL BE AS A CLEANING AGENT. | S <br> A <br> SED |
| 4 | Clean the exterior of equipment and all plastic surfaces covering the indicators. |  |
| 5 | Use a small soft bristle brush to clean dust from the surfaces of the read station and card track area. |  |
| 6 | Plug in power cord at rear of unit and verify that the power mains are of the proper voltage and frequency. ( $115 \pm 11.5$ VAC 60 Hz ) |  |
| 7 | Verify that the circuit breaker is set by pushing button in. |  |
| 8 | Connect AC power cord to the power outlet |  |
| 9 | Connect the interface connector between the card reader and the data processor. |  |
| 10 | Activate POWER switch | Indicator illuminates, main |
|  |  | HOPPER CHECK indicator illuminates |
|  |  | STOP indicator illuminates |

Table 2-3 Pre-Operational Procedures (Cont.)

| STEP | ACTION | NORMAL INDICATIONS |
| :---: | :---: | :---: |
| 11 | Prepare a card deck for use by manually flexing <br> and ruffling. |  |
| 12 | If a group of cards is severely bowed or <br> warped, manually bow them in the opposite <br> direction to reduce the possibility of feed <br> malfunction. |  |
| Prepare a check card by cutting a portion of the <br> leading edge of a new card and place it near the <br> beginning of the deck. <br> Tamp the cards square against the card tamper <br> on top of the unit. <br> Fill the input hopper with prepared cards (400 <br> maximum), printed side down, column one to <br> the left. Place the hopper card follower weight <br> on top of the card deck. <br> Depress START switch. | Picker motor starts. |  |

Table 2-3 Pre-Operational Procedures (Cont.)

| STEP | ACTION | NORMAL INDICATIONS |
| :---: | :---: | :---: |
| 16 | Request the data processor operator to initiate a pick command. | Upon receipt of the pick command the card reader will start processing the card deck as programmed until the check card (damaged card) is reached. <br> START indicator extinguished. READ CHECK indicator illuminates, STOP indicator illuminates and the unit will stop. Verify that the fault indications; are present at the data processor equipment. |
| 17 | Remove the check card from the stacker and press the START switch. | START switch illuminates, READ CHECK indicator exting-uishes, STOP indicator extinguishes, and the card reader will resume processing the cards. |
| 18 | Apply downward finger pressure to the card follower weight to stall the feed action. | START indicator extinguishes, MOTION CHECK indicator will illuminate, STOP indicator illuminates and the unit comes to a stop condition. |
|  |  | The proper fault indicator lights at the data processing equipment. |
| 19 | 'Release pressure from the card deck and press the start switch. | START indicator illuminates, MOTION CHECK indicator extinguishes, STOP indicator extinguishes and the reader will resume processing the card deck. |
| 20 | Allow the unit to complete processing the card deck. | After the last card, the HOPPER CHECK and STOP indicators illuminate and the START indicator extinguishes. |
| 21 | Request that the data processor operator verify that all data entries are correct. |  |

Table 2-4 Normal Operation

| STEP | ACTION | NORMAL INDICATIONS |
| :---: | :---: | :---: |
| 1 | Verify that the input hopper and output stacker are clean of foreign matter. |  |
| 2 | Remove input hopper card follower weight. |  |
| 3 | Prepare the card deck to be processed by manually flexing and ruffling. |  |
| 4 | Tamp the cards square against the card tamper on top of unit. |  |
| 5 | Fill input hopper with the prepared cards (400 maximum), printed side down, column 1 to the left. Place the hopper card follower weight on top of the card deck. |  |
| 6 | Make sure the power cord is plugged in and the interface cable is connected between the card reader and the control equipment. |  |
| 7 | At the Control Panel, press POWER switch/ indicator. | POWER indicator illuminates, STOP indicator illuminates, drive motor starts, pick motor starts. |
| 8 | Press START switch/indicator | START indicator illuminates to signal that the unit is ready to |
|  | If any of the check indicators (malfunction) are lighted, take the necessary steps to eliminate the problem before continuing to the next step. (See Table 2-5, Minor Malfunction Correction.) |  |

Table 2-4 Normal Operation (Cont.).)



Table 2-5 Minor Malfunction Correction (Cont.)

| INDICATION |  | CORRECTIVE ACTION |
| :---: | :---: | :---: |
| 4. | Unit halted: <br> a. STOP indicator "OFF" <br> b. HOPPER CHECK indicator "lighted" <br> c. READ CHECK indicator lighted <br> d. MOTION CHECK indicator lighted | Replace STOP indicator lamp. (DS3) <br> 1) Refill input hopper. <br> 2) Verify card follower weight is in place <br> 1) Check the last card in output stacker for damage. <br> 2) Duplicate as required and replace at bottom of the input hopper. <br> 3) Restart the unit. <br> 1) Check bottom card in input hopper for damage or two cards stapled or clipped together. If the card damage is mild, it may be possible to straighten the card with hand by "ironing" the card gently across the back edge of the cabinet. Remove any creases using the back of the thumbnail with the card lying flat on the top cover of the unit. |

# SECTION III <br> OPERATOR MAINTENANCE 

### 3.1 INTRODUCTION

This section contains maintenance information for the Series D-150 card readers. These units are of rugged construction and are designed to provide many hours of reliable operation, as such, preventive maintenance is the primary consideration.

### 3.2 PREVENTIVE MAINTENANCE

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that breakdowns and needless interruptions in service are kept ot a minimum. The main object is to prevent certain troubles from occurring.
3.3 GENERAL PREVENTIVE MAINTENANCE TECHNIQUES
a. Use a clean, dry, lint-free cloth or a dry brush for cleaning, If necessary; except for electrical contacts, moisten the cloth or brush with a mild soap solution; after cleaning, wipe the parts dry with a cloth.
b. Tighten screws, bolts and nuts carefully. Fittings tightened beyond the pressure for which they are designed will become damaged or broken.
c. Table 3-1 is a preventive maintenance checklist to be used by the operator as directed. References in the ITEM column refer to paragraphs in test which contain required detailed or additional information. It is recommended that the table be reproduced and used as a weekly maintenance log.

### 3.4 INTERIOR CLEANING AND LUBRICATION

3.4.1 Every six month or 1500 hours of operation the top and bottom covers of the unit should be removed and a detailed inspection and cleaning should be performed. To remove the covers proceed as follows:
a. Remove the power cord and interface cable from unit.
b. Remove the four retaining screws from the top covers (figure 3-1 item 1) with a $3 / 32^{\prime \prime}$ Allen wrench and remove top cover.
c. With the $3 / 32^{\prime \prime}$ Allen wrench, remove the six retaining screws (figure $3-1$ item 2) and remove the bottom cover.

TÁBLE 3-1 OPERATOR MÁNTENANCE CHECKLIST


MONTHLY

| No. | ITEM | Condition |
| :---: | :--- | :--- |
| $\mathbf{5}$ | Inspect fuse holder for corrosion |  |
| 6 | Clean and tighten exterior components |  |
| $\mathbf{7}$ | Inspect case, mountings and exposed metal for dirt and moisture |  |
| 8 | Inspect exterior cables for cuts, breaks, fraying, deterioration, <br> kinks and strain <br> If cleficiencies are noted and not corrected during inspection, <br> indicate action taken for correction |  |



Figure 3-1 Card Reader 3/4 Front View
3.4.2 With the machine exposed, check all visible moving parts for wear, noticeable defects, and excessive accumulation of foreign matter. Also check for loose pulleys and shafts paying particular attention to the drive pulleys and timing belts. Turn the driver power train by hand while making this inspection. Make a visual check of all polyurethane or rubber rollers for excessive wear or grooves. Report any parts that show excessive wear to your maintenance section.

### 3.4.3 Completely clean the unit as follows:

a. Using a small, soft bristle brush, remove all dust, card stock lint and all foreign matter from the exposed surfaces of the unit. If a low pressure (less than 30 psi ) air hose is available, blow out the accumulated card chaff. A vaccuum cleaner may also be used to clean the unit if there is a large amount of accumulated dust.
b. Turn the unit upside down and clean the two polyurethane rollers in the card transport area. To remove accumulated ink or other foreign matter, dampen a cloth in soapy water and wrap it around the index finger. Hold the finger against the roller surface and turn the drive belts slowly by hand to rotate the rollers.

## CAUTION

DO NOT USE ANY CLEANING FLUID ON
SYNTHETIC OR PLASTIC SURFACES AS DAMAGE WILL OCCUR.
c. Use the same procedure as in (b) above to clean the picker wheel.
d. Remove all foreign matter from the fan blades and the rear air screen.
3.4.4 To clean the Picker and Pinch Roller Solenoid plunger and housing proceed as follows:
a. (Refer to figure 3-2) Using your thumb and forefinger, exert downward pressure on the picker solenoid return spring (1) and remove it from the notched pin at the picker rocker arm.
b. Using the same procedure as (a) above, remove the lower end of the pinch roller return spring from its retaining pin (2).
c. Disconnect the picker solenoid electrical plug (item 3, figure 3-2) from its jack.
d. Remove the two retaining screws from the picker solenoid housing (4) and pull the housing away from its plunger.

NOTE

> In the following steps, it is not necessary to lubricate the solenoids or their plungers. Cleaning to remove accumulation of dirt is all the maintenance required.
e. With a clean, dry, lint-free cloth, wipe the interior of the solenoid housing and the solenoid plungers until they are free from all foreign matter. Reinstall all components except the pinch roller return spring.
f. Disconnect the pinch roller solenoid electrical connector from its jack.
g. Remove the two retaining screws that hold the pinch roller solenoid in place (5), and pull the housing away from its plunger.
h. Clean the plunger and the solenoid interior and reinstall.
i. Reinstall the pinch roller return spring, insuring that it snaps into the groove of the retaining pin.
3.4.5 Lubricate the drive and picker motors (figure 3-2) as follows:

CAUTION

DO NOT OVER OIL THE MOTORS. THIS COULD CAUSE DETERIORATION OF THE INSULATION IN THE FIELD WINDINGS AND MOTOR FAILURE.
a. Every 4,000 hours or yearly, whichever comes first, add 3 to 4 drops of SAE 20W non detergent oil to each of the two oil points of the main drive motor (6) and the picker motor (7).
b. Wipe any oil spill from the unit to avoid accumulation of dust.
3.4.6 Clean the interior of the unit top and bottom covers and reinstall on the unit.
3.4.7 Reinstall the reader in its operating configuration and perform a pre-operational check (Paragraph 2.6 and Table 2-3).


FIGURE 3-2 CARD READER BOTTOM INTERIOR VIEW


FIGURE 3-3 CARD READER TOP INTERIOR VIEW

# SECTION IV <br> PRINCIPLES OF OPERATION 

### 4.1 INTRODUCTION

This section contains a block diagram discussion of the card reader, a detail functional description and functional diagrams to enable the service personnel to familiarize themselves with the unit operation.

### 4.2 BLOCK DIAGRAM DESCRIPTION

The block diagram for the $\mathrm{D}-150$ and the $\mathrm{DC}-150$ card readers is shown in figure 4-1. The description that follows applies to both readers since the reliable recovery of data from cards passing down the card track is accomplished in the same manner.

### 4.2.1 Timing and Synchronization

The heart of the card reader electronics is the control and sync logic, where the internal logic timing and the movement of the card past the read station are synchronized to enable accurate sequential interpretation of the data on the card. Primary logic timing is established by a 1.2 MHz oscillator and the associated three phase clock logic, whose outputs are used to shift, store and control other timing operations. Card movement speed is established by the hysteresis synchronous drive motor. Synchronization is accomplished by a notched ferrous timing disc attached to one of the drive roller shafts. As the timing disc rotates, a reluctance pickup senses the movement of the disc's notches past the pickup producing timing signals. These signals are used by the Control and Sync Logic to generate Data Strobes (CSDS) for each of the 80 columns of the punched card.

### 4.2.2 Pick Action

When a PICK COMMAND is received from the external program control, card processing will be started provided no alarm conditions exists, with the cards in the input hopper, and the reader powered up. The Pick Control logic then produces a PICK signal to the Solenoid Driver and a Pick Command Reset (PCR) to the sync control. These actions initialize the various control circuits and energize the solenoid to pick a punched card from the input hopper. When the card reaches the pick sensor, an optical switch will activate, generating a. pinch command, to energize the pinch solenoid. The card is pinched and smoothly accelerated into the constant speed drive rollers.


Figure 4-1 Block Diagram

The Read Station and pick sensors utilize phototransistor to read the card's hole pattern and to monitor the card's movement. When a card is pinched and moved into the card track, the leading edge interrupts the light to the Read Station. This produces a ONE DARK signal that is used by the Control Logic to generate a Good Pick Reset (GPR) which initializes the synchronization of the card's movement through the Read Station. A Column Counter then counts columns via the Control and Sync Logic as the card moves past the Read Station, thus synchronizing the mechanical card movement with the electronic circuits. The Column Counter generates a DARK CHECK at Column 0 and a Light Check at Column 84. Figure 4-2, Timing Relationship for Standard Card, shows these check positions. These checks provide a quality check on both the Read Station and the mechanical card movement.

### 4.2.3 Data Detection

As the card passes between the Light Emitter Diodes (LEDs) of the Light Station and the Phototransistors of the Read Station the light and dark conditions are sensed and amplified by the Read Station's phototransistors. The light (punched hole) and dark conditions are converted to electronic signals at the Phototransistor's emitters and used to drive the Data Amplifiers and Inverters. Output of the Data Amplifiers and Inverters pass through the all Light/all Dark inverters and provide detected data to the Data Register.


Figure 4-2 Timing Relationship for Standard Punched Card

### 4.2.4 Data Storage

To accomplish Data Storage, the Control and Sync Logic sends Synchronized Data Strobes (CSDS) to the Data Register at predetermined punched column positions. Data Storage includes Data Drivers that provide buffering between the Data Register and the interface lines or the communications electronics in the DC-150 model.

### 4.3 DETAIL FUNCTIONAL DESCRIPTION

The following gives a detailed, functional description of the D-150 Card Reader. The description is designed to give the reader an in-depth understanding of how the Card Reader works. The reader should familiarize himself with the signal mnemonics used in the text description since it will aid in interpreting both the description that follows and the logic schematics in Section VI.

### 4.3.1 AC Power Distribution

Figure 6-1 illustrates the AC power distribution in all the D-150 series card readers.

AC power is brought in, to the reader, via the connector filter assembly (J1/FL1), which functions to suppress conducted RF interference. The power is then routed thru the main circuit breaker (CB1), the POWER switch (S1), to a terminal board (TB1).

From TB1, AC power is run to the drive motor (B1), to the pick motor (B2) and to the +5 V power supply via fuse (F1). In models equipped with the C-150 option, jumpers are provided in connector P8 to bring AC power for the $\pm 12 \mathrm{~V}$ power supply required in these units.

### 4.3.2 DC Power and Signal Distribution

The +5 V power supply is wired to J 3 at the card cage to provide +5 V logic power to the $\mathrm{D}-150$ board. The +12 V power supply is wired to J 1 at the card cage to provide power to DC-150 card readers. Refer to figures $6-3$ and $6-4$ for the appropriate PC card wiring diagrams of your reader. The illustrations also present the wiring of the control functions and the input and output signals.

### 4.3.3 Reader Control and Error Logic

4.3.3.1 Reader control starts with the application of power to the reader. When the logic power comes up, the +5 VDC (VCC) applies to the Power On Reset Logic to generate POR. (Refer to Figure 4-3).

POR is used to initialize the Pick and Pinch Logic and the timing and synchronizing logic. POR OR'ed with RESET to form POR + RESET to initialize the Control Logic. The reader is now brought to the ready state by the operator depressing the START switch, which activates the Reset Control Logic. RESET is routed to initialize the Pick Logic and Column Counter and activates the POR + RESET signal to the Error Logic. The Reset Control is designed to ignore all RESET switch signals while a read cycle is in progress.

Reader READY is signalled to the controlling device by the CONTROL Logic when the START Switch is depressed provided HOPPER CHECK is not being presented by the Error Logic. (All other Error Logic Check signals will be reset by POR or RESET.) Reader READY is indicated to the operator by the START Switch illuminating. 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 CHECK signal from the Error Logic or if the STOP Switch is depressed by the operator and RESET INHIBIT is not present. The Stop Control Logic gates the STOP SWITCH CLOSURE signal with RESET INHIBIT, preventing READY from being reset due to STOP during a card read cycle. RESET INHIBIT, generated by the Reset Control, is set by PCEN and reset by CR, these signals identify the beginning and end of a read cycle. The Stop Condition is indicated by the STOP switch illuminating.
4.3.3.2 The Error Logic of Figure 4-3 contains the error/alarm detection circuits.
${ }^{\text {B }}$ Once a PICK CMD is accepted by the reader, the Error Logic is sampled at intervals of card processing for error and reader conditions. These error/ reader conditions are referred to as CHECK CONDITION. Should a CHECK CONDITION occur, the reader READY will go low. The first test is Pick Check. If a PSET is signalled, a Motion Check (MOCK) will be sent to the controlling device. PSET will occur approximately 250 m sec after PICK CMD was received. Pick Check will be signalled to the operator by the MOTION CHECK control panel indicator. If PICK CHECK does not occur, a read cycle will be in process and OCR will sample the Dark Check circuit. Should ONE LIGHT be present during the check, indicating a failed LED, phototransistor, or a torn card leading edge, a READ CHECK signal will be sent to the controlling device and READY dropped. The reader control panel will indicate READ CHECK.


Figure 4-3 Control \& Error Logic (Simplified)

The Hopper Empty circuit senses closure of the Hopper Empty microswitch. This switch is located under the CARD STACK and senses when the last card has left the Hopper. Hopper Empty is signalled to the controlling device and READY is reset. Hopper Empty is signalled to the operator by the HOPPER CHECK indicator.

CR occurs next in the read cycie and samples the Light Check circuitry. A ONE DARK present at CR indicates a failed LED or phototransistor or excessive card slip in the read track. This error is signalled to the controlling device as a READ CHECK and the READY line is reset. The reader control panel will indicate READ CHECK.

All error conditions are cleared by depressing the START switch to generate the Reset signals.

### 4.3.4 1.2 MHz Oscillator and Three Phase Generator

The block diagram and timing diagram for the 1.2 MHz Oscillator and Three Phase Generator is shown in Figure 4-4. The oscillator provides a TTL compatible 1.2 MHz squarewave as an output. The 1.2 output is divided by a two stage counter and the counter's 300 KHz output used to drive the Three Phase Generator. The generator then divides the 300 KHz by four, generating signals that are gated as $\emptyset \mathrm{B}, \emptyset \mathrm{C}, \emptyset \mathrm{D}$ and C 1 as shown by the timing diagram of figure $4-4 .{ }^{\circ} \emptyset \mathrm{B}, \emptyset \mathrm{C}, \emptyset \mathrm{D}$ and C 1 are used throughout the reader as a timing source.

### 4.3.5 Pick and Pinch Functions

Pick and Pinch functions are the same on all models of D-150 series card readers operational description as follows:

The unit will create a Power On Reset (POR) upon activation of the POWER switch which will normalize all the logic circuitry. The START switch will reset all error indications and the unit will be ready for operation.

When operating in the remote mode, an external program must generate the PICK COMMAND. Refer to figure 4-5.

When the external program pick command is received the pick control logic initiates the pick sequence by gating a clock signal (C1) to produce the Pick Command Enable pulse (PCEN). The positive transition of the PCEN signal will cause the logic "O" present at input "D" of the pick flip-flop, to be transferred to output " $Q$ ". This output at " $Q$ " energizes the pick solenoid via the solenoid driver. The action of the pick wheel will move the bottom punched card into the card track. Note that the output of the Pick F/F is also routed to a time delay multivibrator ( 250 m sec ) to disable the Pick Set gate ( $\overline{\mathrm{PSE}}$ ).


 (8D-6)

75 KHz

( $8 \mathrm{C}-8$ )

NUMBERS INDICATE IC LOCATION AND PIN WHERE WAVEFORM CAN BE MONITORED.

Figure 4-4 Oscillator and Three-Phase Generator


Figure 4-5 Pick and Pinch Control Functions (Simplified)

If the card fails to reach the pick sensor in 250 milliseconds, the time delay multivibrator will generate a logic " 1 " to enable the PSET gate. The other inputs to the gate come from the " $\bar{Q}$ " output of the Pick F/F and the clock ( $\varnothing \mathrm{D}$ ) so that at the next positive clock transition, the $\overline{\text { PSET }}$ signal will be sent to the error control logic to generate a Motion Check (MOCK) signal to stop the reader and light the alarm indicator. The error control logic will also generate the STOP signal to preset the Pick F/F and release the pick solenoid.

In normal operation, Power On Reset or activating the start switch, caused flip-flop 4D-6 to preset. The $\overline{\mathrm{Q}}$ output is used to inhibit an eight bit binary counter and preset flip-flop $4 \mathrm{D}-8$. When the card reaches the pick sensor, the optical switch goes dark and its output is conditioned and used to set flip-flop $4 \mathrm{D}-6$, the Q output enables the 8 bit Binary Counter to start to count. To establish the counting rate, the clock signal (C1) is divided by a decade counter and the 7.5 KHz signal is used to increment the eight bit binary counter. When the count reaches 32 ( 4.26 M sec . after pick sensor), bit six is used to preset the pick flip-flop and deenergize the pick solenoid. The $\bar{Q}$ output of the pick flip-flop is inverted and used as a pick command reset signal ( $\overline{\mathrm{PCR}})$. At count 256 (all zeros, 34 M sec . after pick sensor), flip-flop 4D-8 is clocked and the $\bar{Q}$ output conditions the data input of the Pinch F/F. The next positive transition of the clock ( $\boldsymbol{q}_{\mathrm{D}} \mathrm{B}$ ) will cause the $\bar{Q}$ output of the pinch flip-flop to go to logic "O" energizing the pinch solenoid, via the solenoid driver, causing the picked card to move along the card track. The Q output of the pinch flip-flop is used to inhibit the pick command when the pinch solenoid is active. If the card fails to reach the read station in 250 milliseconds, the pinch set (PINSET) signal will be sent, causing the error logic to generate the STOP 2 signal. The STOP 2 signal gated with BUSY, will cause the Pinch F/F to clear, releasing the pinch solenoid. Under normal conditions, when the column counter generates $\overline{81 C \bar{R}}$ the pinch circuits will be cleared for the next cycle.

### 4.3.6 Timing and Synchronization

Synchronization of the timing signals and the mechanical card movement, starts with the generation of the Good Pick Reset signal (GPR). When the pick flip-flop is preset, terminating the pick action, a Pick Command Reset signal is sent to the timing and synchronization control logic (refer to figure 4-6), to enable the good pick reset generator. When the leading edge of the punched card reaches the read station, the first phototransistor to go dark will cause the data detectors to generate the ONE DARK signal, which is used by the Good Pick Reset generator to initiate the $\overline{G P R}$ signal.


Figure 4-6 Timing \& Synchronization (Simplified)

The GPR signal will last for the time interval between clock $\emptyset \mathrm{D}$ and next $\varnothing \mathrm{C}$ ( $10 \mu \mathrm{sec}$ ) and will perform the following functions:
a) Load the Preset Counter (220 octal)
b) Enable the timing strobe (TSTR) gating structure to load the Preset Store at next TST2 signal (001 octal)
c) Load the Offset Counter (000 octail)
d) Reset the Column Counter (000 octal)
e) Enable the Preset/Offset clock (PR/OSCLK)

### 4.3.6.1 Sync Control Logic

The Sync Control logic (figure 4-6) provides data readout synchronization from the timing disc. The timing disc is mounted on the same shaft as the first capstan roller. This capstan roller engages the card as it is pinched and thereafter determines the speed at which the card will be moved through the card track. The asynchronous card pick and pinch sequence causes the card to arrive at the read station at an arbitrary time in relation to the timing disk. The edge of the ferrous alloy timing disc is provided with gear-type serrations such that two flux reversals occur for each column of data on the card track. These are sensed by the magnetic pickup and its associated amplifier to produce two TST1 signals for each column of data.

The TST1 signals produced by the timing disc pickup amplifier are gated with the internal logic clock to produce the TST2 signals as positive-going, 13.3 microsecond output pulses that are phased to $\emptyset \mathrm{C}$ of the three phase clock.

From figure 4-2 it can be seen that the first one-quarter inch of a punched card, (which contains no data per EIA standard) could have two data columns punched into it. The reader logic assumes the presence of these columns as if they do exist and they are called column $0^{\prime}$ (first pseudo-column occurring after the leading edge) and column 0 (second pseudo-column).

When GPR occurs, the sync logic will be conditioned to gate clock signal ( $\overline{\mathrm{C} 1})$ as a Preset and Offset clock (PR/OSCLK).

This clock signal is used to increment the Preset Counter. The Preset Counter is used to produce the delay necessary while the card moves the distance from the leading edge of the card to the beginning of pseudo-column 0 '. The occurrence of the GPR signal was used to "jam" set a hard-wired binary value into the Preset Counter and then when PR/OSCLK is enabled, the counter counts up to all one's. This $\overline{\mathrm{ZERO}}$ value is detected and defines the beginning of pseudocolumn $0^{\prime}$.

Since the leading edge of the card may arrive at the read station at an arbitrary time in relation to the TST signals, it is necessary to determine this "offset" so that later data column strobes generated from the occurrence of the TST1 signals will continue to be offset by the same amount for all 80 columns of that particular card. It should be noted that this offset interval between TST and the data column strobes will be different for each successive card, but is constant within each card.

These circuits count and store the time interval between the TST2 signal and the end of preset interval (i.e., beginning of pseudo-column $0^{\prime}$ ). If two TST2 signals occur before the preset timing is complete (as indicated by generation of ZERO), the second TST2 resets the Offset Counter and its counting begins again (i.e., the shortest time interval between TST2 signals and end of preset timing is always selected). This "offset" interval is the synchronizing point that established the beginning of each of the remaining 80 data columns on that particular card.

The initialization reset for the Offset Counter is produced by TSTR, which is generated by the first and/or second TSTR signal after GPR but before ZERO occurs. After the preset timing ZERO is produced, the PR/OSCLK, and TSTR circuits are inhibited until the next GPR is generated; however, the second, fourth, sixth, etc., TST2 signal after ZERO is used to produce the OSR and OSUCLK signals. These two signals enable the Offset Comparator circuits to reproduce a time interval equal to the original offset count for each of the 80 columns of data in a punched card.

The OSR signal, which is raised by the second, fourth, etc., TST2 signal after the ZERO detect point occurs, allow the Offset Counter to be up-counted by the OSUCLK signal from sync control. A seven-stage, parallel comparator circuit recognizes when this count has equalled the binary value stored in the seven;stage offset counter. This up-count interval is regenerated 80 times as the card moves past the read station. Hence, by using this technique of reestablishing the value of the offset interval at the beginning of each card, the 80 data strobes are able to readjust for the arbitrary leading edge arrival.

The output of the comparator logic is used to generate a sequence of three pulses which actually initiate the various strobe actions. These are derived from the three phase clock as follows: ST $\varnothing \mathrm{C}$ occurs first, followed by STDD, and STDB (STØB is used to reset the compare cycle).

### 4.3.6.2 Wide-Strobe Control Logic

The Wide-Strobe Control logic is used to produce the index marker strobes (IMST) and the column storage data strobe (CSDS). The STØD signal, generated by the comparator logic, presets an eight stage counter to a binary value ( 322 octal). The counter then counts to all ones and in so doing, opens the

Character Buffer gates for a time interval controlled by the hard-wired binary value ( $600 \mu \mathrm{sec}$ ). During the count cycle of the counter, any TRUE signals from the 12 read station sensors will be stored into the latch-type storage registers of the Character Buffer. At the end of the count cycle, the index marker strobe control circuits produce the six-microsecond wide IMST signal, which is routed through the column-counter logic to produce the Index Marks for external equipment synchronization. This insures that the data for the particular column being read is stored properly, allowing transients to settle out before the Index Mark is transmitted.

### 4.3.6.3 Column Counter Control Logic

The Column-Counter Control logic is initialized by GPR to being counting the number of data columns read as the card moves past the read station. The eight-stage binary is triggered by STØC, which is synchronized to the data column of the card. The counter decode gating recognizes OCR (pseudocolumn 0) to produce the dark check (DC). This provides the dark check of the read station at the beginning of the card being read. The counter decode gating circuits also detect 1 CR (enable) and 81CR (disable) to control the Index Marker generation. The CR count recognition is used to initiate the Light Check and to indicate the end of the read eycle. This signal also re-establishos the readiness of the card reader to accept the next pick command (provided no alarm conditions have occurred for the card being processed).

### 4.3.7 Data Detection and Storage

Data detection is accomplished by data amplifiers and inverters. The Light Station contains one infra-red Light Emitting Diode (LED) and the Read Station one phototransistor for each of the 12 punched card rows. Light emitted by the LEDs is allowed to pass to the phototransistors by the presence of punched holes ; in the tab card. Figure 4-7 presents a block diagram and typical waveform for the Data Amplifiers and Inverters. Light reaching the Phototransistor (PT) is amplified by the PT and converted into an electrical signal at its' emitter. A typical PT's emitter waveform is ROW 12 (A). As the leading edge of the card passes over the PT lens, the received light is reduced causing a reduction in the PT's output voltage. The emitter of the PT is coupled to pull down resistor $R$ and the input of a high impedance TTL inverter. When the PT's emitter voltage drops through the switching threshold of the inverter (nominally) ( 1.4 volts) the inverter changes states. The High Impedance Inverters output is amplified by the Inverter and then used to drive the One Light and One Dark Logic. As can be seen from the waveforms each time the High Impedance Inverters threshold is crossed the device switches states driving the inverter to produce waveform ROW 12 (B).

, Figure 4-7 Block and Timing Diagram, Data Amplifiers and Inverters
In order to provide the Dark Check at OCR and the Light Check at CR, the outputs of the Data Amplifiers and Inverters are OR'ed in a One Light nor gate and inverted and OR'ed in a One Dark nor gate. These nor gates consist of 12 each open collector, TTL inverters in a wired OR configuration. Figure 4-8 is a block and timing diagram for the One Dark and One Light logic.


Figure 4-8 Block and Timing Diagram, One Dark and One Light

Data storage is implemented by use of a 12 bit data register controlled by the timing and synchronization circuits.

Data detected by the Data Amplifiers and Inverters is routed through the One Dark and One Light circuitry to the Data Register for transfer to the Controlling Device. Figure 4-9, Data Registers and Data Drivers diagram and timing details this sequence.

The 12 bit Data Register is reset each time STOC is generated by the Timing and Sync Logic. The 1.65 usec STOC is followed in approximately 4 usec by the Column Storage Data Strobe, CSDS. CSDS is synchronized with the card movement by the Timing and Sync Logic so that they occur in the center of the card's data columns. Any ROW's input to the Data Register that is low during CSDS will cause a " 1 " to be stored for the row. When CSDS goes low, a period of guaranteed data occurs. This period lasts until CSDS again goes true.

The Data Drivers provide the necessary buffering between the Data Register and the Controlling Device. The standard interface is supplied as the output of TTL type 7416 and 7417. Circuit characteristics are shown in figure 4-10. Other output drive configurations are available.


Figure 4-9 Block and Timing Diagram, Data Register and Data Drivers


Figure 4-10 Circuit Characteristics

### 4.3.8 Data Handling and Timing Summary

Figure 4-11 illustrates the timing and data handling sequence for $D-150$ series reader.

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 6.6 usec duration are generated while the BUSY is present. The time spacing of the Index Marks and the BUSY signal are shown by intervals B, D, and $E$ on figure 4-11.

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 Read Station Sensors indicates a mark, 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 usec 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 io remain on the output lines available for transfer to the external equipment for interval C.
4.4 COMMUNICATIONS BOARD, BLOCK DIAGRAM DISCUSSION

The following paragraphs describe the components and changes in operation for units equipped with the $\mathbf{C}-150$ option, which enables the reader to interface with any 103 or 202 Series Modem for telephone line communications. (Refer to figure 4-12).

### 4.4.1 Data Handling

a. Twelve negative true output data lines, from the reader, are brought to the C-150 board where they are terminated and presented to a gating structure to encode the twelve bits into eight bits compressed Hollerith code. When split Hollerith (6 bit binary) is specified the gating structure is rewired to meet the requirement. When ASCII or EBCDIC coding is specified, a 2048 Bit Read Only Memory is used to convert the compressed Hollerith code to the required output code.
b. The output from the code converter is stored in a one card memory, implemented with five MOS static dual 128 bit shift registers. The register has recirculate capabilities to permit retransmission of the last card between pick commands.


Figure 4-11 Interface Timing for D Series Readers


Figure 4-12 Communications Board, Block Diagram
c. Four customer coded special characters are generated by a wire "or" matrix and are used to indicate the following function:

1. Start of Message (SOM): Reader START switch has been depressed and the unit is ready to receive a pick command.
2. Start of Record (SOR): Framing character transmitted at the beginning of a new card (Record).
3. End of Record (EOR): Framing character to denote the end of a card (Record).
4. End of Message (EOM): A character denoting that the last card has been read and transmitted and the input hopper is empty.

### 4.4.2 Timing

To generate the required baud rate, a 4.8 MHz crystal oscillator is used. The output of the oscillator is divided by two MODULO-N dividers. The N-Modulus is selected by the baud rate switches. (See Appendix A for specific switch configuration on this unit.) The resultant output of the dividers is a frequency of thirty-two times the bit rate. This output is divided by two and used at the Line Rate Clock (LRC) at 16 times the bit rate. Two additional timing outputs at 1.2 MHz (Clock A and Clock B) are also derived from the oscillator for use as system clocks.

### 4.4.3 Transmitter/Receiver

The transmitter/Receiver is a general purpose, programmable MOL/LST device that generates the format required for line communications. It consists of three functional sections as follows:
a. Transmitter - This section converts the stored parallel data of the reader to the serial data required for transmission. It also inserts the start bit, an additional parity bit, and one or two stop bits as required.
b. Receiver - Converts the incoming control characters from a serial to parallel format, removes the start and stop bits and checks parity if this function is selected. It also checks the number of bits between the start and stop bits to determine the correct character length.
c. Transmitter/Receiver Controller - The array contains five input lines for program control. Five switch sections control the word length, which can be either $5,6,7$, or 8 bits; parity generation and checking to be inhibited or active; the parity selection to be odd or even; and the number of stop bits one or two bits.

### 4.4.4 Interface Driver/Receivers

The input and output interface units are selected at the user's option to meet the following configuration:
a. Line Drivers - Match the transmitter MOS output to RS 232-C, TTL, or differential output as required.
b. Line Receivers - Match the received interface RS 232-C, TTL or differential to TTL levels required for internal logic of the unit.

### 4.4.5 Received Character Decoder

This unit decodes the received characters that control the following functions:
a. Read and Transmit one card.
b. Retransmit last card.
c. Start reading and transmitting in automatic mode.
d. Stop the automatic mode.

### 4.4.6 Operation

With the C-150 board installed in the reader, the electronic operational sequence is as follows:
a. The operator loads a deck of cards to be read into the reader and depresses the START pushbutton. A special, customer coded, character for Start of Message (SOM) is loaded into the transmitter and sent serially via the interface.
b. The reader waits for either a "Read One Card" character or an "Auto Start" character.
c. When the "Read One Card" character is received and decoded the following sequence occurs:

1. A pick command is generated ( $350 \mu \mathrm{sec}$.), the reader will pick one card and clear the one card memory of all data.
2. The data on the card is read, code converted and stored. At the end of the read cycle a sequencer is initiated.
3. The sequencer causes the stored data to be shifted so that it is at the output end of the shift registers.
4. The sequencer then generates a "Request to Send" signal and the unit waits for a "Clear to Send" response.
5. Upon recognition of a Clear to Send from the controller, the sequencer loads the "Start of Record" (SOR) character into the transmitter and starts sending. The sequencer also causes the unit to enter the data. mode.
6. In the data mode, the sequencer causes the stored data for the entire card to be loaded character by character into the transmitter and be transmitted serially via the interface logic.
7. After the last data character is loaded, the sequencer causes the "End of Record" (EOR) character to be loaded and transmitted.
8. The Hopper empty circuit is examined and if the hopper is empty, the sequencer loads the "End of Message" (EOM) character.
9. After EOM is transmitted the sequencer lowers the request to send line and the unit returns to an idle state and waits for another input command.
d. If the unit receives a "Retransmit" character, it will enter a transmit sequence and the contents of memory, which is the last card read, will be transmitted. This will occur as many times as desired. SOR and EOR characters are transmitted and if the hopper is empty, EOM will also be retransmitted.
e. If the unit receives an "Auto Start" character the reader will initiate a new pick command at the end of the previous transmit sequence. This will continue until the hopper is empty, or the unit receives an "Auto Stop" command, or the operator presses the STOP switch.
f. The 2 wire/4 wire switch control the transmit senquence as follows: When in the 2 wire position, the transmitter always waits for "Clear to Send" signal before transmitting a record. When the switch is in the 4 wire position, the "Request to Send" is held on continuously, and the sequencer ignores the "Clear to Send" line.

# SECTION V <br> MAINTENANCE 

### 5.1 INTRODUCTION

This section contains adjustment and replacement procedures for those components that require replacement during the life of the unit.

Preventive maintenance is included in Section II and will not be repeated here. Troubleshooting should be performed to determine whether an adjustment or replacement procedure is required. All adjustments and/or replacement of components should be done by a qualified technician familiar with tools, their use and disassembly/assembly techniques of precision electromechanical units.

To perform any maintenance on the reader, it is necessary to open or remove applicable cover(s) to gain access to the area(s) desired. These procedures are listed in paragraph 5.3 and the applicable procedure is referenced in the maintenance sequence.

### 5.2 REQUIRED TOOLS

The following tools, listed in Table 5-1, are required to perform maintenance on the card reader.

### 5.3 ACCESS FOR MAINTENANCE

The following paragraphs detail the procedures for removal of covers and panels required to give access for adjustment and/or repair of interior components.

Prior to removal of covers or panels insure that power cord and interface cables are disconnected from the reader.
5.3.1 Front Panel Removal
a. With a $3 / 32^{\prime \prime}$ Allen wrench, remove three retaining screws that hold panel in place.
b. Remove panel and set aside.
c. After maintenance, replace panel in reverse order of removal.

Table 5-1 Required Tools

| Description | Manufacturer and Part Number of Special Tools |
| :---: | :---: |
| 1/16" Allen Screwdriver <br> $3 / 32^{\prime \prime}$ Allen Wrench (long arm) <br> 5/64" Allen Wrench (long arm) <br> 7/64" Allen Wrench (long arm) <br> $1 / 8^{\prime \prime}$ Allen Wrench (long arm) <br> $9 / 64^{\prime \prime}$ Allen Wrench (long arm) <br> . 050" Allen Wrench (short arm) <br> $1 / 16^{\prime \prime}$ Allen Wrench (short arm) <br> AMP Extraction Tool <br> "Twin Leaf Contact" Extraction Tool <br> "AMP Modified Fork" Contact Extraction Tool <br> "AMP Mod IV" Contact Extraction Tool <br> Deutsch Insertion/Extraction Tool (on base plate) <br> IC Removal Tool <br> Elco Extraction Tool <br> Elco Insertion Tool <br> Feeler Gaüge Set $0.0015^{\prime \prime}$ thru $0.025^{\prime \prime}$ <br> Long Nose Plier <br> IC Test Clip <br> Medium Flat Blade Screwdriver $3^{\prime \prime}$ long <br> Medium Flat Blade Screwdriver $6^{\prime \prime}$ long <br> $6^{\prime \prime}$ Metal Scale, decimal/fraction per inch <br> 1/4" - Open End or Socket Wrench <br> 1/2" - Open End Wrench <br> 11/32" - Open End or Socket Wrench <br> $7 / 16^{\prime \prime}$ - Open End or Socket Wrench <br> \#1 Phillips Screwdriver 6" long <br> \#2 Phillips Screwdriver 6" long <br> Printed Circuit Card Extender <br> \#2 Retaining Ring Remover <br> Side Cutter <br> Solder Removal Tool <br> 60-Watt Soldering Tool <br> 32-oz. Spring Scale <br> Guard Rail Template | AMP 91022-1 <br> AMP 91073-1 <br> AMP 91037-2 <br> AMP 91029-1A <br> M15570-16 <br> AMP 91049-1 <br> Elco 061877-04 <br> Elco 061742-04 <br> AP Inc. 923700 <br> Documation, Inc. Part \#4012601 <br> Documation, Inc. Part \#T008A |

### 5.3.2 Rear Panel Removal

a. With a $3 / 32^{\prime \prime}$ Allen wrench, remove four retaining screws that hold panel in place.
b. Remove panel and set aside.
c. After maintenance, replace panel in reverse order of removal.

### 5.3.3 Top Cover Removal

a. With a $3 / 32^{\prime \prime}$ Allen wrench, remove two retaining screws from each side of reader. (See figure 5-1, item 1.)
b. Remove cover and set aside.
c. After maintenance, replace cover in reverse order of removal.

### 5.3.4 Bottom Cover Removal

a. Turn reader upside down and with a $3 / 32^{\prime \prime}$ Allen wrench remove three screws from each side of reader. (See Figure 5-1, item 2.)
b. Remove cover and set aside.
c. After maintenance, replace cover in reverse order of removal.

## 5.4 <br> TROUBLESHOOTING

,
Table 5-2 Fault Isolation Chart, lists possible symptoms and probable causes of trouble and corrective action indicated. It is not possible to list all combinations of symptoms and causes. Familiarity with the reader will provide infor mation leading to the source of trouble.

Prior to performing troubleshooting per Table $5-2$, verify that the reader is thoroughly clean, and minor malfunction correction procedures (Table 2-5) have been performed.


Table 5-2 Fault Isolation Chart

| Symptom | Probable Cause | Corrective Action |
| :---: | :---: | :---: |
| The corrective actions indicated assume that procedures outlined in Table 2-5, Minor Malfunction Correction have been performed. |  |  |
| POWER indicator fails to light. Unit will not run. | 1. Defective AC wiring. <br> 2. Defective Power Switch. | 1. Check continuity on AC wiring (see Figure 6-1). Replace wires and/or connectors as required. <br> 2. Replace switch. |
| HOPPER CHECK indicator fails to light when hopper is empty. | 1. Defective hopper empty switch. <br> 2. Defective error circuits. | 1. Replace hopper empty switch. <br> 2. See Figure 6-8 sh. 8. Isolate fault and replace defective component. |
| The unit will process a card at a time and a Read check is lit after each card. | 1. Defective LED in light station or defective read station. <br> 2. Magnetic pickup out of adjustment. | 1. Replace light station and read station matched set. (See paragraph 5.8.) <br> 2. Readjust per paragraph 5.7. |
| MOTION CHECK lit, the unit fails to pick a card. | 1. Maladjusted throat block. <br> 2. Defective pick mechanism check: Pick Motor, Pick Belts, Solenoid and Solenoid return springs. <br> 3. Faulty pick control electronics. | 1. Adjust throat block. (See paragraph 5.5.1.) <br> 2. Replace or adjust components as required. (See paragraph 5.5.4.) <br> 3. Isolate fault and replace defective components. (See Figure 6-8 sh. 7.) |

Table 5-2 Fault Isolation Chart (Cont.)

| Symptom | Probable Cause | Corrective Action |
| :---: | :---: | :---: |
| PICK CHECK indicator fails to light when reader attempts and fails to pick a card. | 1. Lamp is burned out. <br> 2. Defective Error circuits. | 1. Replace lamp. <br> 2. See Figure 6-8 sh. 8 . Isolate fault and repiace defective component. |
| READ CHECK indicator fails to light when a dark check or light check condition occurs. | 1. Lamp is burned out. <br> 2. Column " 0 " output or Column "CR" output is missing from the Column Counter. <br> 3. One light or one dark output missing. <br> 4. Defective Error Circuits. | 1. Replace lamp. <br> 2. Refer to Figure 6-8 sh. 6. Isolate fault and replace defective component. <br> 3. Refer to Figure 6-8 sh. 1. Isolate fault and replace defective component. <br> 4. Refer to Figure 6-8 sh. 8. Isolate fault and replace defective component. |
| Reader picks one card, and then stops with a PICK CHECK. <br> 1 | 1. Good pick reset output is missing. <br> 2. Pick Command Reset is missing. | 1. Refer to Figure 6-8 sh. 5. Isolate fault and replace defective component. <br> 2. Refer to Figure 6-8 sh. 2. Isolate fault and replace defective component. |
| Reader picks one card but the reader will not pick additional cards. Unable to stop the reader by pressing the STOP switch. | 1. Column Counter CR output is missing. <br> 2. Column strobe phase " B " or phase " $D$ " is missing. <br> 3. Clock phase "B", Clock phase "C" or phase " D " is missing. | 1. Refer to Figure $6-8$ sh. 6. Isolate fault and replace defective component. <br> 2. Refer to Figure 6-8 sh. 4. Isolate fault and replace defective component. <br> 3. Refer to Figure 6-8 sh. 3. Isolate fault and replace defective component. |

Table 5-2 Fault Isolation Chart (Cont.)

| Symptom | Probable Cause | Corrective Action |
| :---: | :--- | :--- |
| $\begin{array}{l}\text { Reader reads erroneous } \\ \text { data. }\end{array}$ | 1. Defective Clock circuits. | $\begin{array}{l}\text { 1. Refer to Figure 6-8 sh. 3. } \\ \text { Isolate fault and replace } \\ \text { defective component. }\end{array}$ |
| 2. Refer to Figure 6-8 sh. 4. |  |  |
| Isolate fault and replace |  |  |
| defective component. |  |  |
| 2. Defective Sync circuits. |  |  |$\}$| 3. Refer to Figure 6-8 sh. 1. |
| :--- |
| Isolate fault and replace |
| defective component. |

NÓTE

When using test equipment for troubleshooting, connect test equipment ground to card logic ground to obtain accurate values.

## 5.5 <br> PICK AND FEED ADJUSTMENTS

### 5.5.1 Throat Knife/Ramp Adjustment

a. LOOSEN two screws holding throat knife to throat block, Figure 5-2.


Figure 5-2 Throat Knife/Ramp Adjustment
b. Insert a . 009 feeler gauge between ramp and knife.

## NOTE

The feeler gauge should be a single loose gauge which is free to "float" to highest tangent point of ramp.
;
c. Exert finger pressure in directions shown to ensure that knife edge is parallel to a horizontal line, tangent to high point of ramp.
d. Maintain directional pressures and tighten two screws.
e. Check that feeler gauge slides easily between knife and ramp. If not, repeat procedure.
f. Remove . 009 inch gauge and insert . 010 inch gauge. The fit should be snug.

## CAUTION

DO NOT FORCE GAUGE TO FIT.

### 5.5.2 Card Guide Rail Adjustment

a. LOOSEN two screws holding left rear guide rail, Figure 5-3.


Figure 5-3 Left Rear Guide Rail Adjustment
b. Using a feeler gauge, set clearance under left rear guide to . 025-. 030 inch. Make sure both sides of guide rail are flush against pick sensor cover.
;
c. Remove front, top and bottom cover as per paragraph 5.3.1, 5.3.3 and 5.3.4.
d. LOOSEN two screws underside picker plate holding left front guide rail to the picker plate.
e. Position Guide Rail template (Documation Part No. T008A) so that left rear corner of template is snug against left rear guide rail and right rear corner of template is snug against plate, Figure 5-4.


Figure 5-4 Use of Guide Rail Template
f. Exert light finger pressure against left front guide rail toward rear and to right against template. Tighten screws. Template should fit snugly but not bind.

### 5.5.3 Card Stop Action Adjustment

a. Manually raise pick wheel until it is flush with picker plate. Card stop should protrude no more than . 030 inch above picker plate, Figure 5-5. If more than . 030 inch proceed with step b. and c.


Figure 5-5 Card Stop Action Check
b. LOOSEN two screws holding card stop support and move support toward front plate, Figure 5-6. If desired measurement is met, tighten screws; if not, see paragraph 5.5.4 for removal of pick assembly.


Figure 5-6 Card Stop Acceleration Adjustment

### 5.5.4 Picker Assembly Adjustment

a. (Refer to Figure 5-7) Using your thumb and fore-finger, exert downward pressure on the picker solenoid return spring (1) and remove it from the notched pin at the picker rocker arm.
b. Using the same procedure as (a) above, remove the lower end of the pinch roller return spring from its retaining pin (2).
c. Disconnect the picker solenoid electrical plug (item 3, Figure 5-2) from its jack.
d. Disconnect the pinch roller solenoid electrical connector from its jack (4).
e. Remove the retaining screw (5) that holds the connector mounting plate to the pinch roller solenoid and move plate aside.
f. Remove two screws from card stop support.
g. Slide card stop assembly to left to disengage from actuating pin and remove.
h. Remove two screws from picker support and remove picker drive belt. Picker assembly is now free.


Figure 5-7 Card Reader, Bottom Interior View
i. LOOSEN two screws in center of picker arm and deflect the assembly slightly downward, Figure 5-8.


Figure 5-8 Picker Assembly Adjustment
j. Ensure that picker belt tension is as specified in paragraph 5.5.8 and tighten two screws in center of picker arm.
k. Position picker assembly and replace picker drive belt around drive motor pulley and picker assembly pulley. Insert two mounting screws into picker support and tighten.

1. Adjust picker drive belt per paragraph 5.5.7.
m. Replace card stop assembly by sliding to right to engage slot with actuating - pin.
n. Secure card stop assembly to picker plate with two screws in card stop support.
o. Check for proper action per paragraph 5.5.3.
p. Re-install connector mounting plate and the solenoids return springs.
5.5.5 Optical Switch Assembly (Pick Sensor) Adjustment
a. LOOSEN two screws holding optical switch assembly and adjust so that bottom of slot is flush or slightly below picker plate. Top of slot should be . 050 inch minimum above picker plate, Figure 5-9.
b. Tighten two screws.


Figure 5-9 Optical Switch Assembly Adjustment

### 5.5.6 Track Drive Belt Adjustment

To adjust tension of track drive beit:
a. LOOSEN four screws holding track drive motor so that motor slides freely. Using spring scale, move motor in vertical direction to show three ounces of spring tension with $1 / 8$ inch deflection, Figure 5-10.

note
A LOOSEN FOUR MOTOR MOUNTING SCREWS A APPLY PRESSURE TO MOTOR IN DIREGTION SHOWM.

Figure 5-10 Track Drive Belt
b. Maintain tension and tighten motor mounting screws.

### 5.5.7 Picker Drive

a. LOOSEN four screws holding picker drive motor so that motor slides freely. Using spring scale, move motor to show seven ounces of spring tension with. 1/16 inch deflection, Figure 5-11.


Figure 5-11 Picker Drive Belt
b. Maintain tension and tighten mounting screws.

### 5.5.8 Picker

a. Remove picker assembly per paragraph 5.5 .7 steps $a$. and b.

## NOTE

When making picker belt tension adjustment, note position of assembly so as not to change relative angular position. (Figure 4-8).
b. LOOSEN two screws in center of picker arm and adjust carefully to provide ten ounces of spring tension on scale with $1 / 16$ inch deflection, Figure 5-12.


Figure 5-12 Picker Belt
c. Maintain tension and tighten two screws.
d. Replace picker assembly per paragraph 5.5 .4 , steps k . through p .
e. Check card stop action per paragraph 5.5.3.
5. 6 MAGNETIC PICKUP REPLACEMENT
a. Remove cover per paragraph 5.3.
b. Remove P. C. cards from reader using card extractor levers.
c. Using AMP tool 465195-2, remove two magnetic pickup wires and shield from card connector. (See Figure 6-3 for wiring diagram.)
d. Remove cable ties from cable assembly.
e. Using a $1 / 16$ Allen wrench, loosen set screw in magnetic pickup mounting block, Figure 5-13.
f. Remove magnetic pickup from mounting block and lift from unit.
g. Insert new pickup unit into mounting block.
h. Replace wires from new magnetic pickup unit into their proper positions in card connector, Figure 6-3.
i. Adjust unit per paragraph 5.7.
5.7 MAGNETIC PICKUP ADJUSTMENT
'The magnetic pickup is adjusted to ensure that timing pulses are developed correctly. There are two adjustments: horizontal alignment and air gap. Refer to Figure 5-13.
a. Using a $5 / 64$ Allen wrench, LOOSEN set screw that is holding timing disc on drive roller shaft and position timing disc on drive roller shaft so that it is in a horizontal plane with center of magnetic pickup tip.

## CAUTION

If THE TIMING DISC MUST BE REMOVED, EXERCISE EXTREME CAUTION. DAMAGE TO DISC WILL RESULT IN ERRONEOUS MACHINE OPERATION.


Figure 5-13 Magnetic Pickup Adjustment
b. Align disc in correct position and tighten set screw, making sure that set screw is tightened on flat side of shaft.
c. To adjust air gap between magnetic pickup and timing disc, LOOSEN set screw holding magnetic pickup in its mounting block and reposition pickup. The air gap should be set to $.007^{\prime \prime} \pm .001^{\prime \prime}$.
d. Rotate timing disc and check two other positions to make sure that air gap is maintained.

If either of these two adjustments of the magnetic pickup are not correct, card ; synchronization may be erratic resulting in read checks or incorrect data being read.

## 5. 8 READ HEAD AND LIGHT STATION REPLACEMENT

When trouble develops in either the Read Head or the Light Station, both units should be replaced with a matched set. Order Read and Light Station Documation Part No. 30112301.

### 5.8.1 Read Head

a. Remove covers per paragraph 5.3.
b. Remove P. C. cards from reader using extractor levers.
c. Using AMP Tool 465195-2, remove read station wires from card connector. (See Figure 6-3 for wiring diagram.)
d. Remove cable ties from cable assembly.
e. From rear of unit locate two $6-32 \times 1 / 2$ Phillips screws securing the rear of the read station cover to the unit.

## CAUTION

WHEN REMOVING THE LEFT SCREW EXERCISE CARE SO THAT DAMAGE IS NOT DONE TO THE TIMING DISC.

Carefully remove screws.
f. From bottom of unit remove screw holding read station cover to card track.
g. Work cable out from unit and remove read station assembly from unit.
h. Remove two flat head Phillips screws holding read station to cover and remove the read station.
i. Install new read station and reassemble into unit.
j. Dress all cables away from moving parts and tie down as required.

### 5.8.2 Light Station

a. Using AMP Tool 465195-2, remove light head wires from card connector. (See Figure 6-3 for wiring diagram.)
b. Remove cable ties from cable assembly.
c. Turn unit upside down and remove two Phillips $6-32 \times 1.25^{\prime \prime}$ screws holding light section assembly to unit (6), Figure 5-7.
d. Work cable out from unit and remove light station assembly.
e. Remove two flat head Phillips screws holding light head to support block and remove the light head.
f. Install new light head and reassemble into unit.
g. Reassemble reader to operational configuration and perform the following tests:

1) Light Reading. With power applied and no card in the card track, measure with a DVM and record the voltage at the following IC pins; 2 E 13 , $2 \mathrm{E} 11,2 \mathrm{E} 9,2 \mathrm{E} 5,2 \mathrm{E} 3,2 \mathrm{E} 1,3 \mathrm{~K} 13,3 \mathrm{~K} 11,3 \mathrm{~K} 9,3 \mathrm{~K} 5$, 3 K 3 and 3 K 1 . Voltage must be 2.3 volts minimum.
2) Dark Reading. Insert a card into the read station so as to block the light reaching the phototransistor and repeat the above readings. Voltages shall be 0.9 volt maximum.
h. Reposition either light station or read station if readings in step i-1 above are out of tolerance.

## SECTION VI

## SCHEMA TICS

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Figure 6-1 AC Wiring Diagram (Dwg. \#2041550)


Figure 6-2 Card File Assembly

1. unless otherwise noted: ALL WIRE WHT
ALL WIRE AWG 24


Figure 6-3 D-150 PC Card Interconnect Wiring Diagram
(Dwg. \#2041358)

NOTES:
unless otherwise noted: ALI WIRE WHT
ALL WIRE AWG 24


Figure 6-4 DC-150 PC Cards Interconnect Wiring Diagram (Dwg. \#2041503)


Figure 6-5 Power Supply Schematic (115 VAC 60 Hz )


Figure 6-7 D-150 Card Assembly


Figure 6-8 D-150 Logic Diagram (Storage Registers) sheet 1 of 9


Figure 6-8. D-150 Logic Diagram (Solenoid Driver)(sheet 2 of 9)


PCKUP AMMIFIER, OSCILLATOR, AND CLDCK GENEAATOR

Figure 6-8 D-150 Logic Diagram (Pickup Amp, Osc, Clock) sheet 3 of 9


Figure 6-8 D-150 Logic Diagrarn (Sync Control) sheet 4 of 9


Figure 6-8 D-150 Logic Diagram (Control) sheet 5 of 9


Figure 6-8. D-150 Logic Diagram (Column Counter)(sheet 6 of 9)


Figure 6-8 D-150 Logic Diagram (Pick Control) sheet 7 of 9


Figure 6-8 D-150 Logic Diagram (Error Control) sheet 8 of 9


Figure 6-8 D-150 Logic Diagram (Regulator, Solenoid Drivers) sheet 9 of 9


Figure 6-9 C-150 Card Assembly


Figure 6-10 C-150 Logic Diagram sheet 1 of 8
(Dwg. \#2041472)


Figure 6-10 C-150 Logic Diagram sheet 2 of 8


Figure 6-10 C-150 Logic Diagram sheet 3 of 8


Figure 6-10 C-150 Logic Diagram sheet 4 of 8


Figure 6-10 C-150 Logic Diagram sheet 5 of 8


Figure 6-10 C-150 Logic Diagram sheet 6 of 8


Figure 6-10 C-150 Logic Dia.gram sheet 7 of 8


Figure 6-10 C-150 Logic Diagram sheet 8 of 8

TABLE 6-1 D-150 SIGNAL LIST AND ABBREVIATIONS

| MNEMONIC | DESCRIPTION | LOCATION | SOURCE |
| :---: | :---: | :---: | :---: |
| VCC | +5 V Logic Power | J3-4 |  |
| LOGIC GND | +5 V Return | J3-N, F |  |
| +VS | +Solenoid Power | J3-9 |  |
| -vs | -Solenoid Power | J3-7 | Power Supply |
| +5 V IND | Indicators Power | J3-30 | ( Figure 6-5 \& 6-6 |
| -12V | C-Board Power | J7-27 |  |
| $\pm 12 \mathrm{~V}$ COM | C-Board Power | J7-28 |  |
| ${ }^{+} 12 \mathrm{~V}$ | C-Board Power | J7-29 |  |
| D12 | Data Output Row 12 | J4-3 |  |
| D11 | Data Output Row 11 | J4-2 |  |
| D0 | Data Output Row 0 | J4-1 |  |
| D1 | Data Output Row 1 | J4-4 |  |
| D2 | Data Output Row 3 | J4-6 |  |
| D3 | Data Output Row 2 | J4-5 |  |
| D4 | Data Output Row 7 | J4-12 | S Storage Register Logic |
| D5 | Data Output Row 8 | J4-11 | ( Figure 6-8, sheet 1 |
| D6 | Data Output Row 6 | J4-9 |  |
| D7 | Data Output Row 9 | J4-7 | Figure 6-3 |
| D8 | Data Output Row 5 | J4-8 |  |
| D9 | Data. Output Row 4 | J4-10 |  |
| ONE DARK | Read Station All Light | 3F-6 |  |
| ONE LIGHT | Read Station All Dark | 3E-8 | $\rho$ |
| ROW 12 | Read Sensor Output Row 12 | J3-20 |  |
| ROW 11 | Read Sensor Output Row 11 | J3-21 | Read Station |
| ROW 0 | Read Sensor Output Row 0 | J3-P | $\}$ Figure 6-8, sheet 1 |
| ROW 1 | Read Sensor Output Row 1 | J3-17 | $\int^{\&}$ |
| ROW 2 ROW 3 | Read Sensor Output Row 2 Read Sensor Output Row 3 | J3-19 J3-18 | $\int$ Figure 6-4 |

TABLE 6-1 D-150 SIGNAL LIST AND ABBREVIA TIONS (Cont'd)

| MNEMONIC | DESCRIPTION | LOCATION | SOURCE |
| :---: | :---: | :---: | :---: |
| ROW 4 | Read Sensor Output Row 4 | J3-T | 7 |
| ROW 5 | Read Sensor Output Row 5 | J3-S | Read Station |
| ROW 6 | Read Sensor Output Row 6 | J3-R | ) Figure 6-8, sheet 1 |
| ROW 7 | Read Sensor Output Row 7 | J3-U |  |
| ROW 8 | Read Sensor Output Row 8 | J3-V | $\int$ Figure 6-4 |
| ROW 9 | Read Sensor Output Row 9 | J3-X |  |
| PICK | Pick Relay Drive | $1 \mathrm{E}-8$ | 7 |
| PCR | Pick Command Reset | 1E-6 |  |
| PSET | Pick Check Set (Error) | 2D-12 | , $\begin{aligned} & \text { Solenoid Drivers } \\ & \text { Figure 6-8, sheet } 2\end{aligned}$ |
| PINSET | Pinch Check Set (Error) | 2D-6 | - Figure 6-8, sheet 2 |
| PINCH | Pinch Relay Drive | 1E-12 |  |
| $\emptyset \mathrm{B}$ | Clock ØB | 8C-6 | 7 |
| $\emptyset \mathrm{C}$ | Clock $\emptyset \mathrm{C}$ | 8C-12 |  |
| $\emptyset \mathrm{D}$ | Clock $\emptyset \mathrm{D}$ | $8 \mathrm{C}-8$ | - Clock Logic |
| C1 | 75 KHz Clock | 8C-5 | Figure 6-8, sheet 3 |
| TST | Timing Strobe (Sensor Output) | J3-Y |  |
| TST 2 | Timing Strobe 2 | 9D-10 | - |
| TSTREN | Timing Strobe Reset Enable | 5A-5 | T |
| STØB | Column Strobe $\emptyset \mathrm{B}$ | 5B-11 | $\}$ Sync Control |
| STøC | Column Strobe $\emptyset \mathrm{C}$ | 5B-8 | $\int$ Figure 6-8, sheet 4 |
| STøD | Column Strobe øD | 5B-6 |  |
| $\overline{\mathrm{OSR}}$ | Offset Reset | 4A-1. |  |
| OSUCLK | Offset Up Clock | $4 \mathrm{~A}-3$ |  |
| PR/OSCLK | Preset/Offset Clock | $4 \mathrm{~A}-6$ | Control Logic |
| GPR IMST | Good Pick Reset Index Mark Strobe | $4 \mathrm{~A}-1.1$ $1 \mathrm{~A}-6$ | ( Figure 6-8, sheet 5 |
| $\overline{\text { CSDS }}$ | Column Storage Data Strobe |  |  |

TABLE 6-1 D-150 SIGNAL LIST AND ABBREVIATIONS (Cont'd)

| MNEMONIC | DESCRIPTION | LOCATION | SOURCE |
| :---: | :---: | :---: | :---: |
| $\overline{0 C R}$ | Zero Column Reset | 6F-8 | T |
| IM | Index Marks | 9B-10 |  |
| $\overline{81 \mathrm{CR}}$ | 81st Column Reset | 6H-8 | $\rangle$ Column Counter |
| CRSET | Column Reset + POR | 9F-8 | Figure 6-8, sheet 6 |
| CR | Column Reset | 9H-2 | J |
| STOP | Stop | $11 \mathrm{E}-6$ | ) |
| POR | Power On Reset | 9D-2 |  |
| RESET + POR | Reset or Power On Reset | 9D-4 |  |
| RESET + GPR | Reset or Good Pick Reset | $10 \mathrm{C}-10$ | Pick Control |
| RESET INHIBIT | Reset Inhibit | 11B-6 | $\rangle$ Figure 6-8, sheet 7 |
| RESET | Logic Reset | 11C-6 |  |
| BUSY | Busy Signal | 9C-5 |  |
| PCEN | Pick Control Enable | $9 \mathrm{C}-8$ |  |
| PICK | Pick Command | J4-13 | , |
| $\overline{\text { READY DR }}$ | Start Indicator Driver | 10K-3 | ? |
| STOP DR | Stop Indicator Driver | 10K-5 |  |
| HCK DR | Hopper Check Indicator Driver | 11K-3 |  |
| $\overline{\mathrm{RCK}} \mathrm{DR}$ | Read Check Indicator Driver | 11K-5 | Error Control |
| $\overline{\text { MOCK DR }}$ | Motion Check Indicator Driver | 9K-3 | ( Figure 6-8, sheet 8 |
| READ CHECK | Read Check Signal | 10J-12 |  |
| READY | Ready Signal | $10 \mathrm{~J}-8$ |  |
| HOPPER CHECK | Hopper Check Signal | 10J-6 |  |
| MOTION CHECK | Motion Check Signal | $10 \mathrm{~J}-4$ | , |
| PICK SOLENOID | Pick Solenoid Driver | Q1-C | ) |
| PINCH SOLENOID | Pinch Solenoid Driver | Q2-C | Regulators \& Solenoid |
| VCC 1 | +5 V Reg. To Logic Col. A, B \& C | Q3 Out | ) Drivers |
| VCC 2 | +5V Reg. To Logic Col. D, E, F \& H | Q4 Out | Figure 6-8, sheet 9 |
| VCC 3 | +5V Reg. To Log. Col. J, K \& Light Sta. | Q5 Out |  |

TABLE 6-1 D-150 SIGNAL LIST AND ABBREVIA TIONS (Cont'd)


TABLE 6-1 D-150 SIGNAL LIST AND ABBREVIATIONS (Cont'd)


TABLE 6-1 D-150 SIGNAL LIST AND ABBREVIATIONS (Cont'd)


# SECTION 7 <br> ILLUSTRATED PARTS BREAKDOWN (RECOMMENDED SPARES ONLY) <br> D-150 

The figures contained herein call out only the recommended spares and show their location in the specified reader. The numbered callouts for each figure are listed together with the corresponding eight-digit part number and item description. For all other parts not in the recommended spares list, contact Spares Department.

## NOTE

When ordering any part, spared item or otherwise, be sure to include the model and serial number (or numbers) of the reader (or readers) for which the part is to be used. This precaution will avoid the possibility of ordering a standard item instead of a customer specified item.

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Figure 7-0. Figure Reference



Figure 7-2. Card File Assembly


Figure 7-3. Power Supply Assembly


Figure 7-4. Control Panel Assembly


Figure 7-5. Connector Panel Assembly


Figure 7-6. Front Panel Assembly

| FIG. \& INDEX NO. | PART NUMBER | 1223450674 DESCRIPTION |  | VENDOR |
| :---: | :---: | :---: | :---: | :---: |
| 7-1 |  | MAIN FRAME ASSEMBLY |  |  |
| -1 | 00000617 | BELT, Pick Motor, $72 \mathrm{~T}, 3 / 16$ Wide, 40 DP | 1 | SDP |
| -2 | 00000615 | PULLEY, 32T | 1 | SDP |
| -3 | 00000614 | PULLEY, 25T | 3 | SDP |
| $=4$ | 00000618 | BELT, Picker, 54 T | 1 | SDP |
| -5 | 20102201 | ROLLER, Pick | 1 | Documation |
| -6 | 20137201 | SOLENOID ASSEMBLY | 2 | Documation |
| -7 | 10150802 | MOTOR, Pick, $115 \mathrm{~V}, 50 / 60 \mathrm{~Hz}$ | 1 | Documation |
|  | 10150804 | MOTOR, Pick, $230 \mathrm{~V}, 50 / 60 \mathrm{~Hz}$ | 1 | Documation |
| -8 | 20140201 | SWITCH, Optical, Post Read, OD | 1 | Documation |
| -9 | 20137601 | SWITCH, Hopper Empty | 1 | Documation |
| -10 | 20135901 | BUMPER ASSEMBLY, Pinch | 1 | Documation |
| -11 | 20136001 | BUMPER ASSEMBLY, Pick | 1 | Documation |
| -12 | 20135601 | STOP ASSEMBLY, Card | 1 | Documation |
| -13 | 00000285 | SPRING, Solenoid | 2 | LEF |
| -14 | 00000904 | BELT, Drive, 143 T | 1 | SDP |
| -15 | 30136701 | MOTOR, Drive, $115 \mathrm{~V}, 60 \mathrm{~Hz}$ | 1 | Documation |
|  | 10147401 | MOTOR, Drive, $115 \mathrm{~V}, 50 \mathrm{~Hz}$ | 1 | Documation |
|  | 10147402 | - MOTOR, Drive, $230 \mathrm{~V}, 50 \mathrm{~Hz}$ | 1 | Documation |
| -16 | 00000634 | BLADE, Fan | 2 | Thor |
| -17 | 30127701 | PICKER ASSEMBLY | 1 | Documation |
| 7-2 |  | CARD FILE ASSEMBLY |  |  |
| -1 | 40114301 | P. C. ASSEMBLY, PT Logic, D150 | 1 | Documation |
| -2 | 40114302 | P. C. ASSEMBLY, GT Logic, D150 | 1 | Documation |
| -3 | 40139806 | P.C. ASSEMBLY, OD 150 | 1 | Documation |
| -4 | 40140101 | P. C. ASSEMBLY (C Models Only) | 1 | Documation |
| 7-3 |  | POWER SUPPLY ASSEMBLY |  |  |
| -1 | 40107001 | POWER SUPPLY, $115 \mathrm{~V}, 60 \mathrm{~Hz}$ | 1 | Documation |
|  | 40107003 | POWER SUPPLY, $230 \mathrm{~V}, 50 \mathrm{~Hz}$ | 1 | Documation |
| -2 | 00000199 | CAPACITOR, $6,200 \mu \mathrm{f}$ | 1 | GE |
| -3 | 00000596 | CAPACITOR, $13,800 \mu \mathrm{f}$ | 1 | GE |
| -4 | 20127101 | TRANSFORMER ASSEMBLY, 115 V | 1 | Documation |
|  | 20127301 | TRANSFORMER ASSEMBLY, 230V | 1 | Documation |
| -5 | 00001566 | CAPACITOR, $3 \mu \mathrm{f}$ | 1 | GE |
| -6 | 00000511 | CAPACITOR, $2 \mu \mathrm{f}$ | 1 | GE |
| -7 | 00000143 | DIODE, Bridge | 1 | Motorola |
| -8 | 30127201 | POWER SUPPLY, DC, OD, ODC, 115V (Used with 40107001) | 1 | Documation |
|  | 30127202 | POWER SUPPLY, DC, OD, ODC, 230V (Used with 40107003) | 1 | Documation |
| 7-4 |  | CONTROL PANEL ASSEMBLY |  |  |
| -1 | 00000318 | LAMP, Incand., 6V, . $20 \mathrm{~A}, \mathrm{~T}-13 / 4$ | 6 | GE |
| -2 | 00000946 | SWITCH, Start \& Stop, 1P, MOM | 2 | MSC |
| -3 | 00000947 | SWITCH, Power, 2P, Ind., Alternate | 1 | MSC |
| -4 | 20126502 | DEPRESSOR CARD | . 1 | Documation |



