INSTRUCTION MANUAL

Installation and Operation

THE DIRECTOR™
TAPE READER

MT-82 Tape Reader
MTS-82 Tape Reader/Spooler

EECO
Incorporated

EECO Incorporated

INSTRUCTION MANUAL

DOC10006

April 2, 1982

SUPPLEMENT

Please make the following changes where indicated:

1. Page 1-3, Table 1-2.

    a. Line input voltage specification should read:

Line Input Voltage	Card Position	Range @47-63 HZ
	100	95-115
	120	105-130
	220	190-230
	240	210-260

    b. Add the following Parameter and Specification:

Line Input Frequency	47-63 Hertz

2. Page 1-4, Table 1-2

    Add the following Parameter and Specification:

Isolation Chassis to Signal Ground	$\leq 0.1\,\Omega$ with shorting screw installed. 100-500 Ω nominal without shorting screw installed. This low resistance is due to the read head switch installed on a conductive read head.

3. Page 3-1, Paragraph 3-2.

    Add reference, (See table 1-2), at end of note.

4. Page 4-1, Paragraph 4-2.

    Add reference, (See table 1-2), at end of note.

EECO Incorporated

5. Page 5-2.

   Add reference, (See table 1-2), at end of note.

6. Page 5-17, figure 5-11.

   Change tape data pin callout from 2 to 3 in factory preset position. Should read:

   ```
   Preset ────► TAPE DATA PIN 3/Reader Command PIN 2     3
   ```

7. Page 8-4, Paragraph 8-4A.

   Add to list of required equipment:

   3. One 7.5 inch reel full of mylar tape.

8. Page 8-4, Paragraph 8-4B.

   Add the following steps and amendments to the SERVO PCB adjustment. RE-NUMBER STEPS as indicated (changes are underlined):

   To adjust the servo motor pots on the servo PCB:

   1. Place switch S1 (2) in the "0" position (See figure 3-3).

   2. Clean and close the read head. (See paragraph 8-2A0.

   3. Calibrate the reader (See Paragraph 8-2D).

   4. Turn power off.

   5. Place full reel of mylar tape on right hub.

   6. Connect a voltmeter positive lead to test point (+MRT) at center of Servo PCB. Connect the negative lead to test point (-MRT). (See figure 8-1.)

   7. Turn power on.

   8. Press LOAD SPOOL switch.

   9. While right motor is turning, adjust R31 (right hand pot) for 4.2 + 0.2 volts. Repeat steps 8 and 9 as necessary.

   10. Turn off power.

   11. Place full reel of mylar tape on left hub (was on right hub.

12. Place switch S1(2) in the "1" position (See figure 3-3).

13. Connect a voltmeter positive lead to test point (+MLF) at center of servo PCB. Connect the negative lead to (-MLF). (See figure 8-1.)

14. Turn on power.

15. Press LOAD SPOOL switch.

16. While left motor is turning, adjust R30 (left hand pot) for 4.2 + 0.2 volts. Repeat steps 15 and 16 as necessary.

17. Turn off power and reset switches to appropriate settings. (See figure 3-3, 4-3, or 5-3).

INSTRUCTION MANUAL

THE DIRECTOR™
TAPE READER

MT-82 TAPE READER

MTS-82 TAPE READER / SPOOLER

For customer service contact...

EECO
Incorporated

WARNING

This equipment generates and uses radio frequency energy and if not installed and used properly, i. e., in strict accordance with the instruction manual, may cause harmful interference to radio communications. It is designed to comply with the limits for a Class A computing device pursuant to sub-part J of part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment.

March 1982

(230990)

Printed in U.S.A.

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Figure 1-1. MTS-82 Tape Reader/Spooler

SECTION I

GENERAL DESCRIPTION

1-1.   SCOPE

This manual contains operation and maintenance information
for all versions of the MT-82 Microprocessor Based Punched
Tape Reader (reader) and the MTS-82 Microprocessor Based
Punched Tape Reader/Spooler (reader/spooler).

1-2.   EQUIPMENT DESCRIPTION

The Microprocessor Based Punched Tape Reader (figure 1-1)
converts information from hole patterns in either spooled
or strip (loose) punched tape to electrical signals.
These signals are stored in a buffer memory under micro-
processor control until needed for control of user equip-
ment. Data is requested and transmitted from memory via
an INPUT/OUTPUT interface to the requesting equipment.
When the active buffer is depleted, tape is advanced to
replenish the memory and the cycle is repeated.

Front Panel controls consist of LOAD, REWIND, and POWER
switches. The read head contains a low-current, visible
LED light source, phototransistor sensing elements, a
stepper motor, and drive sprocket. In the reader/spooler
version, tape spools are driven by direct current spooler
motors mounted on the front panel. Only one motor (step-
per or spooler) is operational during any given operation.
This feature results in low power consumption.

Data conversion control, and power logic circuits are
contained on three modular printed circuit boards:

(1)   A CPU board contains power supply, stepper motor
      drive, microprocessor, and memory circuits.

(2)   An INPUT/OUTPUT board provides an interface between
      the CPU board and user equipment. It also contains
      switches for setting logic levels.

(3)   A SERVO board controls the spool mode drive motors.
      Two potentiometers adjust motor speed.

The reader may be configured in one of several versions. The rear chassis nameplate identifies the reader version when factory shipped.

Table 1-1. Equipment Part Number

P/N	MODE	I/O TYPE
230990-10	Reader Only	EECO Parallel
230990-15	Reader/Spooler	EECO Parallel
230990-20	Reader Only	Remex Parallel
230990-25	Reader/Spooler	Remex Parallel
230990-30	Reader Only	Serial
230990-35	Reader/Spooler	Serial

Table 1-2. Specifications

PARAMETER	SPECIFICATION
Read Speed (Switch Selectable)	201 characters per second maximum or 402 characters per second maximum
Rewind Speed I/O	402 characters per second maximum
Front Panel	1000 characters per second typical (varies with amount of tape on reel)
Dimensions	
Front Panel Width	19.00 inches (48.26 centimeters maximum)
Front Panel Height	5.25 inches (13.34 centimeters maximum)
Depth (front to rear panel)	7.10 inches (18.03 centimeters maximum)
Read Head Protrusion	2.15 inches (5.46 centimeters maximum)
Hub Protrusion	2.275 inches (5.78 centimeters maximum)
Weight	17 pounds (7.71 kilograms)
Finish	
Front Panel	Lexan overlay on aluminum base

Table 1-2. Specifications (continued)

PARAMETER	SPECIFICATION
Chassis	Clear chemical film on aluminum
Tape	
Material	Paper, aluminum-Mylar, paper-Mylar, or Mylar-aluminum
Thickness	Up to 0.0045 inches (0.1143 millimeters)
Tolerance	Tape punched per EIA Standard RS-227-A, ECMA, ANSI, or ISO
Width/Levels	1.000 + 0.003 inches (25.400 + 0.076 millimeters) standard 8 track plus sprocket
Line Input Voltage	100/120/220/240 volts A.C. (Selectable) +/- 10%, 50/60 Hertz +/- 3%
Power Consumption:	80 watts maximum. (50 watts typical)
Peak Inrush Current:	9 amperes at 115 Vac.
Fusing	a. 1.5 ampere fuse, slo-blo at 115 Vac. b. 0.75 ampere fuse, slo-blo at 230 Vac.
Power Cord	3 conductor detachable cord, Switchcraft P/N P-3292 (EECO P/N 346323-01)
Input/Output Connector	See paragraph 3-1, 4-1, or 5-2.
Temperature	
Operating	0 to +60 degrees centigrade
Non-Operating	-20 to +100 degrees centigrade
Humidity	0 to 95% Relative humidity, non-condensing

Table 1-2. Specifications (continued)

PARAMETER	SPECIFICATION
Altitude Operating:	0 to 10,000 feet (0 to 3048 meters)
Non-operating:	0 to 15,000 feet (0 to 4572 meters)

Vibration	Mil STD 810C,
	  Category G
	  Procedure X

Shock	Mil STD 202
	  Method 213
	  Condition K
	  11 milliseconds, 1/2 sine

SECTION II

INSTALLATION

2-1. UNPACKING

Remove reader from shipping container. Remove packaging material from reader. Check to see that no parts are left in container.

2-2. INSPECTION

After unpacking, carefully inspect the reader for any loose or missing hardware. Check for foreign material in the chassis or read head. Inspect for shipping damage. Clear away any foreign material and repair or replace any defective hardware or electrical components before attempting to operate the reader.

2-3. EQUIPMENT MOUNTING

The reader is provided with mounting holes for installation in a standard 19-inch RETMA equipment rack. Refer to figure 2-1 for reader outline dimensions and space requirements.

2-4. POWER (See table 1-1 and figure 2-2)

WARNING

To insure safe and proper grounding of the reader, make sure the power line has a third-wire ground.

CAUTION

Before applying power to the unit, make certain that the power connector PC CARD is set up for the correct voltage (see figure 2-2). To remove PC card from equipment, insert a pointed instrument into hole in card and pry out. Do not use pliers as this may damage the card. Also, verify that the correct fuse is installed.

NOTES: UNLESS OTHERWISE SPECIFIED

[1.] DIMENSION IS WITHOUT TOP COVER OPTION.
TOP COVER WILL ADD .062 (1.57) PLUS SCREW HEADS
WHICH WILL EXTEND .062(1.57) BEYOND TOP OF FRONT
PANEL.
[2] DIMENSIONS XXX INCHES (XXX) MM

TOP VIEW

134627A

Figure 2-1.   Outline and Dimensions
(Reader/Spooler Shown)

A. COVER CLOSED

FUSE

PC CARD   B. COVER OPEN   FUSE EJECTOR

C. FUSE REMOVAL

USE 1.5A
SLO-BLO
FUSE

100 220

USE IF LINE VOLTAGE
IS 95 TO 115 VOLTS

120 240

FACTORY
SETTING

USE IF LINE VOLTAGE IS
105 TO 130 VOLTS

USE 0.75A
SLO-BLO
FUSE

220 100

USE IF LINE VOLTAGE IS
IS 190 TO 230 VOLTS

240 120

USE IF LINE VOLTAGE IS
IS 210 TO 260 VOLTS

PC CARD POSITIONS. TOP VIEWS.
(ARROWS POINT TOWARD DIRECTION OF INSERTION INTO CONNECTOR ASSEMBLY).

BI044

Figure 2-2.   Power Connector Assembly

Electrical power for the reader is selected from four line
input potentials: 100, 120, 220, 240 Vac. Choose the
fuse value according to the input voltage used:

100 to 120 Vac use 1.5 Amp slo-blo fuse.

220 to 240 Vac use 0.75 Amp slo-blo fuse.

2-5.   INTERNAL CONTROLS

Prior to placing the reader into operation, the internal
search/wind and logic level switches must be set to pro-
vide the desired signals and results. Figure 2-3 shows
the locations of all the important internal controls and
assemblies. See Sections III, IV, or V for switch setting
information.
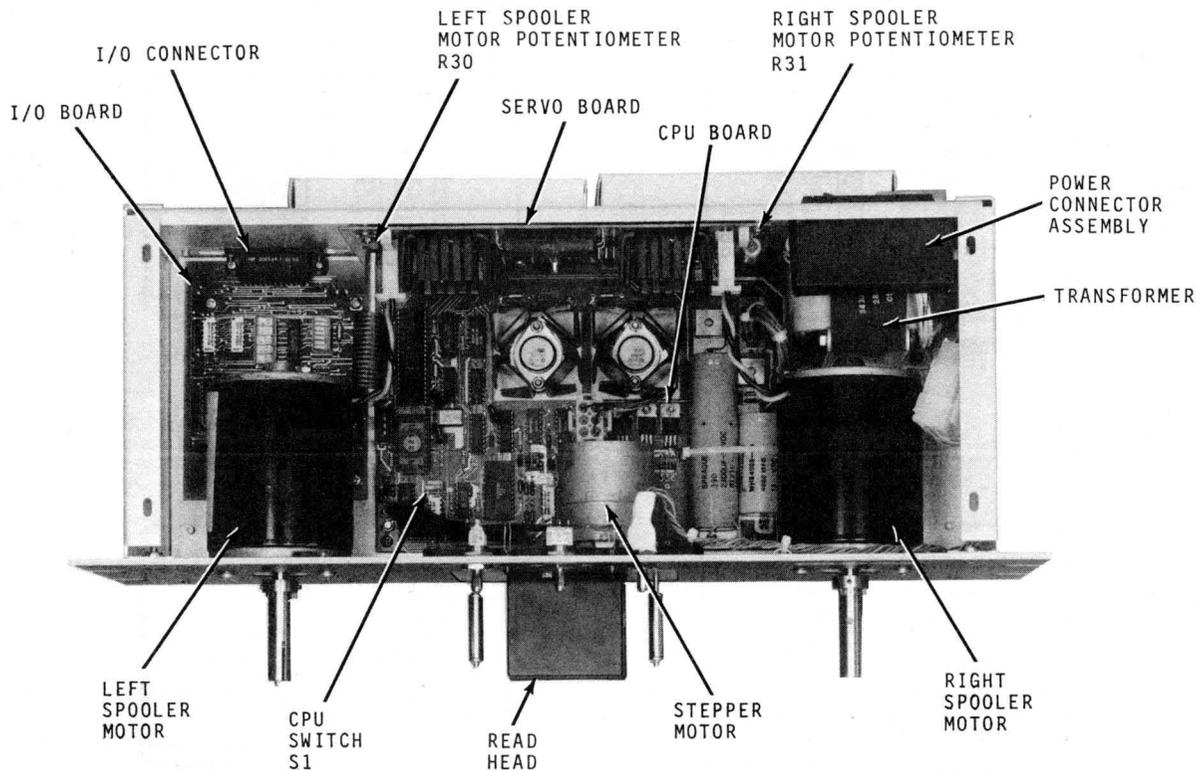
A1256

Figure 2-3.   Internal Controls and Assemblies.

SECTION III

INTERFACE - EECO PARALLEL I/O

3-1. DESCRIPTION

The EECO parallel I/O is a TTL compatible interface which
outputs punched tape data on eight lines. Reader status
and handshaking are provided on another four output lines.
Reader control is obtained with four input signals which
are noise filtered and conditioned. Switches provide se-
lection of logic levels for all signals. Customer connec-
tion is through a DB25S connector located at the rear of
the reader.

3-2. INTERFACE CABLE

To interface with other equipment, provide an appropriate
cable using size 22 AWG wire of necessary length not to
exceed 10 feet. For noise immunity, use twisted pair and
terminate both ends of the cable to the ground points. For
maximum noise immunity and minimum high frequency radia-
tion, the cable should have an overall shield grounded to
I/O connector pin 21.

NOTE

Signal ground and chassis ground are in-
ternally connected for maximum reader im-
munity to power line transient voltages.
Users wishing to employ single-point
grounding in their system can disconnect
signal ground from chassis ground by re-
moving the shorting screw (figure 3-1).
With the internal ground connection removed,
it is especially important that chassis
ground and system ground be externally con-
nected by a low impedance at high frequen-
cies; otherwise power line transients may
develop chassis voltage disturbances suf-
ficient to cause system malfunction.

CPU BOARD

S1

MOUNTING
SCREW
(5 PLACES)

GROUND SHORTING SCREW

AI304
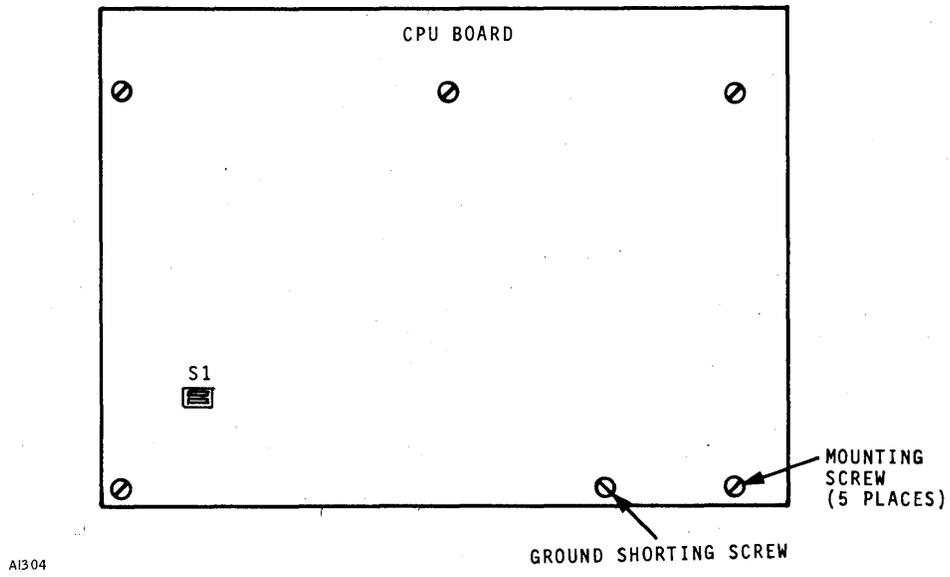
Figure 3-1.   Ground Shorting Screw

DRIVE CIRCUIT

RECOMMENDED USER
DRIVE CIRCUIT

74LS04
7404,
OR EQUIVALENT

10FT MAX

+5V   EECO INPUT CIRCUIT

10K
220Ω
0.001
74LS240

OUTPUT CIRCUIT

EECO OUTPUT CIRCUIT

74LS241

10FT MAX

+5V   RECOMMENDED
USER INPUT CIRCUIT

10K
220Ω
0.001
74LS14
OR EQUIVALENT
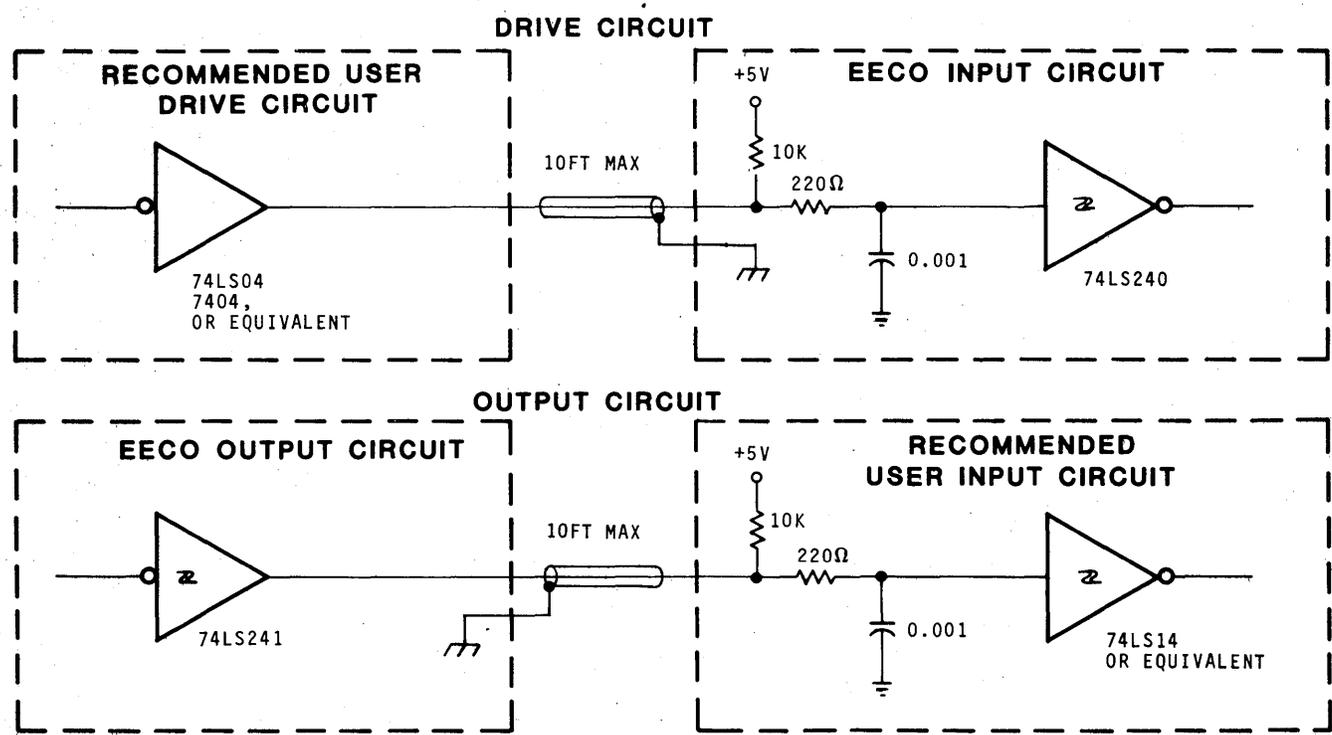
AI255

Figure 3-2.   Recommended Interface Circuits.

3-2

Table 3-1. Connector Pin List

PIN	SIGNAL	SIGNAL FUNCTION
1	(SPARE)	(SPARE)
2	REMOTE REWIND RIGHT (RRR)	INPUT, SELECTABLE LEVEL
3	REMOTE REWIND LEFT (RRL)	INPUT, SELECTABLE LEVEL
4	DRIVE RIGHT (DR)	INPUT, SELECTABLE LEVEL
5	DRIVE LEFT (DL)	INPUT, SELECTABLE LEVEL
6	READER READY (RR)	OUTPUT, SELECTABLE LEVEL
7	RUN STATUS (RS)	OUTPUT, SELECTABLE LEVEL
8	(SPARE)	(SPARE)
9	DATA CLOCK (DC)	OUTPUT, SELECTABLE LEVEL
10	DRIVE ACKNOWLEDGE (DA)	OUTPUT, SELECTABLE LEVEL
11	DATA CHANNEL (D1)	OUTPUT, SELECTABLE LEVEL
12	DATA CHANNEL (D2)	OUTPUT, SELECTABLE LEVEL
13	DATA CHANNEL (D3)	OUTPUT, SELECTABLE LEVEL
14	DATA CHANNEL (D4)	OUTPUT, SELECTABLE LEVEL
15	DATA CHANNEL (D5)	OUTPUT, SELECTABLE LEVEL
16	DATA CHANNEL (D6)	OUTPUT, SELECTABLE LEVEL
17	DATA CHANNEL (D7)	OUTPUT, SELECTABLE LEVEL
18	DATA CHANNEL (D8)	OUTPUT, SELECTABLE LEVEL
19	(SPARE)	(SPARE)
20	BROKEN TAPE (BT)	OUTPUT, SELECTABLE LEVEL
21	CHASSIS GROUND	TIED TO POWER LINE (EARTH GROUND)
22	GROUND	SIGNAL GROUND, RETURN
23	GROUND	SIGNAL GROUND, RETURN
24	GROUND	SIGNAL GROUND, RETURN
25	GROUND	SIGNAL GROUND, RETURN

3-3. LOGIC LEVELS

I/O levels are switch-selectable depending on user
equipment requirements.

Table 3-2. Logic Levels

INPUT/ OUTPUT	LEVEL	VOLTAGE RANGE	MAX. CURRENT
Input	+5V	+2.0 to +5.2 Vdc	40 uA
Input	0V	0.0 to +0.8 Vdc	-0.7 mA
Output	+5V	+2.4 to +5.2 Vdc	-2.6 mA
Output	0V	0.0 to +0.4 Vdc	12 mA

Table 3-3. Input/Output Signals
(Defined for switches in factory preset positions)

SIGNAL	LEVEL	DEFINITION
DATA (Dl-D8)	ØV	Hole condition in punched tape. All data channels (Dl-D8)
	+5V	No-hole condition in punched tape.
Reader Ready (RR)	ØV	Reader is operational and ready to accept a command.
	+5V	Reader is not ready to accept a command or a fault has occurred.
Data Clock (DC) (See note 1)	ØV	Data on the data lines is available and valid.
	+5V	Data on the data lines is not available or is invalid.
Broken Tape (BT)	ØV	Tape did not transport correctly through the read head mechanism.
	+5V	Tape is transporting correctly.
Drive Acknowledge (DA)	ØV	A 218 microsecond pulse responses to a drive or rewind command. This pulse is generated at the beginning of each frame to signify receipt of a drive or rewind command. During slew operation, DA is generated once per output frame.
	+5V	No drive or rewind commands have been received.
Remote Rewind Right (RRR) or Remote Rewind Left (RRL)	ØV	Causes reader to output data at 400 characters per second in spool mode or approximately 250 characters per second in loop mode.
	+5V	Disables the rewind mode.

Table 3-3. Input/Output Signals
(Defined for switches in factory preset positions)
(continued)

SIGNAL	LEVEL	DEFINITION
Drive Right (DR)	ØV	Pulse or level commands reader to output data from the reader memory.
or Drive Left (DL)	+5V	Commands the reader to stop outputting data.
Run Status (RS)	ØV	Level informs user that read head cover is closed, tape is loaded, and reader is ready to accept an input command.
	+5V	Level informs user that read head cover is open and that the reader is not ready to receive commands.

NOTE 1: The Data Clock (DC) signal serves the same function as the SPROCKET signal of conventional readers. In the microprocessor controlled reader, it is a "synthesized" sprocket signal.

CPU ASSEMBLY

"0" "1"

200
LDL

400
LDR

PRESET
POSITIONS

S1

"0" "1"

200 ┌─────┐ 400
LDL └─────┘ LDR
S1

READ
RATE   S1(1)

	200	0
PRESET →	400	1

"0" "1"

200 ┌─────┐ 400
LDL └─────┘ LDR
S1

LOAD DIRECTION   S1(2)

PRESET →	RIGHT	1
	LEFT	0

AI264

Figure 3-3. CPU Switch Settings.

EECO PARALLEL I/O ASSEMBLY

"0" "1"
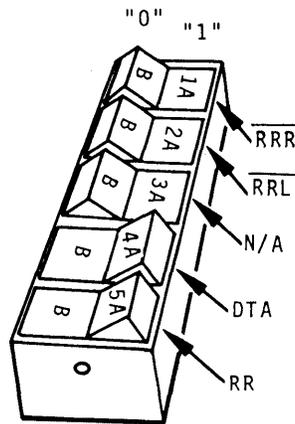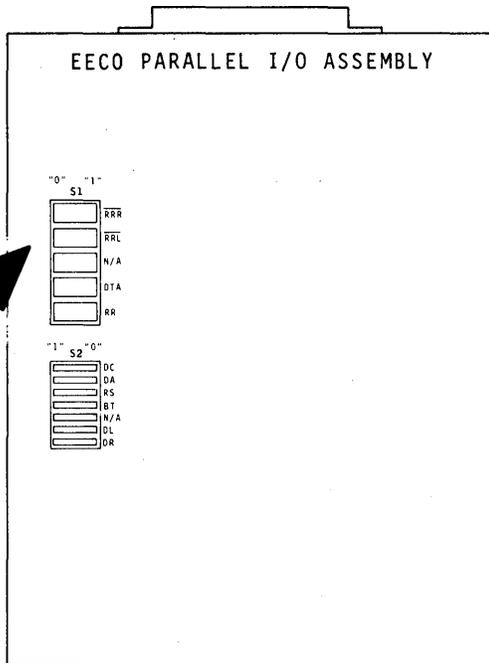
PRESET
POSITIONS
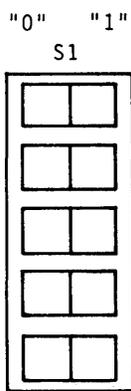
		SWITCH POSITION	ACTIVE LEVEL	FUNCTION
$\overline{RRR}$	PRESET	"1"	0V	REMOTE REWIND RIGHT ($\overline{RRR}$)
		"0"	+5V	
$\overline{RRL}$	PRESET	"1"	0V	REMOTE REWIND LEFT ($\overline{RRL}$)
		"0"	+5V	
N/A	PRESET	"1"	---	(SPARE)
		"0"	---	
DTA		"1"	+5V	DATA (HOLE = +5V, NO HOLE = 0V)
	PRESET	"0"	0V	DATA (HOLE = 0V, NO HOLE = +5V)
RR		"1"	+5V	READER READY (RR)
	PRESET	"0"	0V	(READER WILL ACCEPT COMMAND)

"0" "1"
S1

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Figure 3-4. I/O Switch Settings - S1.
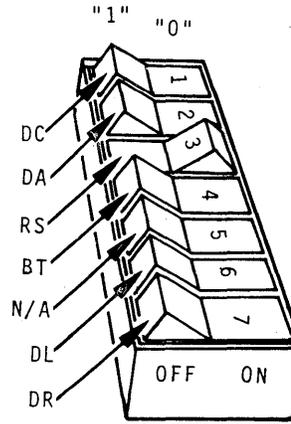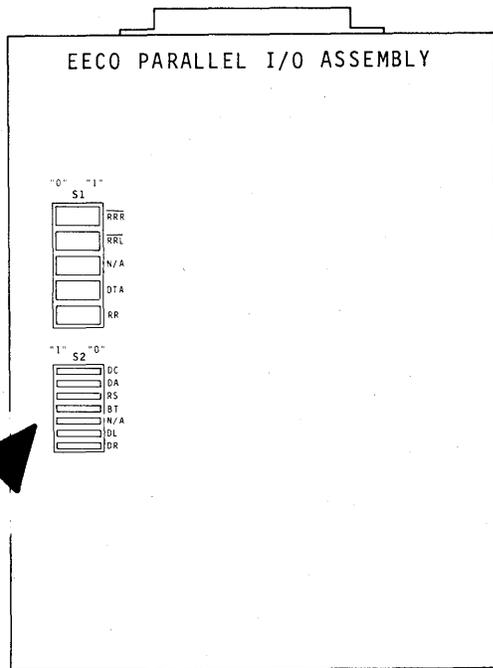
EECO PARALLEL I/O ASSEMBLY

"1"   "0"
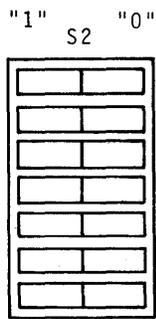
PRESET
POSITIONS

	SWITCH POSITION	ACTIVE LEVEL	FUNCTION
	"1"	+5V	DATA CLOCK (DC)
PRESET	"0"	0V	(DATA IS AVAILABLE)
	"1"	+5V	DRIVE ACKNOWLEDGE (DA)
PRESET	"0"	0V	(DRIVE HAS BEEN RECEIVED)
PRESET	"1"	+5V	RUN STATUS (RS)
	"0"	0V	(READY TO RUN)
	"1"	+5V	BROKEN TAPE (BT)
PRESET	"0"	0V	(TAPE IS BROKEN)
	"1"	---	(NOT APPLICABLE)
PRESET	"0"	---	
	"1"	+5V	DRIVE LEFT (DL)
PRESET	"0"	0V	
	"1"	+5V	DRIVE RIGHT (DR)
PRESET	"0"	0V	

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Figure 3-5.   I/O Switch Settings - S2.

3-8

3-4. SIGNAL TIMING
(All timing diagrams shown with switches in factory preset positions.)

A. Step Timing.

A single DR or DL pulse causes the reader to output one character. Figure 3-6 shows the timing relationships between the control signals involved.

NOTE: TIMING IS FOR 400 CPS.
TIMING IN [BRACKETS] IN FOR 200 CPS.

ALL VALUES TYPICAL EXCEPT WHERE NOTED.

* READER READY MUST BE ACTIVE BEFORE THIS READER WILL
RESPOND TO A NEW DRIVE COMMAND.

A1252

Figure 3-6. Step Timing.

B. Slew Timing.

A DR or DL signal causes the reader to output data from
memory or to load the memory with data from the tape.
Figure 3-7 shows the timing relationships between the
control signals involved.
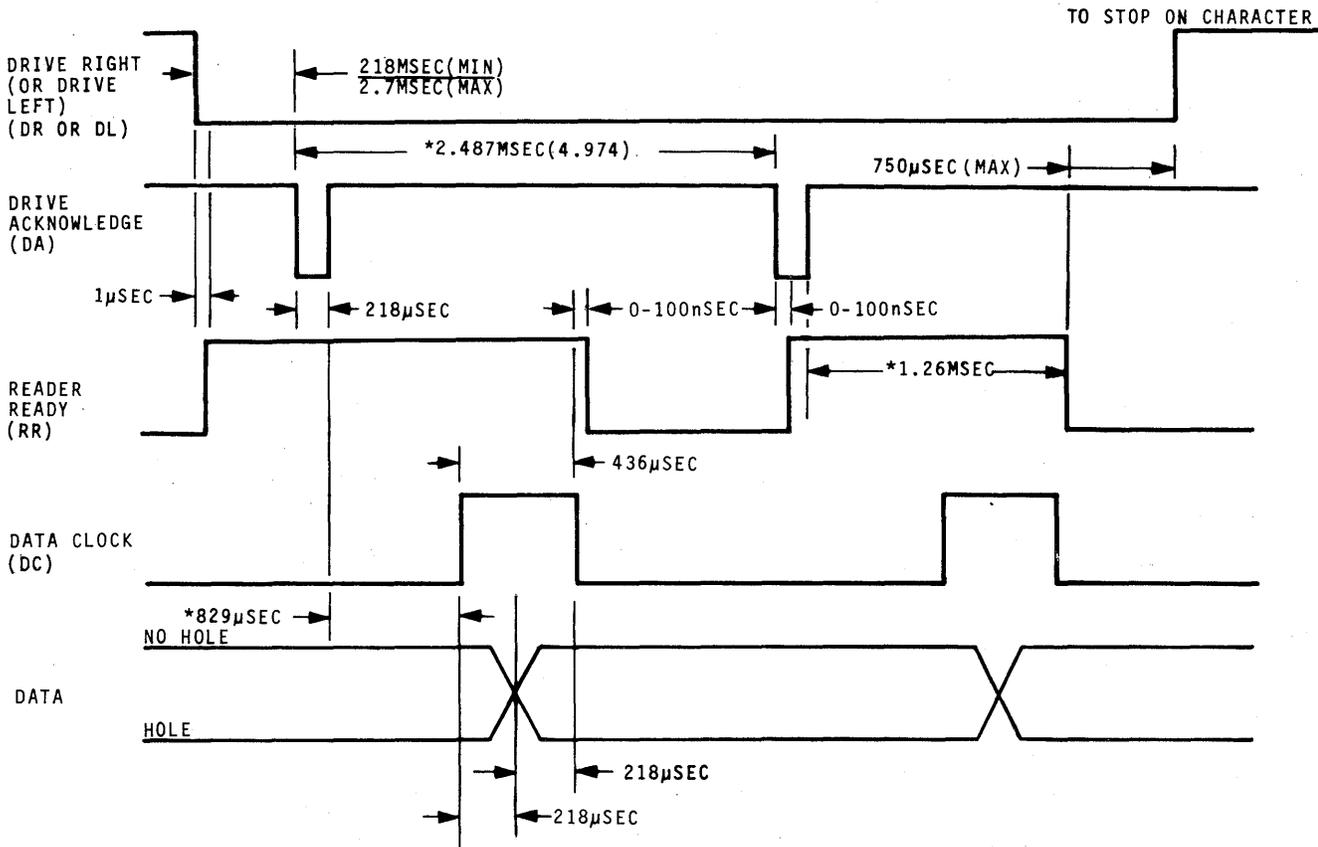
NOTE: TIMING IS FOR 400 CPS.

ALL VALUES TYPICAL EXCEPT WHERE NOTED.

* THESE VALUES WILL BE EXTENDED FOR THOSE CONDITIONS WHERE
  THE INTERNAL CHARACTER BUFFER IS EMPTY. IN THIS CASE THE
  NEXT CHARACTER OUTPUT TIMING WILL BE DETERMINED BY THE
  ARRIVAL OF THE TAPE AT THE NEXT CHARACTER.

AI254

Figure 3-7. Slew Timing.

3-10

C. Turn Around Time (Step or Slew).

On a turn around, one character is output in the re-
verse direction with the normal timing for step or
slew. Additional characters are output as soon as the
tape reader can reposition the tape. The time to re-
position (t) is 2 seconds (maximum) for reel mode and
200 milliseconds (maximum) for loop mode. (See figure
3-8.)

DRIVE RIGHT
(DR)

0 nSEC(MIN)

DRIVE LEFT
(DL)

1μSEC(MAX)   t

READER
READY
(RR)

$\frac{1.7MSEC(MIN)}{6.8MSEC(MAX)}$

DATA CLOCK
(DC)

NO HOLE

DATA

HOLE
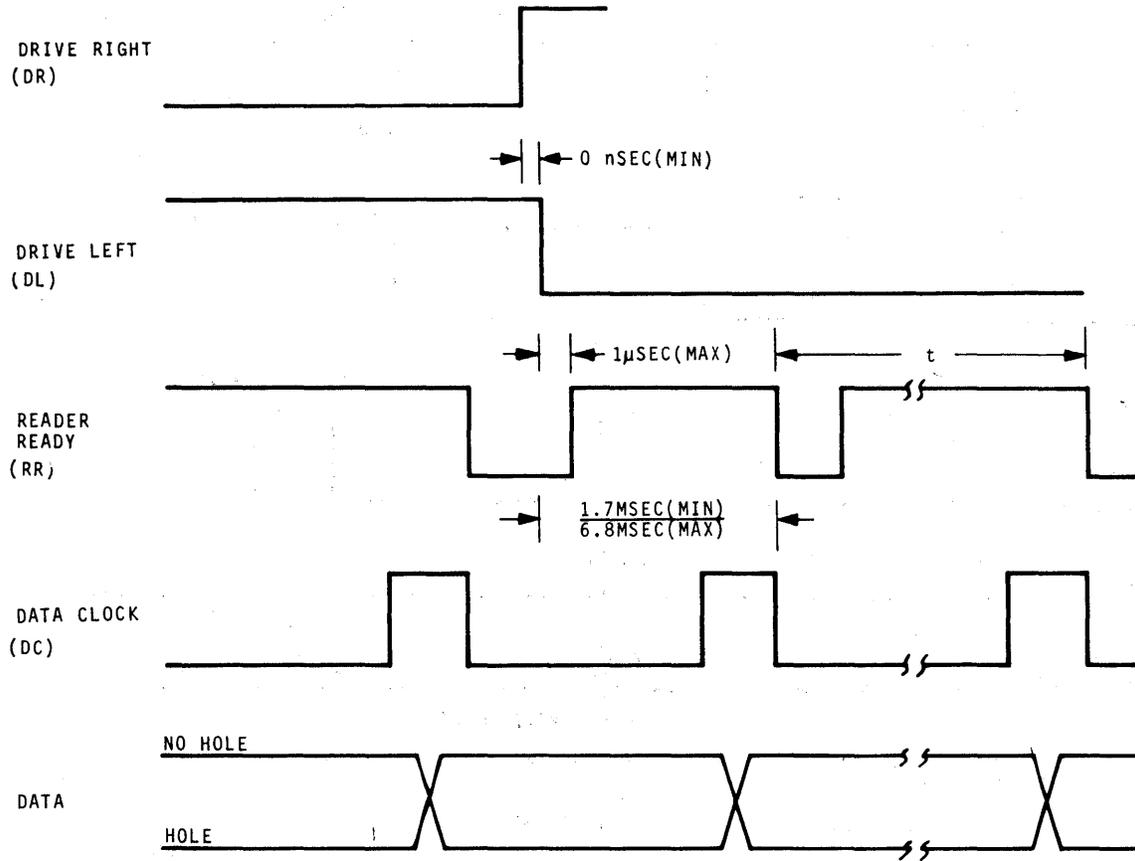
A1298

Figure 3-8. Turn Around Time.

D. Rewind External.

Data is output at a rate of 400 characters per second in response to a rewind command.
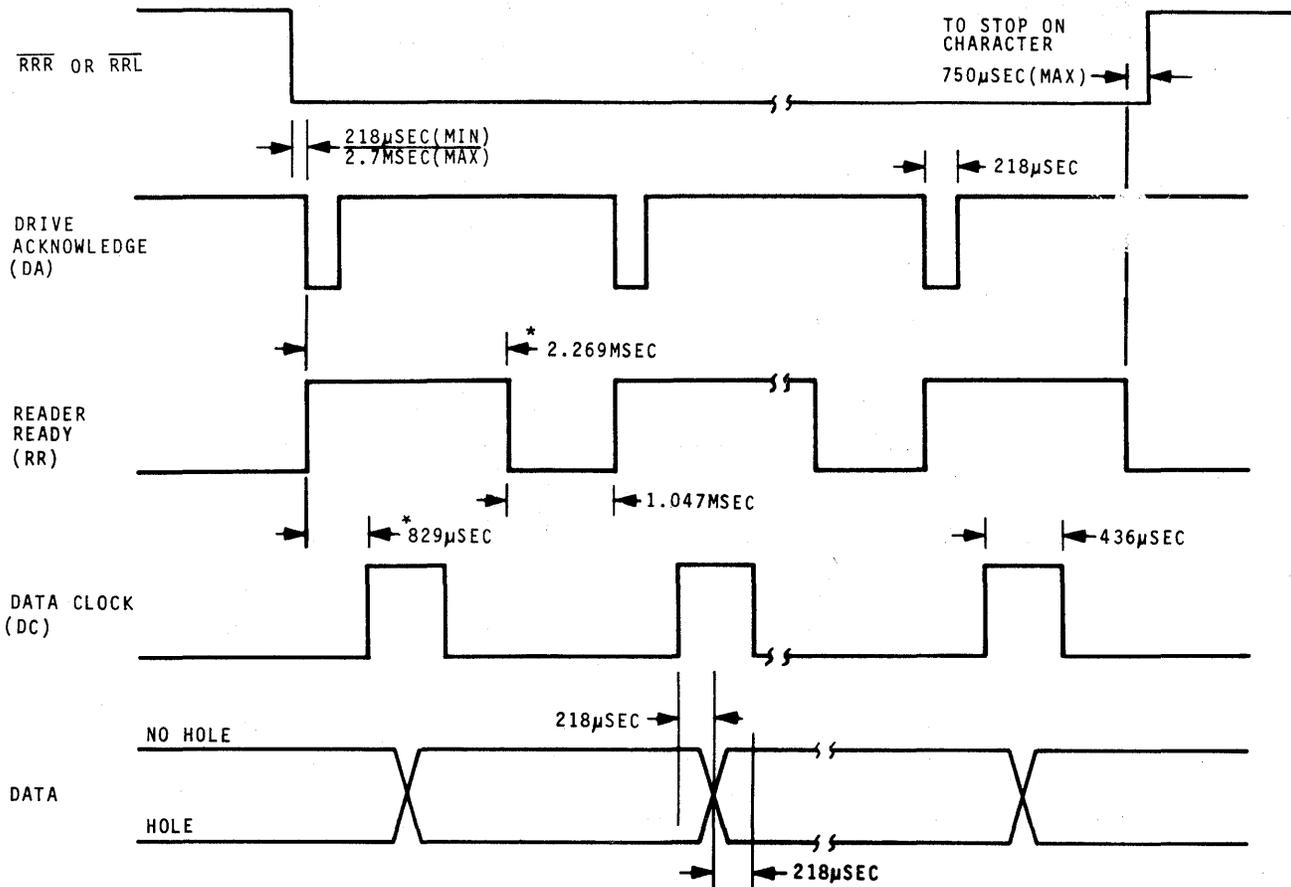
NOTE: TIMING IS FOR 400 CPS. TIMING IN (BRACKETS) IS FOR 200 CPS.

ALL VALUES TYPICAL EXCEPT WHERE NOTED.

* THESE VALUES EXTENDED WHEN INTERNAL CHARACTER BUFFER IS EMPTY. NEXT CHARACTER OUTPUT TIMING IS DETERMINED BY ARRIVAL OF THE TAPE AT THE NEXT CHARACTER.

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Figure 3-9. Search Timing.

E.   Rewind (Front Panel).

Momentary (less than 50 milliseconds) actuation of the
front panel rewind switch causes the tape reader to en-
ter the high speed wind mode. Actuation of the switch
in the direction toward the load point causes the
reader to wind until the load point is approached. The
reader slows down and then stops when the load point is
reached. The READER READY signal is used to indicate
that the reader is busy during rewind and will not ac-
cept an external command.

1.   Front Panel Rewind (Autostop). Momentary actuation
     of the front panel rewind switch toward the load
     point causes the reader to rewind and stop auto-
     matically at the load point.

Figure 3-10.   Rewind (Autostop).

2. Front Panel Rewind (Manual). Actuation of the
    front panel switch in either direction causes the
    reader to wind as long as the switch is held.
    Momentary operation of the switch also causes the
    reader to rewind. A second momentary operation of
    the switch stops the reader motion. If the load
    point is encountered during momentary operation the
    reader will stop. To resume winding, actuate the
    switch again.

Figure 3-11. Rewind (Manual).

SECTION IV

INTERFACE - REMEX COMPATIBLE PARALLEL I/O

4-1.   DESCRIPTION

The Remex parallel I/O is designed to simulate the inter-
face of the following Remex models:

                    RRD7300BEX/660/DRB
                    RR7155BA1/660/D-A
                    RRS7155BA1/660/G-A

Interface is provided through the DB25P connector on the
rear of the reader.

4-2.   INTERFACE CABLE

To interface with other equipment, provide an appropriate
cable using size 22 AWG wire of necessary length not to
exceed 10 feet. For noise immunity, use twisted pair and
terminate both ends of the cable to the ground points.
For maximum noise immunity and minimum high frequency
radiation, the cable should have an overall shield
grounded to I/O connector pin 25.

                              NOTE

         Signal ground and chassis ground are in-
         ternally connected for maximum reader im-
         munity to power line transient voltages.
         Users wishing to employ single-point
         grounding in their system can disconnect
         signal ground from chassis ground by re-
         moving the shorting screw (figure 4-1).
         With the internal ground connection removed,
         it is especially important that chassis
         ground and system ground be externally con-
         nected by a low impedance at high frequen-
         cies; otherwise power line transients may
         develop chassis voltage disturbances suf-
         ficient to cause system malfunction.
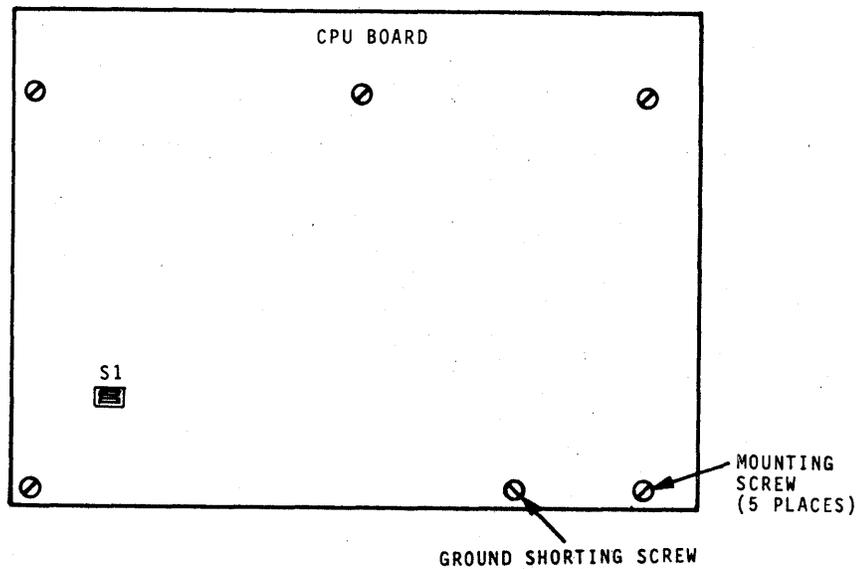
Figure 4-1. Ground Shorting Screw.
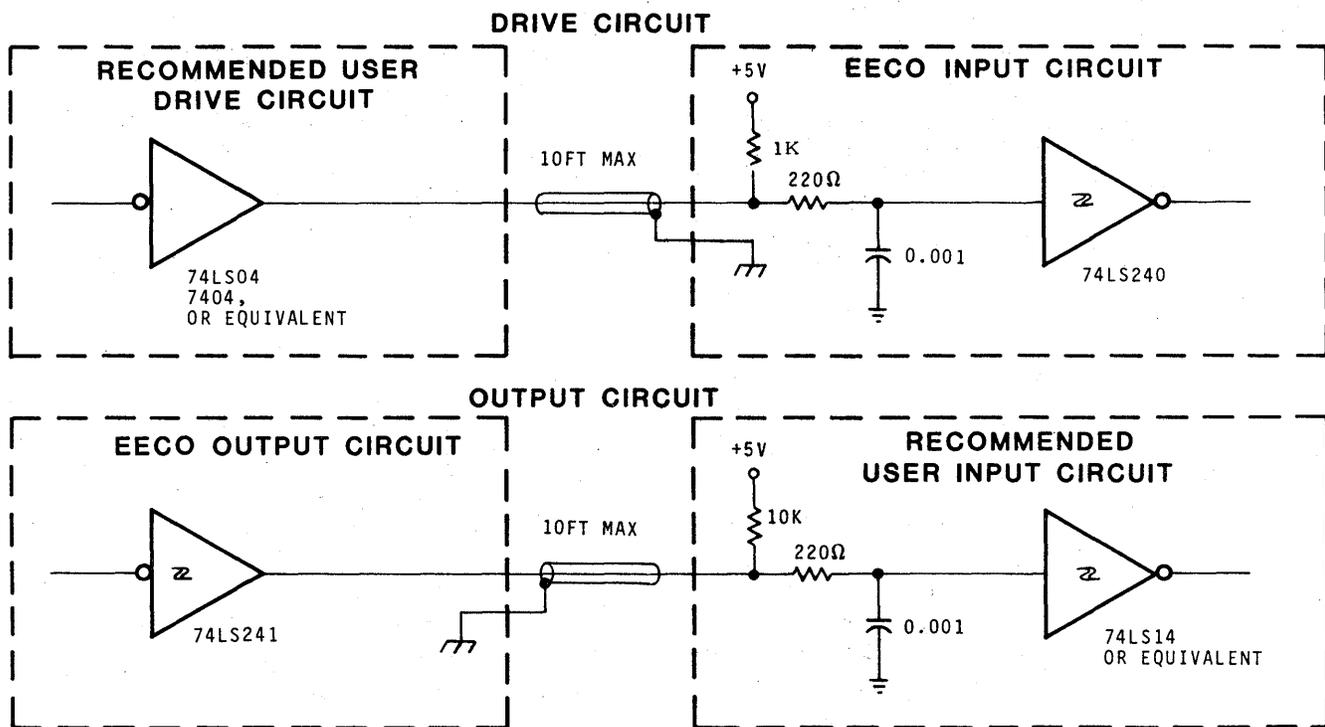
Figure 4-2. Recommended Interface Circuits.

Table 4-1. Connector Pin List.

PIN#	SIGNAL NAME	SIGNAL FUNCTION
1	Data Track 1	Output ⎫
2	Data Track 2	Output ⎪
3	Data Track 3	Output ⎪ Levels
4	Data Track 4	Output ⎬ Determined
5	Data Track 5	Output ⎪ by Mode Select
6	Data Track 6	Output ⎪ Inputs
7	Data Track 7	Output ⎪
8	Data Track 8	Output ⎪
9	Data Ready (DR)	Output ⎭
10	Data Mode Select	Input
11	Signal Ground	Signal Ground
12	Signal Ground	Signal Ground
13	Signal Ground	Signal Ground
14	System Ready (-SYSRDY)	Output
15	External Inhibit (-XINH)	Input (Not Implemented)
16	Drive Right (-DR)	Input
17	Drive Left (-DL)	Input
18	High Speed Enable (-HISPD)	Input (Not Required)
19	Spare*	Spare
20	Rewind Right External (-WR)	Input
21	Rewind Left External (-WL)	Input
22	Winding (-WDG)**	Output (Not Implemented)
23	+5 VDC at 200 miliamps	Power (Not Implemented)
24	Signal Ground	Signal Ground
25	Chassis Ground	Chassis Ground

  * +12V at 100 mA on 7155 model
 ** -12V at 100 mA on 7155 model

Table 4-2. Logic Levels.

INPUT/ OUTPUT	LEVEL	VOLTAGE RANGE	MAX. CURRENT
Input	+5V	+2.0 to +5.2 Vdc	40 uA
Input	0V	0.0 to +0.8 Vdc	-0.7 mA
Output	+5V	+2.4 to +5.2 Vdc	-2.6 mA
Output	0V	0.0 to +0.4 Vdc	12 mA

Table 4-3. Input/Output Signals.

SIGNAL	LEVEL		DEFINITION
	Mode 5	Mode 6	
Data Track (1-8)	+5V	ØV	Hole condition.
	ØV	+5V	No-hole condition.
Data Ready	+5V	ØV	Data is available and valid.
	ØV	+5V	Data is not available.
	Either mode		
System ready	ØV		Reader is ready to receive commands.
	+5V		Reader will not accept input command.
Drive Right (-DR) or Drive Left (-DL)	ØV		Pulse or level commands reader to output data.
	+5V		Stops the output of data in the read mode.
Rewind Right (-WR) or Rewind Left (-WL)	ØV		Command to output data at 400 cps ($\approx$ 200 cps in loop mode).
	+5V		Stops the output of data in the rewind mode.
Data Mode Select	ØV		**Specifies** mode 5 output **levels for** DATA and DATA **READY.**
	+5V		**Specifies** mode 6 output **levels** for DATA and DATA **READY.**

CPU ASSEMBLY

"0" "1"

```
        200  ┌──┬──┐  400
        LDL  ├──┼──┤  LDR
             └──┴──┘
              S1
```

"0" "1"

```
        200  ┌──┬──┐  400
        LDL  ├──┼──┤  LDR
             └──┴──┘
              S1
```

PRESET POSITIONS

	READ RATE	S1(1)
	200	0
PRESET →	400	1

	LOAD DIRECTION	S1(2)
PRESET →	RIGHT	1
	LEFT	0
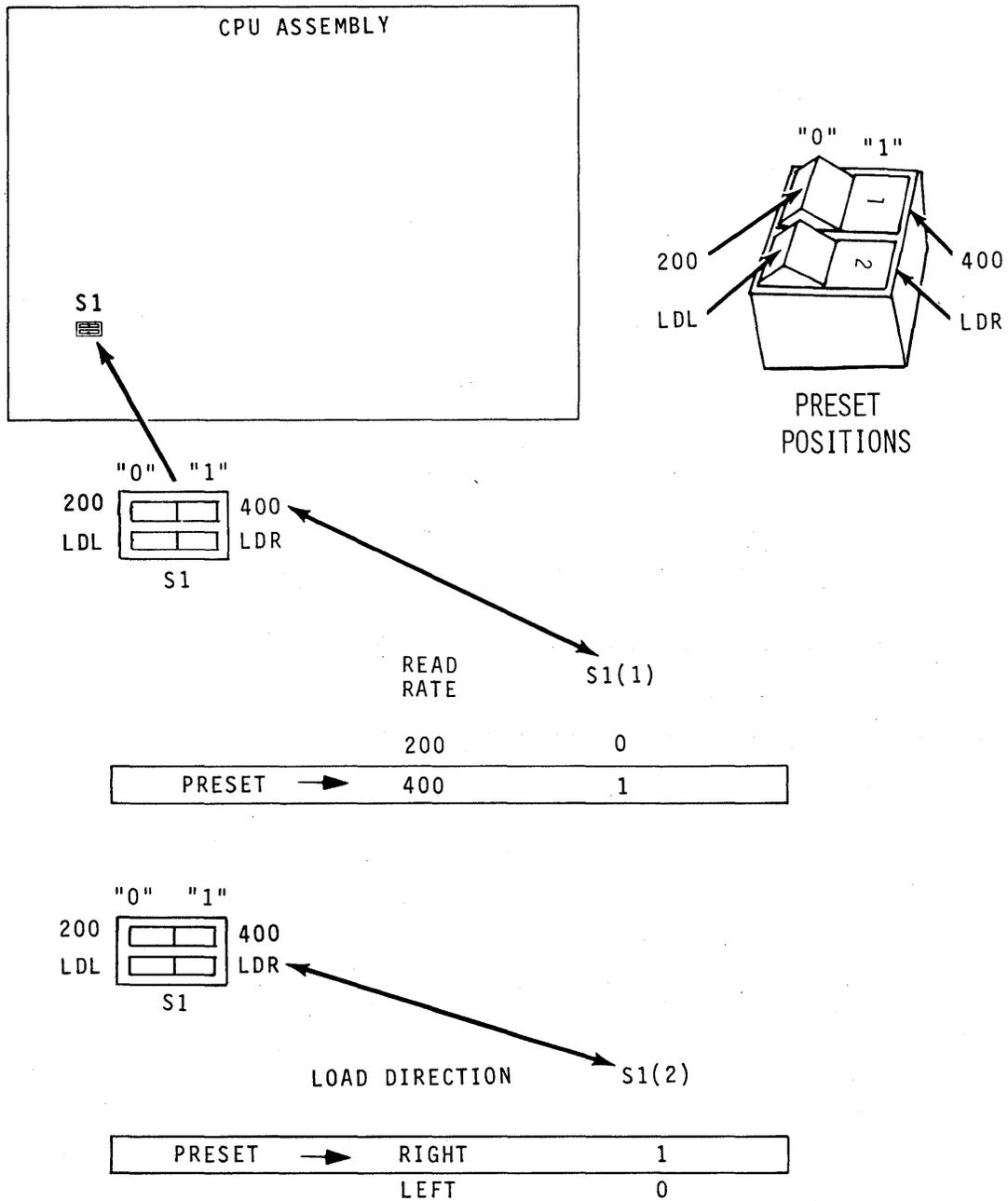
A1264

Figure 4-3.   CPU Switch Settings.

4-3. SIGNAL TIMING

A. Step Timing.

A single DR or DL pulse causes the reader to output one character frame. Figure 4-4 shows the timing relationships between the control signals involved.

Figure 4-4. Step Timing.
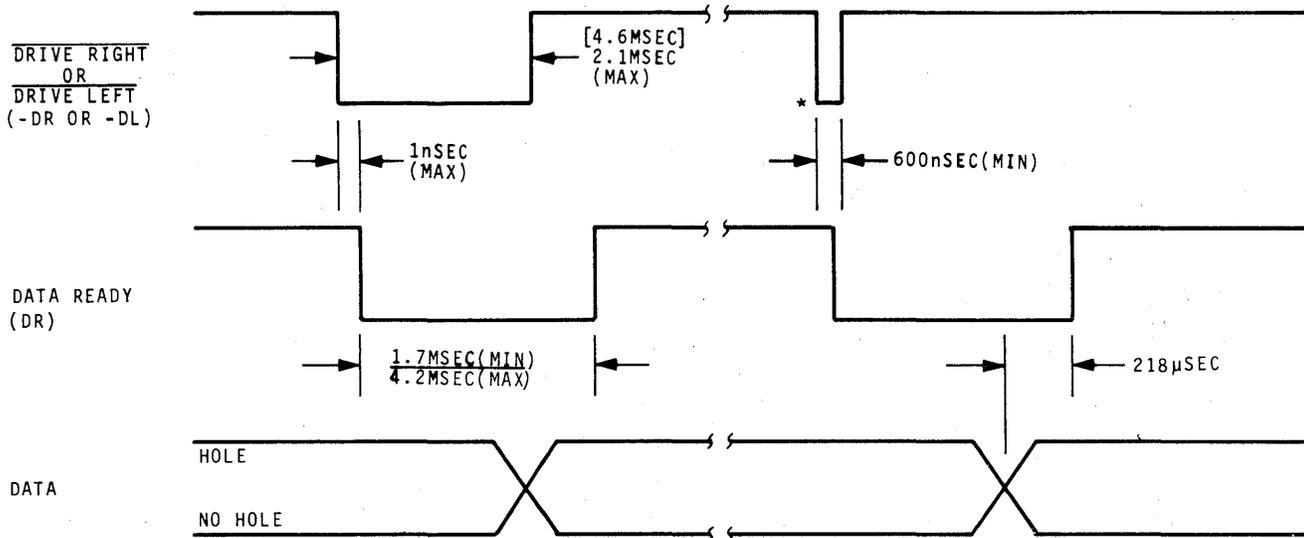
NOTE:
1. TIMING IS FOR 400 CPS. TIMING IN [BRACKETS] IS FOR 200 CPS.
2. MODE 5 SHOWN.
3. VALUES TYPICAL EXCEPT WHERE NOTED.
* 4. DATA READY MUST BE ACTIVE BEFORE READER WILL ACCEPT NEXT INPUT COMMAND.

A1271

B. Slew Timing.

A DR or DL signal causes the reader to output data continuously. Figure 4-5 shows the timing relationships between the control signals involved.

Figure 4-5. Slew Timing.

C. Turn Around Time (Step or Slew).

On a turn around, one character is output in the reverse direction with the normal timing for step or slew. Additional characters are output as soon as the tape reader can reposition the tape. The time to reposition (t) is 2 seconds (maximum) for reel mode and 200 milliseconds (maximum) for loop mode.

DRIVE RIGHT
(-DR)

0 nSEC(MIN)

DRIVE LEFT
(-DL)

1μSEC(MAX)   t

DATA READY
(DR)

1.7MSEC(MIN)
6.8MSEC(MAX)

DATA

A1297
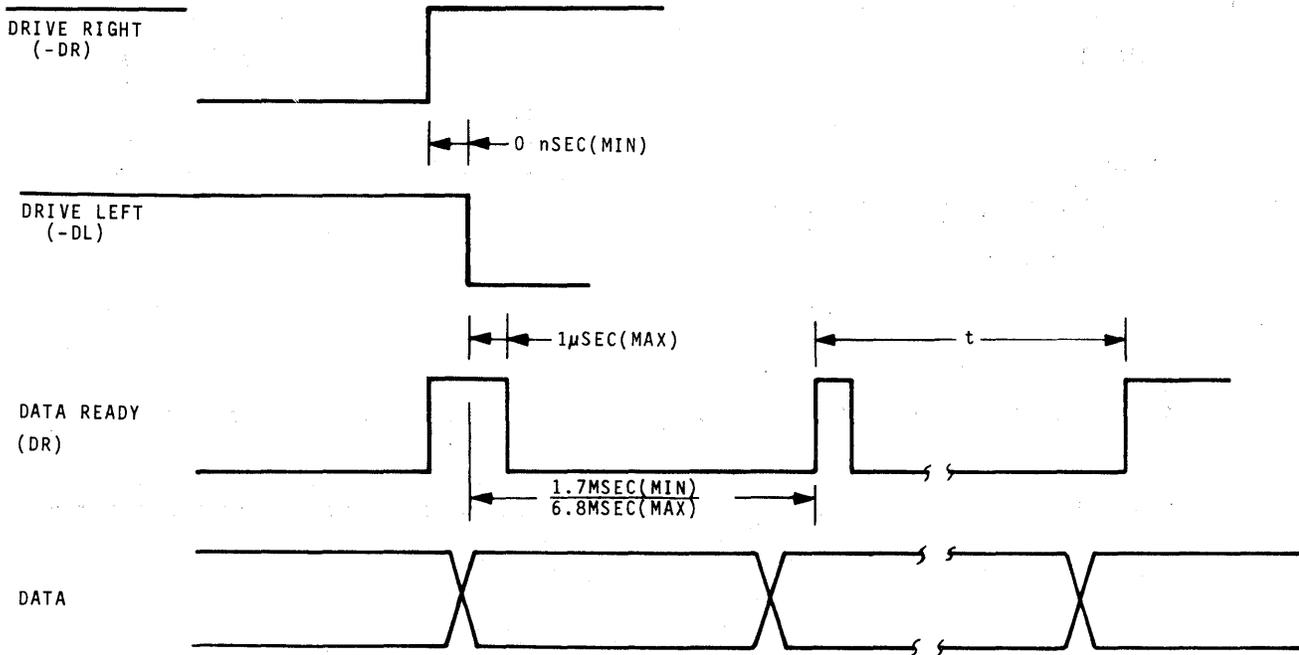
Figure 4-6.   Turn Around Time.

D. Rewind (External).

Data is output at a maximum rate of 400 characters per second in response to a rewind command.
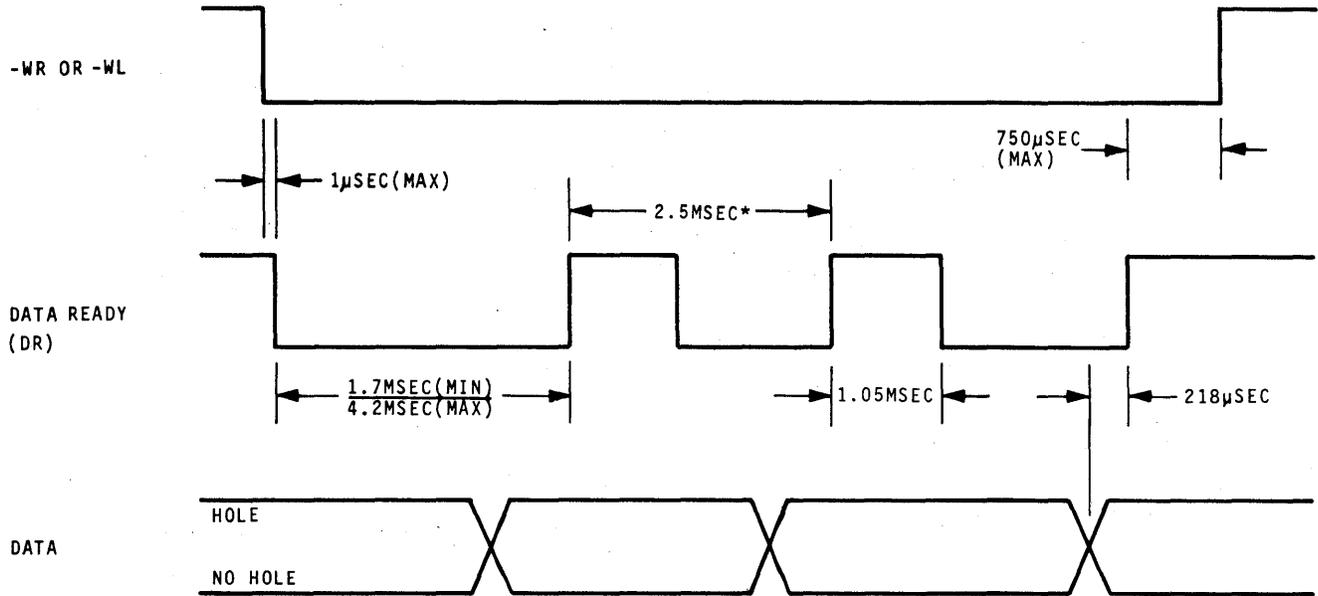
NOTE: MODE 5 SHOWN

* PERIODS OF TIME MAY EXIST WHERE CHARACTERS ARE NOT AVAILABLE IN THE INTERNAL BUFFER. IN THIS CASE THE TIME BETWEEN CHARACTERS WILL DEPEND UPON THE SPEED OF THE REELS.

A1267

Figure 4-7. Rewind (External).

E. Rewind (Front Panel).

Momentary (less than 50 milliseconds) actuation of the
front panel rewind switch causes the tape reader to
enter the high speed wind mode. Actuation of the
switch in the direction toward the load point causes
the reader to wind until the load point is approached.
The reader slows down and then stops when the load
point is reached. The READER READY signal is used to
indicate that the reader is busy during rewind and
will not accept an external command.

1. Front Panel Rewind (Autostop). Momentary actua-
    tion of the front panel rewind switch toward the
    load point causes the reader to rewind and stop
    automatically at the load point.
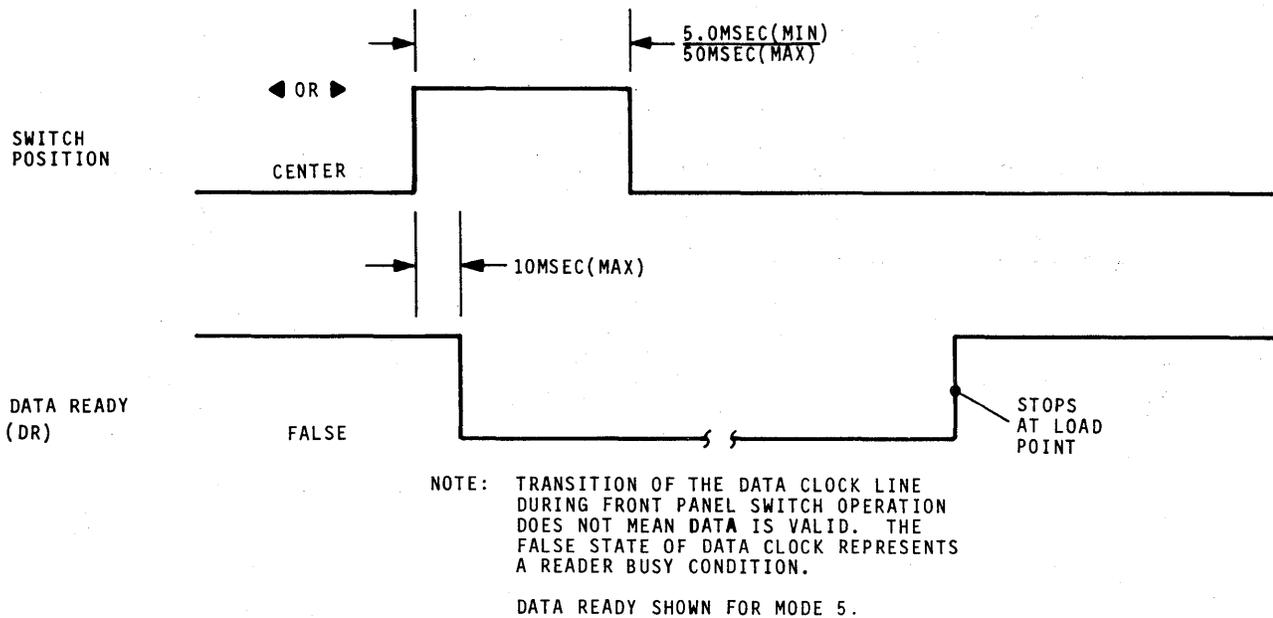
Figure 4-8. Rewind (Autostop).

2. Front Panel Rewind (Manual). Actuation of the front panel switch in either direction causes the reader to wind as long as the switch is held. Momentary operation of the switch also causes the reader to rewind. A second momentary operation of the switch stops the reader motion. If the load point is encountered during momentary operation the reader will stop. To resume winding, actuate the switch again.
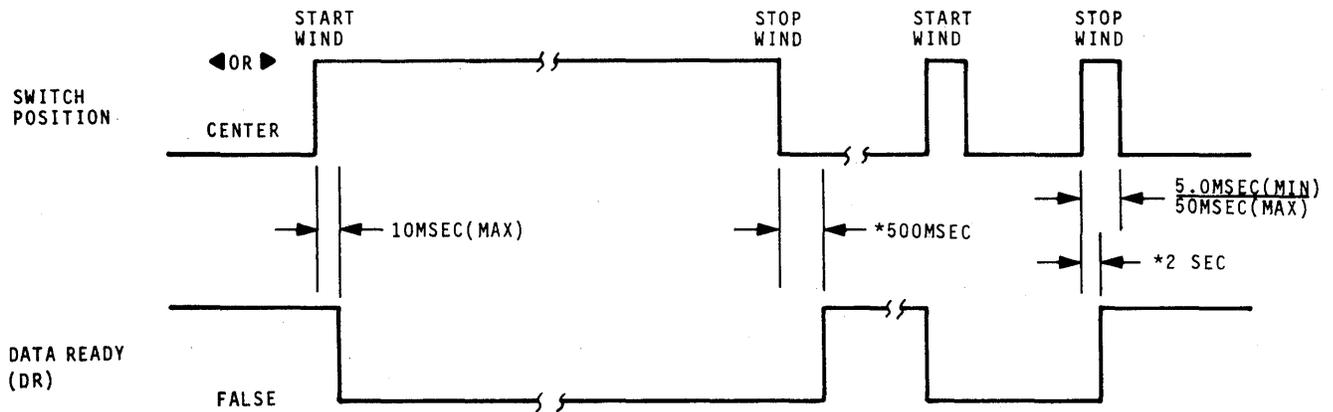
NOTE: IF THE TAPE SHOULD RUN OFF THE END OF THE REEL SYSTEM READY WILL GO FALSE AND DATA READY WILL REMAIN FALSE.

*CAN VARY DUE TO REEL SIZE AND TAPE LOADING.

A1269

Figure 4-9. Rewind (Manual).

SECTION V

INTERFACE - SERIAL I/O

5-1.   DESCRIPTION

The serial interface provides full duplex RS-232C serial
I/O in the reader. Interface connection to user equipment
is provided through the 25-pin I/O connector on the rear
of the reader.

5-2.   INTERFACE CABLE

To interface with other equipment, provide an appropriate
cable using size 22 AWG wire of necessary length not to
exceed 50 feet.   Longer cables may be used, especially in
point-to-point configurations, when the user knows that
the total load capacitance will not exceed 2,500 pF. For
noise immunity, use twisted pair and terminate both ends
of the cable to the ground points. For maximum noise
immunity and minimum high frequency radiation, the cable
should have an overall shield grounded to I/O connector
pin 1. Mating connector is Cannon P/N DB25P.

DTE (NUMERICAL CONTROL)   DCE (EECO READER)
        (DB25P)   (DB25S)
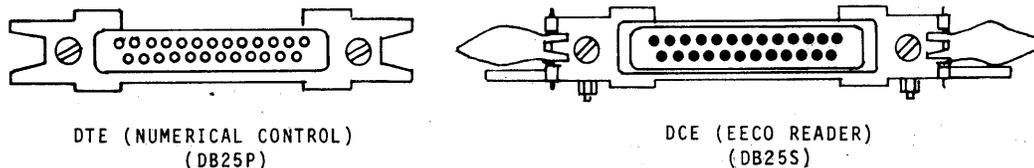
AI306

Figure 5-1.   25-Pin Connector.

NOTE

Signal ground and chassis ground are
internally connected for maximum reader
immunity to power line transient voltages.
Users wishing to employ single-point
grounding in their system can disconnect
signal ground from chassis ground by re-
moving the shorting screw (figure 5-2).
With the internal ground connection removed,
it is especially important that chassis
ground and system ground be externally con-
nected by a low impedance at high frequen-
cies; otherwise power line transients may
develop chassis voltage disturbances suf-
ficient to cause system malfunction.
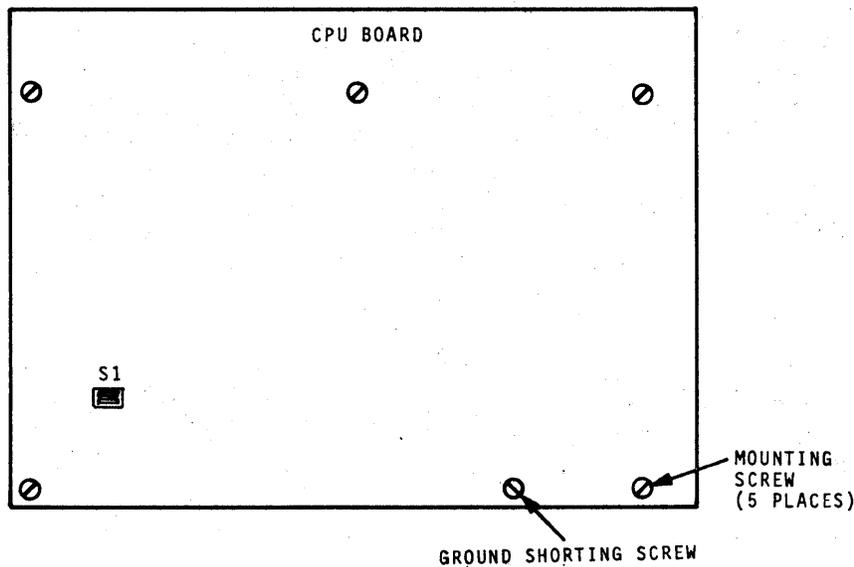
AI304

Figure 5-2.   Ground Shorting Screw.

Table 5-1. Connector Pin List

PIN	RS232C	RS232C DESCRIPTION	COMMENT
1	AA	Protective GND (PG)	Chassis GND in RDR
*2	BA	Transmitted Data (TD)	Reader Receive Line
*3	BB	Received Data (RD)	Reader Transmit Line
4	CA	Request To Send (RTS)	Reader Input
5	CB	Clear To Send (CTS)	Reader Output
6	CC	Data Set Ready (DSR)	Reader Output
7	AB	Signal Ground (SG)	Logic Ground
12	SCF	Secondary Received Line Signal Detector	Current loop send A
13	SCB	Secondary Clear to Send	Current loop receive A
20	CD	Data Terminal Ready (DTR)	Reader Input
24	DA	Transmit Signal Element Timing	Current loop send B
25		Unassigned	Current loop receive B

*Pins 2 and 3 may have transmitted data and received data inter-
changed by setting switch S3 in the appropriate position. The
assignments shown are with S3 set in the "3" position.

5-3.   ELECTRICAL CHARACTERISTICS

A number of electrical parameters and limitations are
defined by RS-232C for each interchange circuit. They
refer to the equivalent interchange circuit shown in
figure 5-3. All voltage measurements are made at the
interface point and with reference to signal ground.
Circuit voltage levels are shown in figure 5-4.
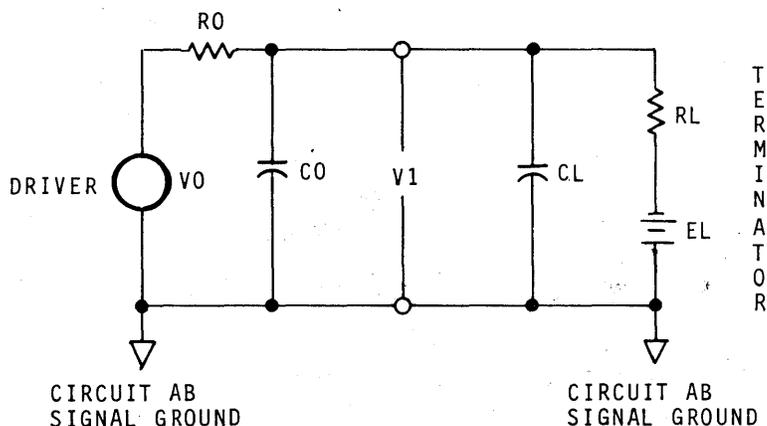
AI303

Figure 5-3. Equivalent Circuit.

```
                          ┌─ +25 VOLTS
┌─────────────────────────┤
│ PERMISSIBLE OPEN-CIRCUIT │
│        VOLTAGE           │
│                          ├─ +15 VOLTS
├─────────────────────────┤
│     LOGICAL "0"          │
│    "ON" CONDITION        │
│       "SPACE"            │
│                          ├─ +5 VOLTS
├─────────────────────────┤
│     NOISE MARGIN         │
│                          ├─ +3 VOLTS
├─────────────────────────┤
│╳╳╳╳╳TRANSITION╳╳╳╳╳╳│
│                          ├─ 0 VOLTS ─ CIRCUIT AB
│╳╳╳╳╳REGION╳╳╳╳╳╳╳│              REFERENCE VOLTAGE
│                          ├─ -3 VOLTS
├─────────────────────────┤  -5 VOLTS
│     NOISE MARGIN         │
├─────────────────────────┤
│     LOGICAL "1"          │
│    "OFF" CONDITION       │
│       "MARK"             │
│                          ├─ -15 VOLTS
├─────────────────────────┤
│ PERMISSIBLE OPEN-CIRCUIT │
│        VOLTAGE           │
│                          └─ -25 VOLTS
└─────────────────────────┘
```
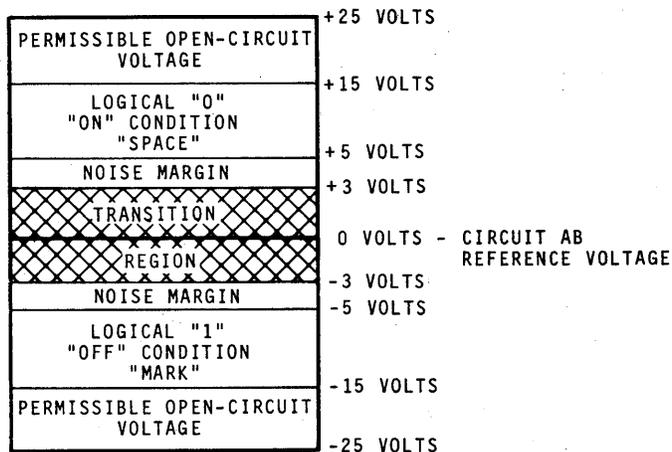
AI303

Figure 5-4.   Circuit Voltage Levels.

A.   Parameters

1.   Open circuit voltage from the driver shall not be
     greater than ±25 volts.

2.   The open circuit voltage of the terminator shall
     not exceed ±2 volts.

3.   The total capacitance of the terminator shall not
     exceed 2,500 picofarads.

4.   The driver output voltage must be between 5 and 15
     volts when the total terminator input resistance
     is between 3 Kohms and 7 Kohms.

5.   The output impedance of the driver circuit, when
     the driver power is off, shall not exceed 300
     ohms.

6.   The rate of change of the driver output voltage
     (slew rate) shall not exceed 30 volts per micro-
     second.

B.   Logic State Definition

1.   A logical "1" (MARK) is indicated when the voltage
     at the interface point is more negative than -3
     volts.

2. A logical "0" (SPACE) is indicated when the voltage at the interface point is more positive than +3 volts.

3. To indicate a "1" signal condition (MARK), the driver shall assert a voltage between -5 volts and -15 volts.

4. To indicate a "0" signal condition (SPACE), the driver shall assert a voltage between +5 volts and +15 volts.

NOTE

These standards allow for a 2-volt noise margin between the minimum driver voltage of 5 volts and the maximum undefined voltage of 3 volts.

C. Transition Region

1. All interchange signals entering the transition region proceed to the opposite valid signal state and do not re-enter the transition region until the next significant change in signal state.

2. While in the transition region, the direction of the voltage change must not reverse.

3. The time required for a control signal to cross the transition region must not exceed one millisecond.

4. The time required for a data or timing signal to cross the transition region must not exceed one millisecond or four percent of the nominal signal period, whichever is the shorter.

5-4. SERIAL WORD FORMAT

SERIAL WORD FORMAT

SPACE

| START | DATA CH 1 | DATA CH 2 | DATA CH 3 | DATA CH 4 | DATA CH 5 | DATA CH 6 | DATA CH 7 | DATA CH 8 | PARITY | STOP 1 | STOP 2 |
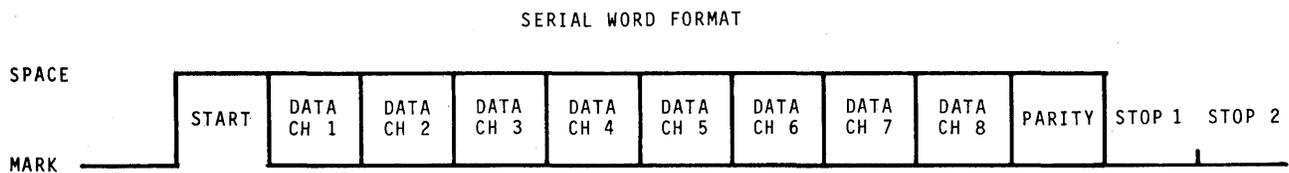
MARK

AI307

The serial bit stream shown above is that which would be viewed on pin 3 of the serial I/O connector when transmitting 8 data bits, parity, and two stop bits. A data

5-5

channel "on hole" is represented as a MARK in the appropriate bit position.

The output serial word is configured as follows:

1. Selectable word length 5, 6, 7, or 8 bits per character. Word lengths of 8 bits must be used for Level II protocol.

2. Selectable·stop bits 1 or 2.

3. Parity enable/disable.

4. Parity select odd/even.

5-5. SIGNAL DEFINITIONS

A. <u>Signal Ground - SG</u>

This conductor connects the numerical control circuit ground directly to the reader circuit ground.

B. <u>Request to Send - RTS (Level I protocol only)</u>

This output signal from the numerical control, when in an "ON" condition, indicates that the numerical control is ready to accept data. The signal may be changed to an "OFF" condition to temporarily suspend the transfer. The transfer resumes when the signal is changed back to the "ON" condition.

To allow for delays in the system, the numerical control must provide buffering for a minimum of five characters after changing "RTS" to "OFF". Any character transmission in progress when "RTS" goes to the "OFF" condition will be completed, but the next character will not be transmitted.

C. <u>**Data Terminal** Ready</u>

Reader input - not used.

D. <u>Data Set **Ready** - DSR</u>

This circuit is supplied by the reader. The "ON" condition indicates that power is supplied to the reader. **All other** circuits supplied by the reader are not considered valid unless DSR in "ON."

E. Receive Data - RD

This circuit is supplied by the reader. It is the actual data being read from the tape. Data is sent using asynchronous, 8-bit, character-oriented transmission.

F. Transmit Data - TD (Level II Protocol Only)

This circuit is supplied by the numerical control. It is the control signal path to the reader. Data is sent using asynchronous, 8-bit, character-oriented transmission.

G. Protective Ground

This is the chassis ground which is tied to earth ground through the AC connector.

5-6. CURRENT LOOP

A passive 20 mA current loop transmitter and receiver are provided. Both transmitter and receiver have full-wave rectified inputs, thus positive and negative current flow is properly connected to the reader circuit.

A. Electrical Requirements

The numerical controller must supply two current sources of 18 to 25 mA each.

1. Voltage Requirements. Each current source must supply a minimum head voltage to the reader of 8 volts.

2. Signal Definition. The flow of current designates a MARK. The absence of current designates a SPACE.

    a. MARK. Current flow designates a MARK. In RS-232 definitions, this is an "OFF" condition. The reader's receiver must be supplied a minimum of 18 mA to recognize a MARK.

    b. Space. No current flow designates a SPACE. In RS-232 definitions, this is an "ON" condition. The reader transmitter has a minimum impedance of 10 Kohms in the SPACE condition. The receiver recognizes any current flow less than 1 mA as a SPACE.

B. Signal Definitions

A pair of terminals are provided for both transmit and
receive.

1. Transmit. The transmit lines are:

Current loop send data A, and
Current loop send data B.

2. Receive. The receive lines are:

Current loop receive data A, and
Current loop receive data B.

A typical connection for full duplex operation requires
the Data Terminal Equipment to provide the current source
for both sending and receiving as shown in Figure 5-5.
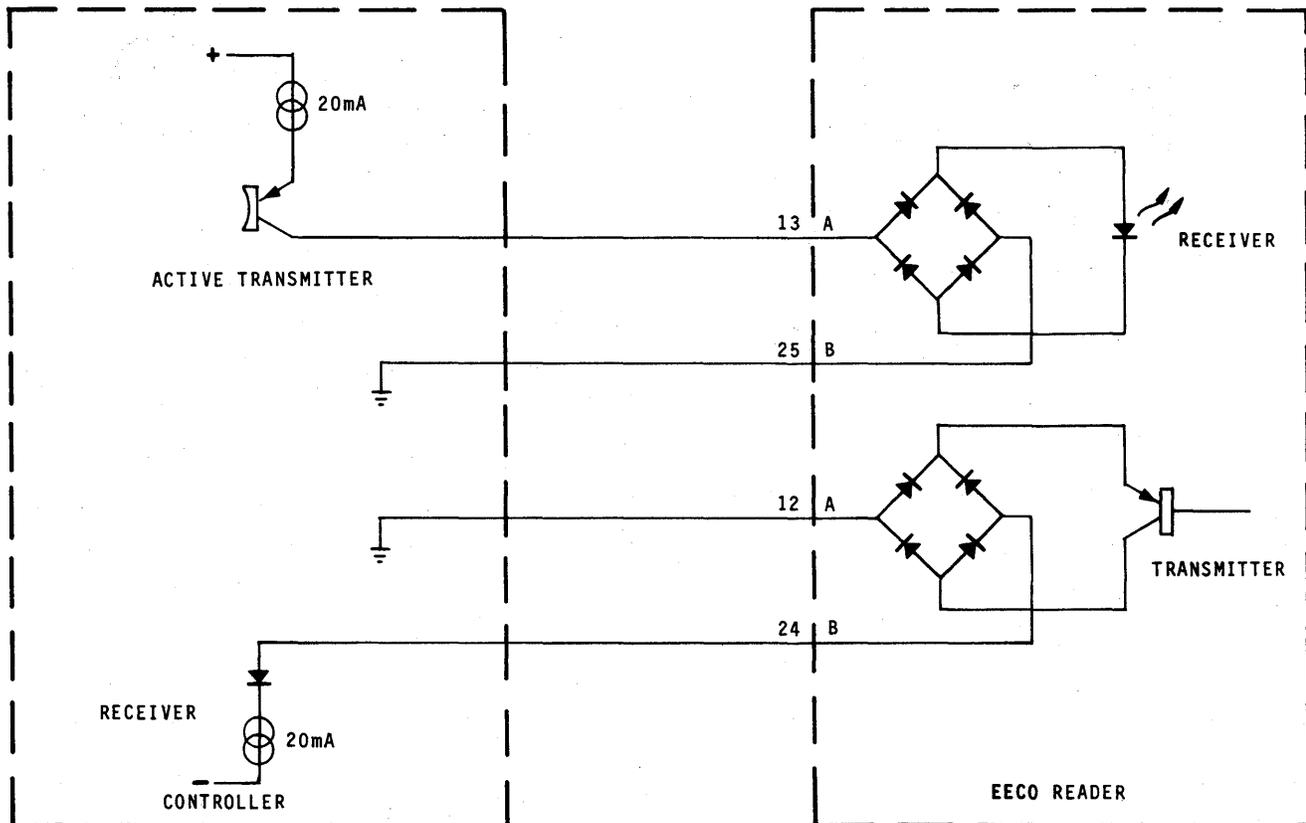
Figure 5-5. Current Loop Interconnector Diagram.

5-7. PROTOCOL

Two protocols are recognized by the reader. The protocols are called Level I and Level II.

A. Level I Protocol

This protocol is intended to be used with simple peripheral devices in a hardware environment. It is based on the use of the control signal RTS to start and stop data transmission. Tape moves in the direction selected by Load Direction switch S1(2): left if the switch is set to LDL, right if the switch is set to LDR.

1. Communication Control

    a. RTS. This output signal from the numerical control, when in an "ON" condition, indicates that the numerical control is ready to accept data. The signal may be changed to an "OFF" condition to temporarily suspend the transfer. The transfer resumes when the signal is changed back to the "ON" condition.

    To allow for delays in the system, the numerical control provides buffering for a minimum of five characters after changing RTS to "OFF." Any character transmission in progress when RTS goes to the "OFF" condition is completed, but the next character is not transmitted.

    b. End Condition. There is no automatic transfer complete indication. As this protocol is intended for simple hardwired use, either end of the communications link may cause transmission termination.

    c. Leader/Trailer. Blank tape (null characters) may be transmitted immediately before and immediately after the part program data.
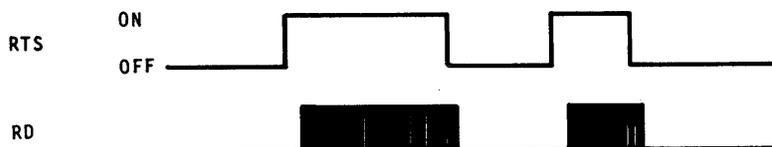
Figure 5-6. Level I Protocol.

AI283

B. **Level II Protocol** (See Figure 5-7)

This protocol provides a basic communications capability between a numerical control and the reader. It enables either to temporarily suspend transmission from the other due to buffering constraints or a higher priority task, such as a complex machining cycle. It does not incorporate any form of error detection other than transmission parity. Characters received by the reader that have a transmission parity error are ignored.

1. **Communication Control Characters.**

a. **DC1.** This character functions as "reader start." It indicates that data should be sent. This character must be transmitted to start a transfer.

b. **DC3.** This character functions as "reader stop." It indicates that data being sent should be stopped.

Upon receipt of a DC3 the reader immediately stops sending characters. To allow for delays in the system, however, the receiving end provides buffering for a minimum of five characters after transmitting a DC3.

c. **BS.** This character functions as "backspace." It is functionally equivalent to DC1, except that it indicates the data stream is reversed. This provides a mechanism to "read" the reader data in reverse.

d. **CAN.** This character puts the reader in high speed wind right. No data is output. Winding stops upon the receipt of a DC3. A two-second delay must be provided after a stop from a high speed wind before sending the reader a new command.

e. **ETB.** This character puts the reader in high speed wind left. No data is output. A two-second delay must be provided after a stop from a high speed wind before sending the reader a new command.

2. Data Protocol

   a. <u>To Receive Data (Numerical Control)</u>

      The numerical control initiates communication.
      To accomplish this, the numerical control
      transmits a DC1 and becomes the receiving end.
      It is recommended that it continue to transmit
      a DC1 every 3 seconds until it begins to re-
      ceive data.

      The tape reader recognizes the DC1 as an in-
      dication that data may be sent and becomes the
      sending end as well as the responding end.

      The use of the 3-second time is optional. It
      is recommended that a means of overriding it
      be provided if it is implemented (such as a
      command from a keyboard).

   b. <u>Data Transmission</u>

      (1) <u>Sending End (Reader)</u>

          Following a DC1 input, the reader begins
          and continues to read and serially trans-
          mit tape data at the maximum character
          rate allowed by the baud rate and charac-
          ter length settings or 400 cps, whichever
          is lower. The reader continues to send
          data until a DC3 is received to terminate
          transmission.

          Blank tape characters are transmitted
          when encountered.

          If the reader should run out of tape or
          encounter a broken tape condition, trans-
          mission is suspended.

      (2) <u>Receiving End (Numerical Control)</u>

          The receiving end may transmit a DC3 at
          any time during a transfer. This indi-
          cates that the receiving end needs to
          temporarily suspend the transfer. The
          reader immediately stops transmitting
          upon receipt of the DC3. To allow for
          system and network delays, the receiving
          end allows for a minimum of five char-
          acters of additional buffering after
          transmitting the DC3. When the receiving

end is again able to receive data, it
transmits a DC1. The reader recognizes
this and resumes the transfer exactly
where it had been suspended. This me-
chanism allows the receiving end to sus-
pend the transfer if it has run out of
available buffering, cannot keep up with
the baud rate being used, or has a higher
priority task to perform.
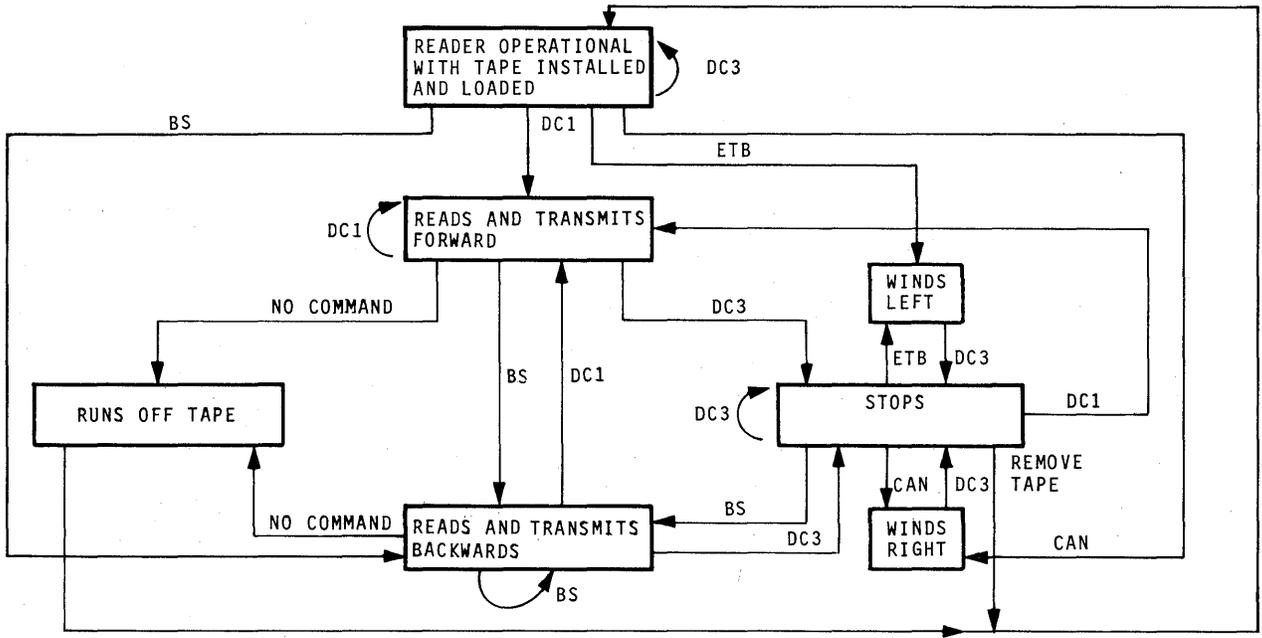
Figure 5-7. Level II Control Protocol.

CPU ASSEMBLY

"0" "1"

200   400

LDL   LDR

PRESET
POSITIONS

S1

"0"   "1"

200 [   ] 400
LDL [   ] LDR
        S1

READ   S1(1)
RATE

PRESET →	200	0
	400	1

"0"   "1"

200 [   ] 400
LDL [   ] LDR
        S1

LOAD DIRECTION   S1(2)

PRESET →	RIGHT	1
	LEFT	0

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"0" "1"

[   ] 400
[   ] LDR
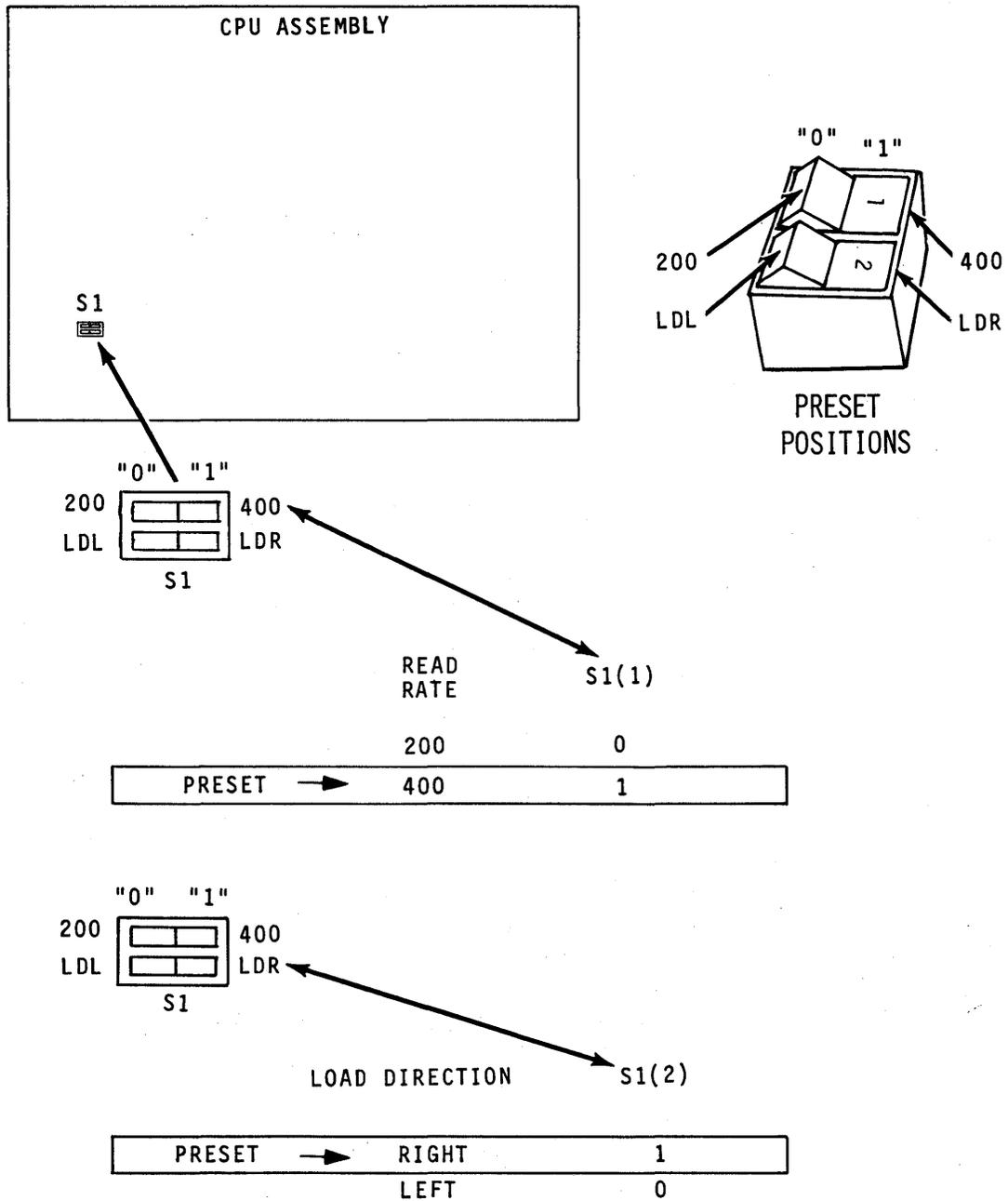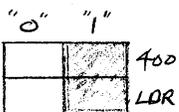
S1 as of
12-1-87 MDL

Figure 5-8.   CPU Switch Settings.

PRESET
POSITION
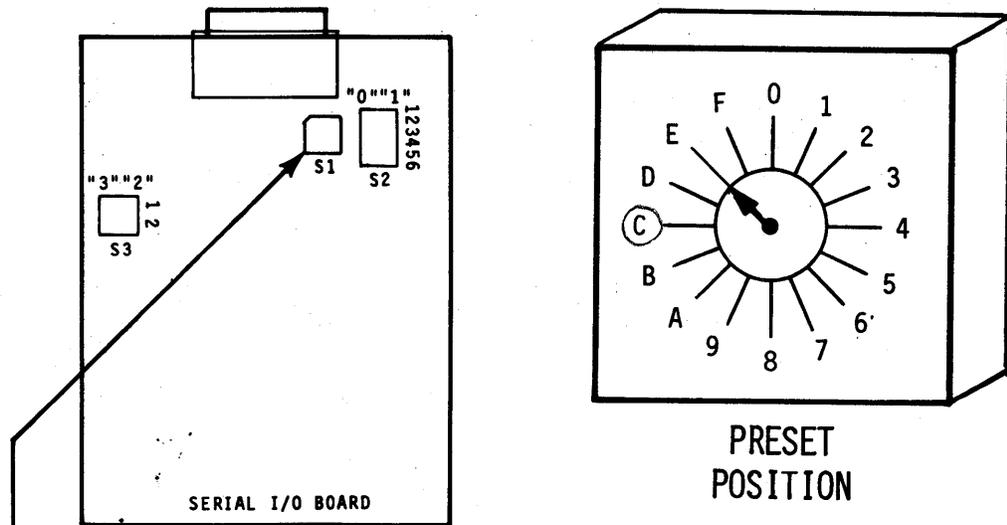
SWITCH SETTING	BAUD RATE	CHARACTER TRANSMISSION RATE CH/SEC.*
0	50	4.17
1	75	6.25
2	110	9.17
3	134.5	11.21
4	150	12.5
5	300	25.0
6	600	50
7	1200	100
8	1800	150
9	2000	167
A	2400	200
B	3600	300
C	4800	400
D	7200	400
E	9600	400
F	19200	400

PRESET → E

* CALCULATED USING 1 START BIT, 8 DATA BITS,
  1 PARITY BIT AND 2 STOP BITS.

NOTE: THE SERIAL INTERFACE OPERATES ON A
        SINGLE GIVEN BAUD RATE.
        THERE IS NO PROVISION TO OPERATE
        WITH A SPLIT BAUD RATE.

AI30I

Figure 5-9. Baud Rate Switch Settings - S1.

"0" "1"
S2
1 2 3 4 5 6

S1 S2 "0""1" 123456

"3""2" 1 2
S3

SERIAL I/O BOARD

"0" "1"
1 2 3 4 5 6
S2

PRESET
POSITIONS

DATA BITS	S2(3)	S2(2)
5	1	1
6	1	0
7	0	1
PRESET → 8	0	0

"0" "1"
1 2 3 4 5 6
S2

STOP BITS	S2(5)
1	1
PRESET → 2	0

"0" "1"
1 2 3 4 5 6
S2

PARITY	S2(4)	S2(1)
ODD	1	1
EVEN	1	0
PRESET → NONE	0	0
NONE	0	1

"0" "1"
1 2 3 4 5 6
S2

PROTOCOL	S2(6)
LEVEL I	1
PRESET → LEVEL II	0

BI052

"0" "1"
1 2 3 4 5 6

S2 AS of
12-1-87
MR
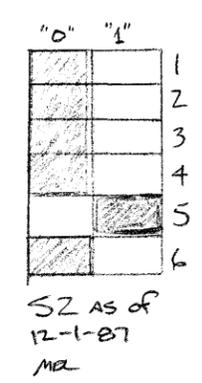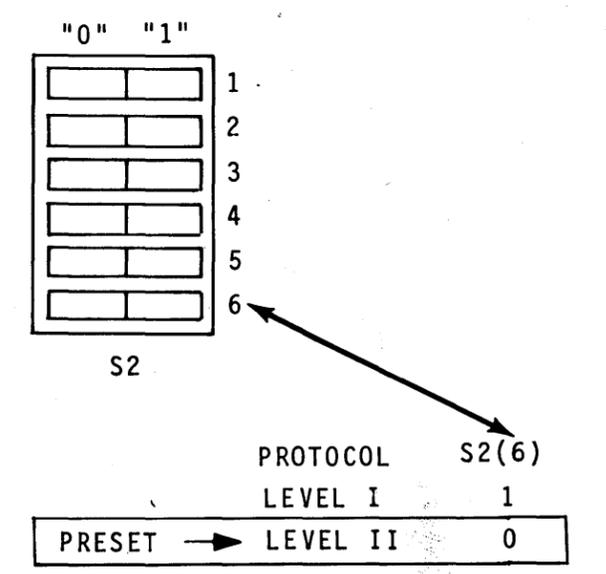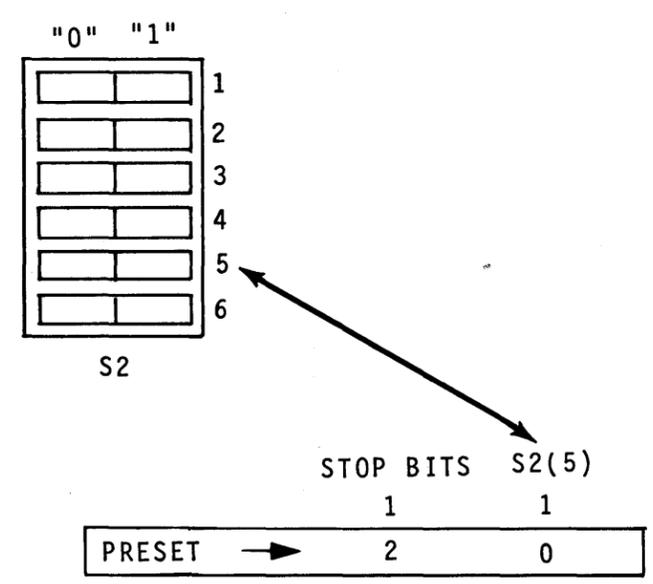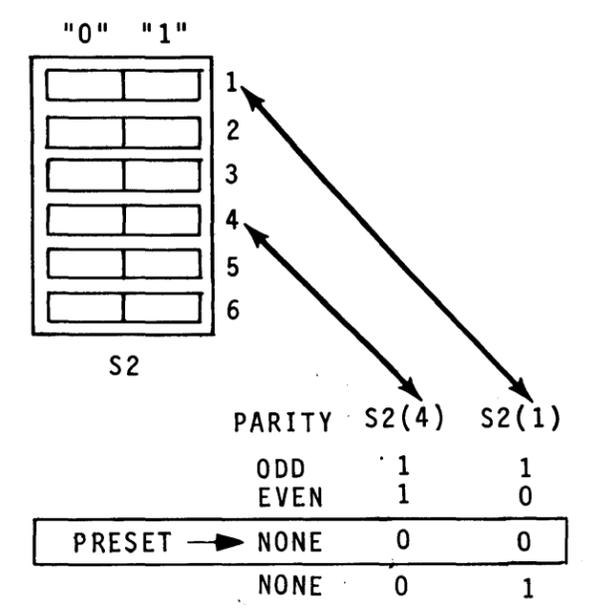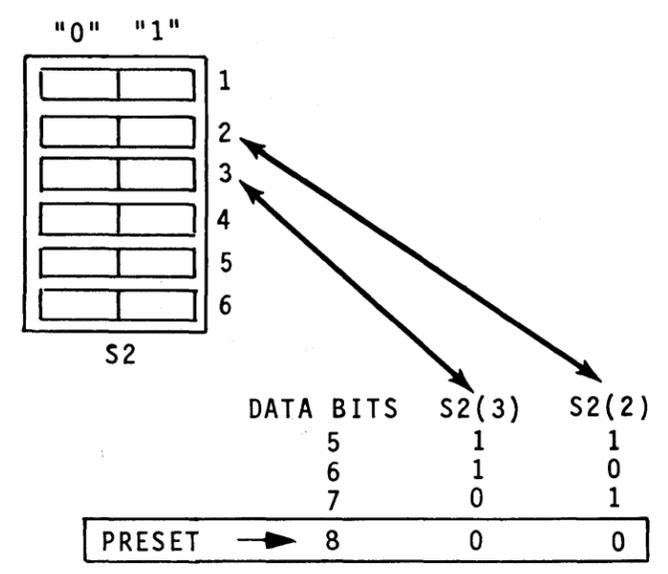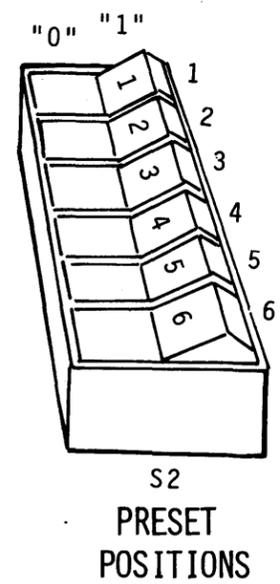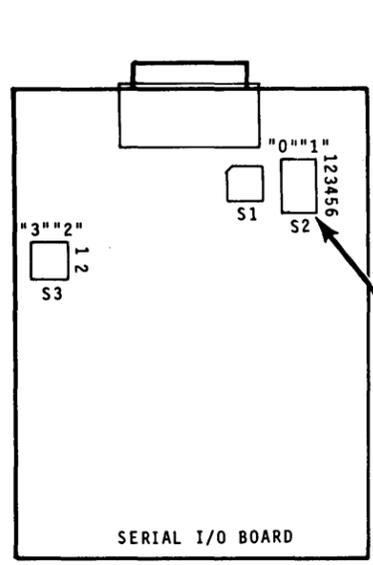
Figure 5-10. Data Configuration
Switch Settings - S2.

5-15/5-16

PRESET POSITIONS

SERIAL I/O BOARD

"3" "2"

S3

A1299

READER TRANSMIT/RECEIVE PINS	S3(2)	S3(1)
TAPE DATA PIN 2/READER COMMAND PIN 3	2	2
PRESET → TAPE DATA PIN 2/READER COMMAND PIN 2	3	3
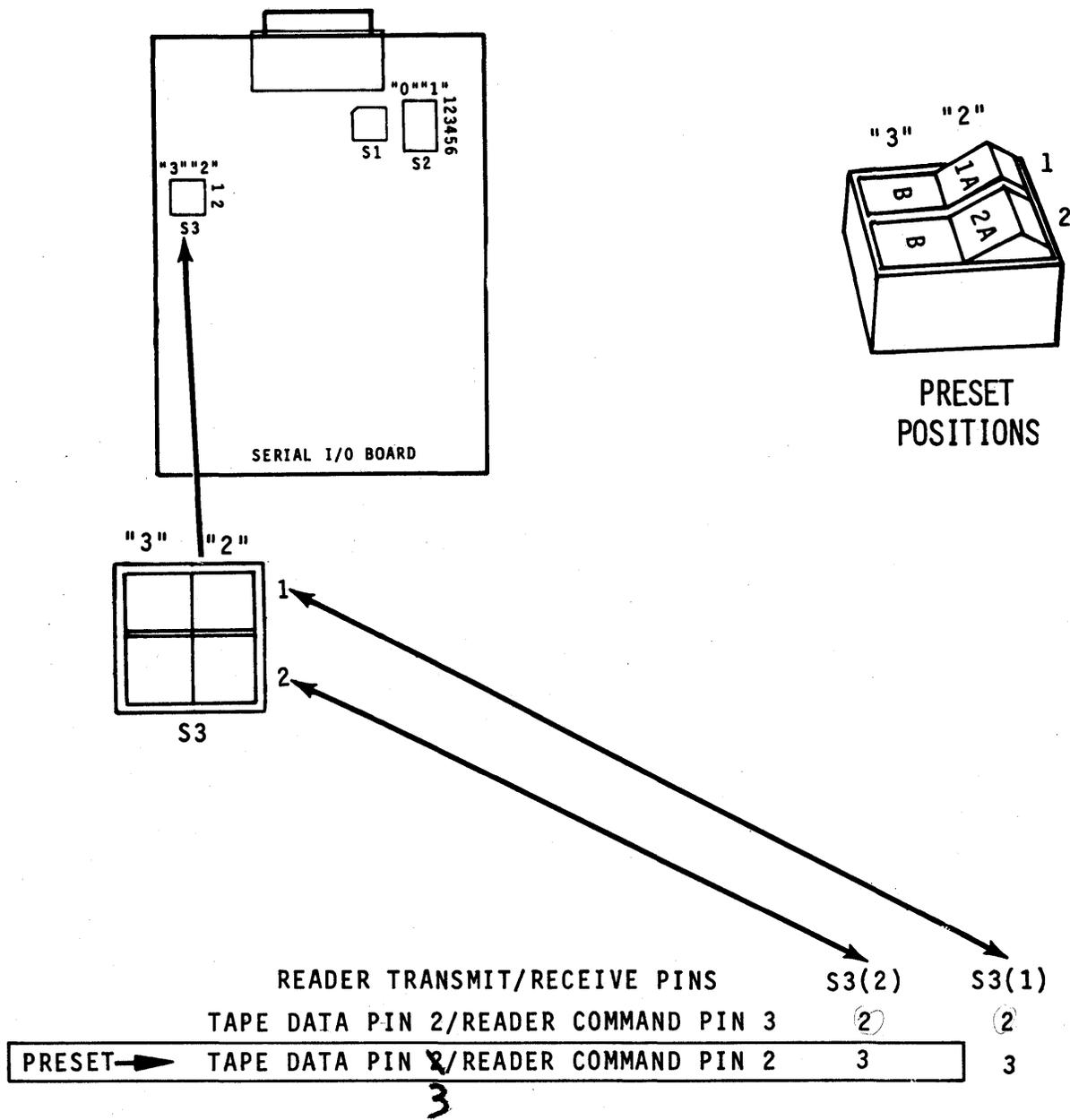
Figure 5-11. I/O Switch Settings - S3.

"3" "2"

1

2

S3 As of
12-1-87 MA
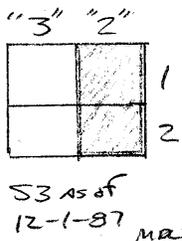
Table 5-2. RS-232C Functions and Reader Applications

CONNECTOR PIN #	RS-232	EECO READER
1	Protective Ground. Electrical equipment frame and ac power ground.	Reader chassis ground.
2	Transmitted Data. Data originated by the terminal to be transmitted via the sending modem.	*Reader command input. Level II protocol.
3	Received Data. Data from the receiving modem in response to analog signals transmitted from the sending modem.	*Reader data output.
4	Request to Send. Indicates to the sending modem that the terminal is ready to transmit data.	Reader Drive command Level I protocol.
5	Clear to Send. Indicates to the terminal that its modem is ready to transmit data.	"ON" when reader is powered up.
6	Data Set Ready. Indicates to the terminal that its modem is not in a test mode and that modem power is ON.	"ON" when reader is powered up.
7	Signal Ground. Establishes common reference between the modem and the terminal.	Reader signal ground.
8	Received Line Signal Detector. Indicates to the terminal that its modem is receiving carrier signals from the sending modem.	
9	Reserved for test.	
1Ø	Reserved for test.	
11	Unassigned.	

*These two assignments may be interchanged by setting switch 3.

Table 5-2. RS-232C Functions and Reader Applications
(continued)

CONNECTOR PIN #	RS-232	EECO READER
12	Secondary Received Line Signal Detector. Indicates to the terminal that its modem is receiving secondary carrier signals from the sending modem.	Current Loop send A.
13	Secondary Clear to Send. Indicates to the terminal that its modem is ready to transmit signals via the secondary channel.	Current Loop receive A.
14	Secondary Transmitted Data. Data from the terminal to be transmitted by the sending modem's channel.	
15	Transmitter Signal Element Timing. Signal from the modem to the transmitting terminal to provide signal element timing information.	
16	Secondary Received Data. Data from the modem's secondary channel in response to analog signals transmitted from the sending modem.	
17	Receiver Signal Element Timing. Signal to the receiving terminal to provide signal element timing information.	
18	Unassigned.	
19	Secondary Request to Send. Indicates to the modem that the sending terminal is ready to transmit data via the secondary channel.	
20	Data Terminal Ready. Indicates to the modem that the associated terminal is ready to receive and transmit data.	

Table 5-2. RS-232C Functions and Reader Applications
(continued)

| CONNECTOR PIN #	RS-232	EECO READER
21	Signal Quality Detector. Signal from the modem telling whether a defined error rate in the received data has been exceeded.	
22	Ring Indicator. Signal from the modem indicating that a ringing signal is being received over the line.	
23	Data Signal Rate Selector. Selects one of two signaling rates in modems having two rates.	
24	Transmit Signal Element Timing. Transmit clock provided by the terminal.	Current Loop Send B.
25	Unassigned.	Current Loop Receive B.

Table 5-3. ASCII Character Set

ASCII CHAR.	BINARY	OCT	HEX	DEC
NULL	00000000	000	00	0
SOH	00000001	001	01	1
STX	00000010	002	02	2
ETX	00000011	003	03	3
EOT	00000100	004	04	4
ENQ	00000101	005	05	5
ACK	00000110	006	06	6
BELL	00000111	007	07	7
3S	00001000	010	08	8
HT	00001001	011	09	9
LF	00001010	012	0A	10
VT	00001011	013	0B	11
FF	00001100	014	0C	12
CR	00001101	015	0D	13
SO	00001110	016	0E	14
SI	00001111	017	0F	15
DLE	00010000	020	10	16
DC1	00010001	021	11	17
DC2	00010010	022	12	18
DC3	00010011	023	13	19
DC4	00010100	024	14	20
NAK	00010101	025	15	21
SYNC	00010110	026	16	22
ET3	00010111	027	17	23
CAN	00011000	030	18	24
EM	00011001	031	19	25
SC3	00011010	032	1A	26
ESC	00011011	033	1B	27
FS	00011100	034	1C	28
GS	00011101	035	1D	29
PS	00011110	036	1E	30
CS	00011111	037	1F	31
SPACE	00100000	040	20	32
!	00100001	041	21	33
"	00100010	042	22	34
#	00100011	043	23	35
$	00100100	044	24	36
%	00100101	045	25	37
&	00100110	046	26	38
'	00100111	047	27	39
(	00101000	050	28	40
)	00101001	051	29	41
=	00101010	052	2A	42
+	00101011	053	2B	43
,	00101100	054	2C	44
-	00101101	055	2D	45
.	00101110	056	2E	46
/	00101111	057	2F	47
0	00110000	060	30	48
1	00110001	061	31	49
2	00110010	062	32	50
3	00110011	063	33	51
4	00110100	064	34	52
5	00110101	065	35	53
6	00110110	066	36	54
7	00110111	067	37	55
8	00111000	070	38	56
9	00111001	071	39	57
:	00111010	072	3A	58
;	00111011	073	3B	59
<	00111100	074	3C	60
=	00111101	075	3D	61
>	00111110	076	3E	62
?	00111111	077	3F	63
@	01000000	100	40	64
A	01000001	101	41	65
B	01000010	102	42	66
C	01000011	103	43	67
D	01000100	104	44	68
E	01000101	105	45	69
F	01000110	106	46	70
G	01000111	107	47	71
H	01001000	110	48	72
I	01001001	111	49	73
J	01001010	112	4A	74
K	01001011	113	4B	75
L	01001100	114	4C	76
M	01001101	115	4D	77
N	01001110	116	4E	78
O	01001111	117	4F	79
P	01010000	120	50	80
Q	01010001	121	51	81
R	01010010	122	52	82
S	01010011	123	53	83
T	01010100	124	54	84
U	01010101	125	55	85
V	01010110	126	56	86
W	01010111	127	57	87
X	01011000	130	58	88
Y	01011001	131	59	89
Z	01011010	132	5A	90
[	01011011	133	5B	91
\	01011100	134	5C	92
]	01011101	135	5D	93
'	01011110	136	5E	94
_	01011111	137	5F	95
°	01100000	140	60	96
a	01100001	141	61	97
b	01100010	142	62	98
c	01100011	143	63	99
d	01100100	144	64	100
e	01100101	145	65	101
f	01100110	146	66	102
g	01100111	147	67	103
h	01101000	150	68	104
i	01101001	151	69	105
j	01001010	152	6A	106
k	01101011	153	6B	107
l	01101100	154	6C	108
m	01101101	155	6D	109
n	01101110	156	6E	110
o	01101111	157	6F	111
p	01110000	160	70	112
q	01110001	161	71	113
r	01110010	162	72	114
s	01110011	163	73	115
t	01110100	164	74	116
u	01110101	165	75	117
v	01110110	166	76	118
w	01110111	167	77	119
	01111000	170	78	120
y	01111001	171	79	121
z	01111010	172	7A	122
{	01111011	173	7B	123
l	01111100	174	7C	124
}	01111101	175	7D	125
~	01111110	176	7E	126
DEL	01111111	177	7F	127

BI053

SECTION VI

OPERATION

6-1. FRONT PANEL SWITCHES (figure 6-1)
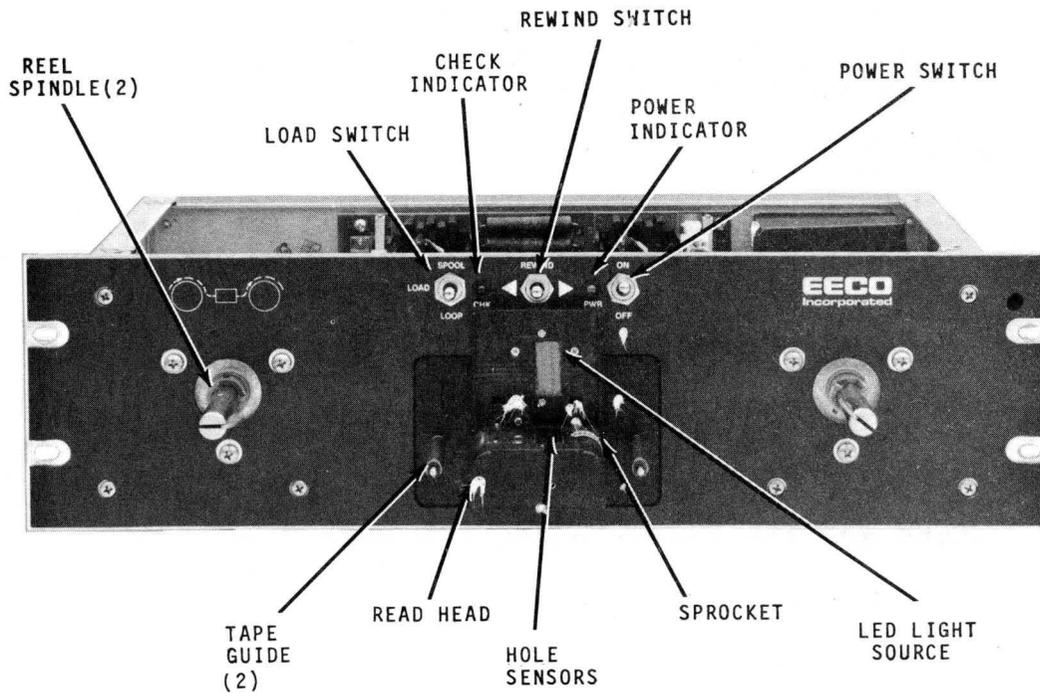
A1257

Figure 6-1. Front Panel Controls and Indicators.

A. __PWR.__

The PWR switch is a two-position toggle switch used to power the reader on and off.

B. __LOAD.__

The LOAD switch is a two-position momentary toggle switch, which, when actuated in the loop direction, causes the reader to enter the loop mode of operation.

Actuation in the spool direction causes the reader to enter the spool mode of operation.

C. REWIND

The REWIND switch is a two-position momentary toggle switch, which, when actuated to the right (▶), causes the reader to move tape in the right direction. Actuating the switch to the left (◀) causes the reader to move tape in the left direction. See figure 6-2.

6-2. FRONT PANEL INDICATORS

A. ON

A yellow LED which illuminates when power is switched on by the PWR switch.

B. CHK

A red LED which illuminates when power is first switched on and remains on or blinking if the reader fails its self-diagnostic checks.

6-3. OPERATOR FUNCTIONS

The front panel switches are used to initialize the reader after the tape has been loaded and to establish a reference point ("load point") on the tape. When the reader is operated from the front panel switches, data I/O operation stops and the reader outputs a reader not-ready signal.

A. To Load the Reader (Spools).

1. Install the tape spools onto the two tape spindles.

2. Open the read head, and thread the tape over the read sensors and under the tape guide rollers as shown on the front panel diagram.

3. Be sure the sprocket holes align with the sprocket teeth in the read head.

4. Close the read head.

5. Momentarily push the LOAD switch to the SPOOL position. The reader will run in the direction selected by switch S1(2), (See Figure 3) ignoring the leader and stopping at a point approximately 16 inches beyond the first encountered data character.

FRONT PANEL REWIND SWITCH

MANUAL REWIND	AUTOMATIC REWIND (TOWARD LOAD POINT)	AUTOMATIC REWIND (AWAY FROM LOAD POINT)

MANUAL REWIND

SWITCH HELD LEFT OR RIGHT

WIND AT 1000 CH/SEC

END OF TAPE — YES

NO

SWITCH RELEASED — NO

YES

STOP

AUTOMATIC REWIND (TOWARD LOAD POINT)

PULSE LEFT OR RIGHT < 0.1 SEC

LOAD POINT WITHIN 128 CH

YES → WIND AT 200 CH/SEC

NO → WIND AT 1000 CH/SEC

SECOND PULSE — YES

NO

LOAD POINT — NO

YES

STOP

AUTOMATIC REWIND (AWAY FROM LOAD POINT)

PULSE LEFT OR RIGHT < 0.1SEC

WIND AT 400 CH/SEC

SECOND PULSE — YES

NO

END OF TAPE — NO

YES

STOP

REWIND LOGIC (FRONT PANEL SWITCH)

EXTERNAL REWIND COMMAND

SPOOL	LOOP

SPOOL

OUTPUTS DATA CHARACTERS AT 400 CH/SEC

END OF TAPE — YES

NO

EXTERNAL REWIND SIGNAL REMOVED — NO

YES

STOP

LOOP

OUTPUTS DATA AT ≈ 250 CPS

YES — END OF TAPE

NO

EXTERNAL REWIND SIGNAL REMOVED — NO

YES
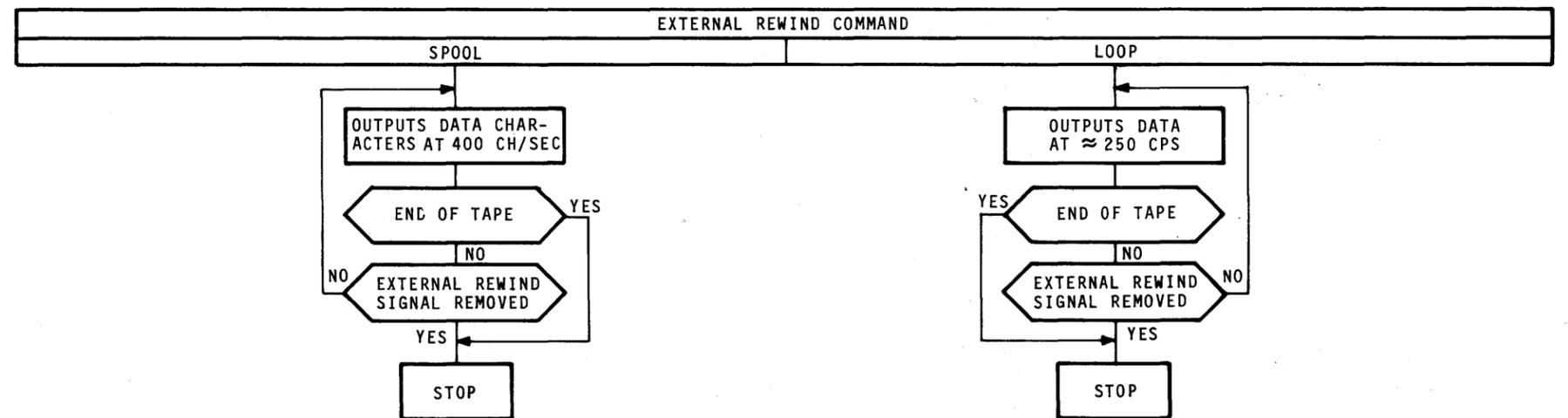
STOP

REWIND LOGIC (EXTERNAL SIGNAL)

C800

Figure 6-2. Rewind Function.

This operation loads characters of data into the buffer memory. It also establishes the first data character as the "load point." The "load point" is a reference stopping point on the tape for subsequent rewind operations.

The reader is now ready to supply data to the user equipment upon command from the I/O. The spooler motors advance tape automatically to load additional data characters into the memory as data is shifted out.

Operation of the reader from the I/O is inhibited during the load operation. Each time the LOAD switch is activated, a new "load point" is established and the previous one is erased.

B. To Load the Reader (Strip or Loop).

   1. Open the read head and thread the tape over the read sensors. Be sure the sprocket holes align with the sprocket teeth in the read head.

   2. Close the read head.

   3. Momentarily push the LOAD switch to the LOOP position. The stepper motor moves the tape in the forward direction and stops at approximately 1.3 inches past the first encountered data character. Just as in the SPOOL operation, data is loaded into the buffer memory. A new load point is established each time the LOAD switch is activated.

C. To Change Modes (Loop to Spool) or (Spool to Loop)

   During normal operation if it is desired to change from loop to spool or vice versa, stop the reader motion, and initiate a load operation in the new mode.

D. To Rewind Tape Right or Left.

   1. After the tape has been satisfactorily loaded, tape may be wound to right or left by pressing the REWIND switch momentarily to right or left. If the tape is wound toward the load point, it will slew to right or left at high speed until the "load point" is approached. At this time the tape will slow down and stop approximately at the "load point." If the tape is wound away from the "load point," it will continue at normal rewind speed to

the end of the tape. To stop the tape, momentarily
press the REWIND switch in either direction.

No data is read into the memory during the rewind
operation. Also, the reader signals to the user
I/O that the reader is "not ready" during the re-
wind operation.

If the REWIND switch is activated and held, the
tape will be moved at high speed to the end of the
tape (or until the switch is released) and will
ignore the "load point." In the loop mode, the
reader pauses momentarily at the load point then
resumes winding. Data is not output during wind-
ing.

E. To Correct Broken Tape Condition

If the tape should break or the end of the tape is
reached, the reader will stop. To resume operation:

1. Splice tape if necessary. (See Section VIII.)

2. Reload tape into read head.

3. Press load spool or load loop as applicable.

4. Resume the desired operation.

F. Tape Not Present.

Anytime tape is not present in the read head, neither
the tape loading nor rewind operation can occur.

G. Reader Only Operation.

If the reader does not have the reel-to-reel servo
system installed (reader only), all Spool mode
operations are bypassed and the stepper motor is
selected to transport tape.

6-4. INTERNAL SWITCH SETTINGS.

Before putting the reader into operation with user equip-
ment, three internal switches must be set.

A. Switch S1 (CPU PCB).

1. Set S1(1) to desired speed (200 cps or 400 cps).
(See Figure 3-3.)

2. Set S1(2) to the desired direction for load tape movement. (See Figure 3-3.)

B. I/O Switches.

See Sections III or V.

SECTION VII

THEORY OF OPERATION

7-1.   GENERAL

The microprocessor controlled tape reader consists of six basic subassemblies:

1. Chassis – contains a transformer and an input power connector.

2. Front Panel – two versions.

    a. Reader/spooler – two spooler motors plus power and control switches and indicators.

    b. Reader only – power and control switches and indicators only, no spooler motors.

3. Read Head – includes phototransistor/LED array, step per motor, and tape sprocket.

4. CPU Circuit Board – includes power supply, microprocessor, support electronics, analog-to-digital converter, and non-volatile memory.

5. Servo Circuit Board – contains all the drive and control electronics for both servo motors.

6. I/O Circuit Board – three versions are available:

    a. EECO Parallel – emulates EECO 9300 and 9200 series readers.

    b. REMEX Parallel – emulates Remex 7300 and 7155 series readers.

    c. RS 232 Serial – provides RS 232 and current loop serial communications.

7-2.   FUNCTIONAL DESCRIPTION

Operation of the reader centers around the CPU with all other assemblies interconnected to it. Figure 7-1 is the block diagram which shows this relationship.

A. CPU Board.

The CPU is an 8-bit microprocessor. The operating
firmware is located in an external EPROM.

1. Program Memory. The operating firmware is located
    in EPROM (U6). A checksum digit is stored on each
    page. The checksum is recalculated during powerup
    diagnostics and compared to the stored digit on
    all pages of memory. This verifies program inte-
    grity.

2. Address Latch. The data bus from the CPU is time
    multiplexed with both address and data informa-
    tion. The address information is demultiplexed by
    the address latch (U2).

3. Decoder. The CPU controls read and write func-
    tions with status bits on Port 2 (P20, P21, P22,
    P23). These bits are decoded and are combined
    with the read and write signals to provide the
    read and write control for the system.

B. I/O Board.

The CPU board communicates to the external world via
the I/O board. Signals are sent to and received from
the I/O board through the data bus via connector J5.

Three types of I/O boards may be connected to the CPU:
EECO parallel, REMEX parallel, or RS 232 serial.

1. EECO Parallel. The EECO parallel interface is de-
    signed to emulate EECO Model 9200 and 9300 series
    tape readers. The interface consists of two 8-bit
    output latches, one 8-bit input latch, and logic
    for signal inversion. Two flip-flops store the
    leading edge transition of the DRIVE RIGHT and
    DRIVE LEFT signals. Because the processor cannot
    respond to signals of short duration, step pulses
    are saved by the flip-flops for later use by the
    processor.

2. REMEX Parallel. The REMEX I/O emulates the REMEX
    7300 and 7155 series readers. The circuit board
    is similar to the EECO I/O board. The output
    connector is a DB25P series. No logic selection
    switches are used. Instead, the I/O board inter-
    prets the Remex mode line to provide mode 5 and
    mode 6 operation.
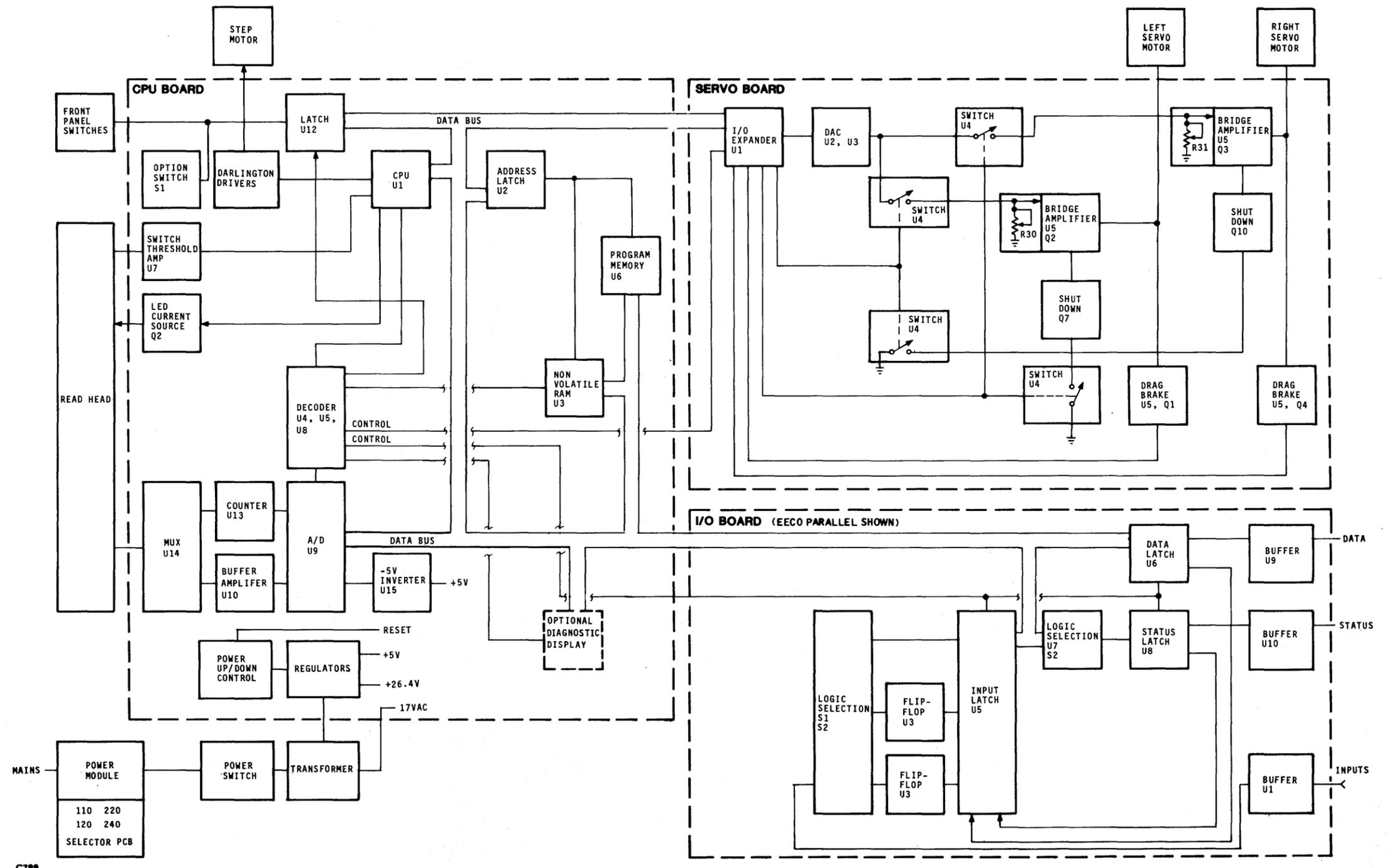
Figure 7-1. Tape Reader
Block Diagram
(EECO Parallel I/O)

7-3/7-4
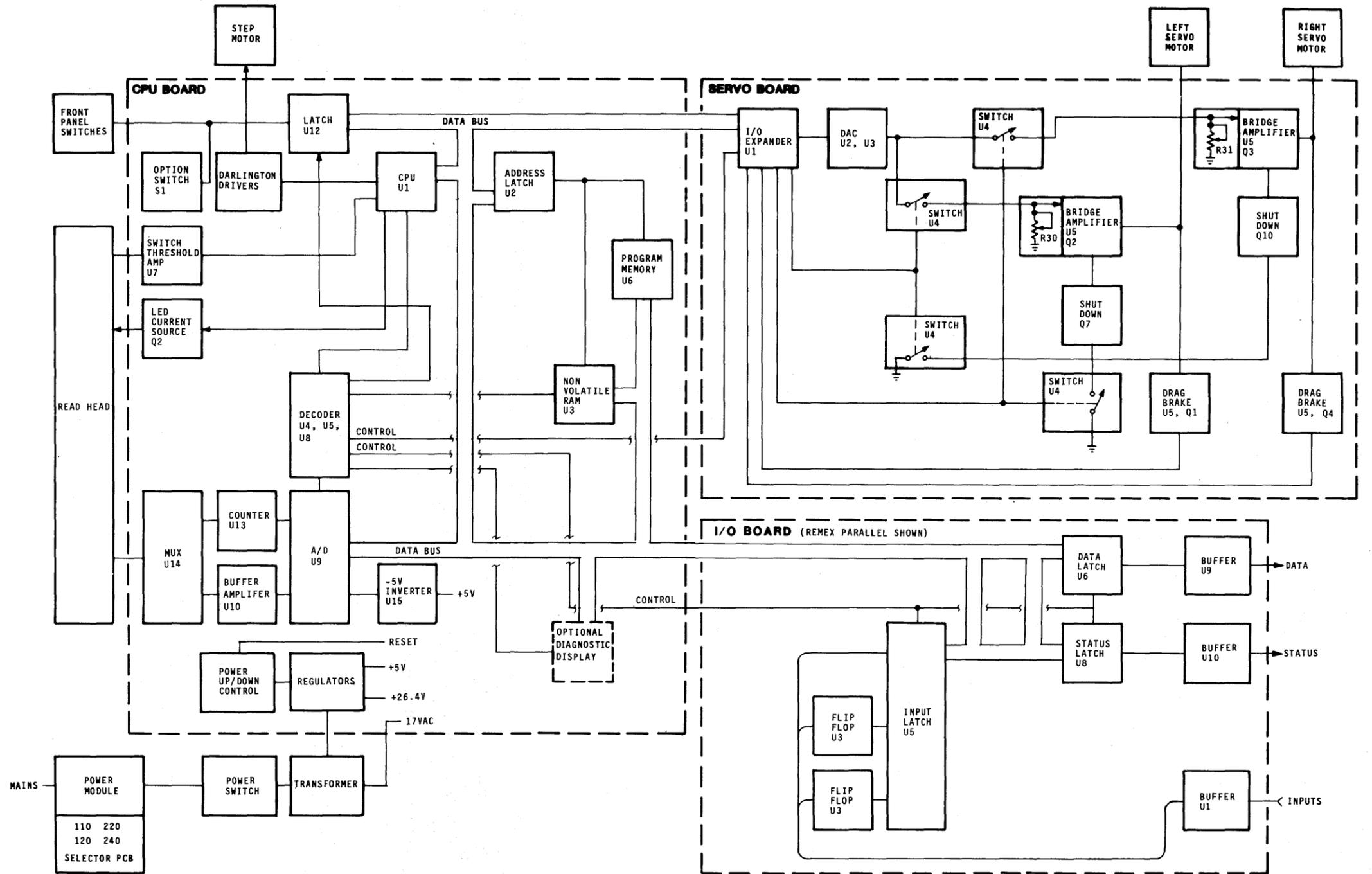
Figure 7-2. Tape Reader
Block Diagram (Remex Parallel I/O)

C806
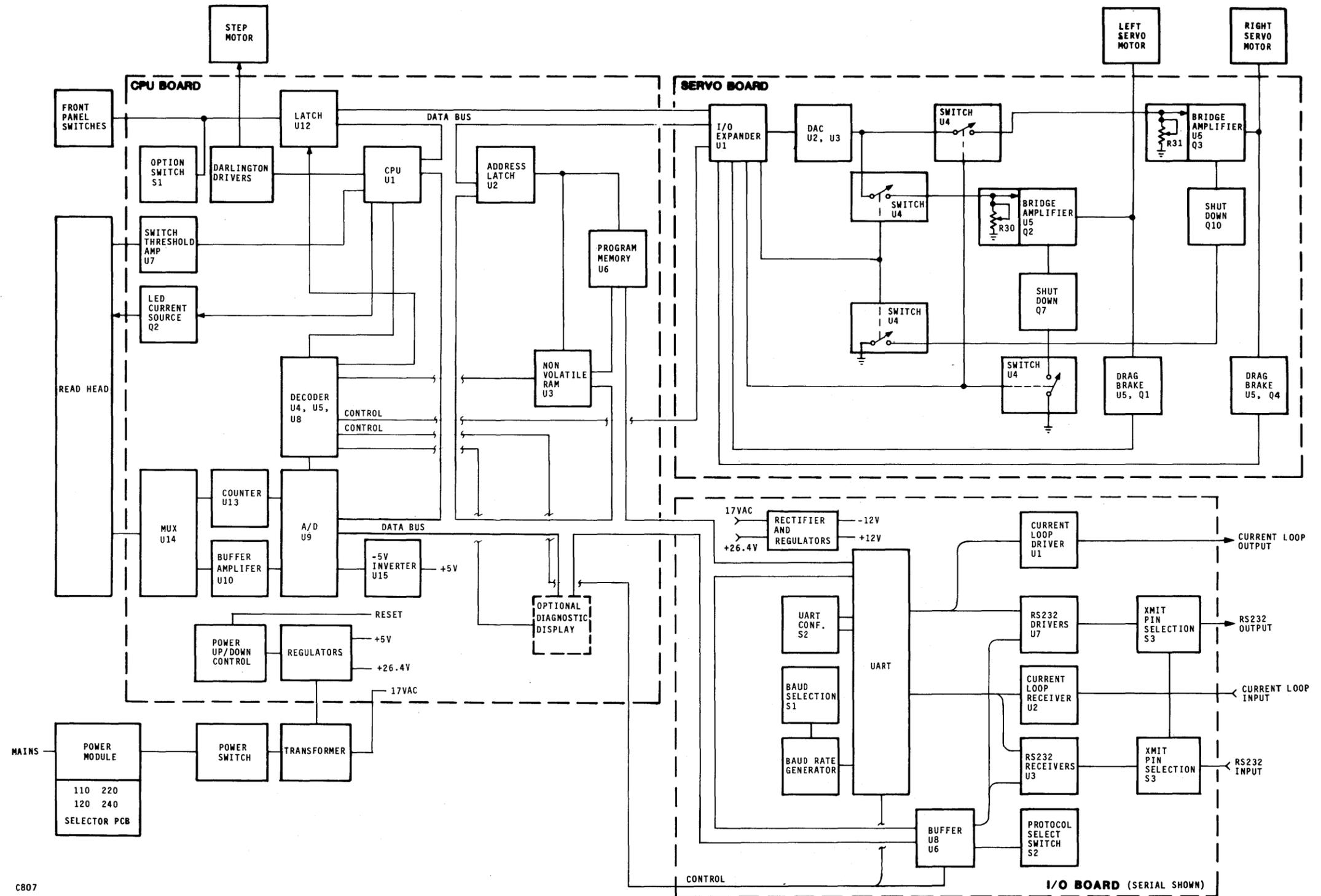
Figure 7-3. Tape Reader
Block Diagram (Serial I/O).

3. Serial I/O. The serial I/O provides full modem and current loop capability, and full duplex communications.

C. Stepper Motor.

The stepper motor is used exclusively for loop or strip tape operation. It is selected for use by actuating the front panel LOAD switch to the LOOP position.

The stepper motor is driven either in blocks or continuously. This eliminates the need for complex stepper motor damping hardware.

D. Servo (Reel).

The second method of tape movement is via the reels. The reels are driven by two servo motors. Each motor is controlled by a closed loop velocity servo. The reel velocity is determined by the processor and commanded to the servo board via the DATA BUS. The circuit maintains the set speed regardless of reel load.

Actual tape speed through the read head is calculated by the processor. This information is used to determine the speed command sent to the servo. When the tape speed reaches the desired speed the processor adjusts the speed command to the servo.

E. Read Head.

The Read Head monitors the tape and develops analog signals which represent holes in the tape. These signals are generated by beaming visible red light onto the tape and sensing the light which passes through the tape holes with phototransistors. A head-open switch is integrated into the head structure. The signal generated by this switch interrupts the processor. Tape motion is stopped and the reader assumes a not-ready status while the head is open.

The phototransistors are arranged in two rows. The first row has nine phototransistors, eight of which sense data holes. The ninth phototransistor senses the sprocket hole. Row two contains only a single sprocket sense phototransistor. This row is positioned 0.123 inches to the left of the first row. At this position, the phototransistors generate a sprocket waveform that is shifted 90 degrees in phase from the waveform generated by the sprocket phototransistor in row one. The two signals are used to

determine the processor to read the data and to calcu-
late the tape speed.

F. Analogue To Digital Converter (ADC).

One of the significant features of the reader is the
use of one input amplifier to sense all the data and
sprocket holes. This eliminates the need for individ-
ually adjusted amplifier circuits for each input chan-
nel.

All data and sprocket signals are multiplexed into one
amplifier (U10). The output of the amplifier is digi-
tized by a high speed analogue-to-digital converter
(U9). The converter is controlled by the processor.

G. Minus Five Volt Regulator.

The A-to-D converter requires a negative reference
voltage. This voltage is provided by a monolithic
voltage inverter (U15) which generates -5 volts from
the +5 volt supply.

H. Front Panel.

The front panel contains a set of three switches and
two LED displays.

1. POWER. This switch controls the ac power.

2. REWIND. This switch controls the rewind function
    of the reader. It can be actuated in either right
    or left direction and initiates a rewind right(▶)
    or a rewind left (◀).

3. LOAD. This switch controls the load function.
    Pushing the switch up initiates a load reel func-
    tion. All subsequent tape movement is made with
    the servo motors. Pushing the switch down initi-
    ates load loop function. All subsequent tape
    movement is made with the stepper motor.

4. POWER "LED". This indicator, when on, indicates
    power has been turned on to the unit and the +5
    volt regulator is operating.

5. CHK "LED". Comes on and stays on or blinks when-
    ever a fault condition is sensed (see "Diagnos-
    tics," paragraph 8-3). This light momentarily
    lights during power up.

All switches except the power switch are connected via
a flexible cable to the CPU board where they are con-
nected to a buffer (U12). The processor monitors the
switch status by periodically reading the output of
the buffer.

I.   Non-Volatile Memory.

The total elimination of adjustments in the read head
electronics is due to the use of a non-volatile mem-
ory. Data representing the electronic trip point be-
tween a hole and no-hole condition is stored in this
memory.

Before the reader is operational it must be cali-
brated. This operation automatically adjusts the
reader to accommodate for the differences between the
phototransistor outputs. During calibration, the
LED's are turned off, then each phototransistor output
is digitized and saved. The LED's are then turned on
and the output of the phototransistors digitized. An
optimum level is calculated for each channel that dis-
tinguishes a hole from a no-hole. This value is saved
in the non-volatile memory. Cycling the power switch
causes the program to recall the values.

Data can be written into the non-volatile memory a
limited number of times. To insure data integrity of
the non-volatile memory, a checksum digit is saved in
the last location. This digit is recomputed each time
the memory contents are read and is compared to the
actual value stored. Any loss of memory capability is
detected. Incorrect data is not accepted. Loss of
memory is detected by the self-contained diagnostic
program and is indicated by blinking the check (CHK)
LED.

J.   Power Supply.

Power is provided by a linear regulated supply. Input
voltage is selectable by installing the selection card
in an appropriate manner. (See figure 2-2.) Two of
the transformer secondaries are connected to the CPU
board where they are rectified and regulated. Regu-
lated output voltages are connected to the remainder
of the circuitry via two removable jumper plugs. This
provides easy isolation of the power supply from the
remainder of the circuit.

A third secondary winding is connected to the I/O
board through connector J5. The output of this wind-

ing is rectified on the I/O board to provide the drive
voltages when an RS-232 interface is specified.

SECTION VIII

MAINTENANCE

WARNING

Hazardous voltages are present in this
equipment when power is connected. Use
caution to avoid electrical shock.

Do not touch the stepper motors with
bare hands. This motor may operate at
high temperatures.

8-1.   GENERAL

This section contains information for maintaining the
Microprocessor Based Punched Tape Reader. The instruc-
tions include preventive maintenance, diagnostic tests,
troubleshooting, repairs, and tape splicing.

8-2.   PREVENTIVE MAINTENANCE

Preventive maintenance consists of cleaning, periodic
inspection, and calibration performed at regular
intervals.

A.   Cleaning.

The glass surfaces of the read head must be cleaned to
prevent an excessive accumulation of dirt from causing
misreading of tape. To clean the read head:

CAUTION

Do not use sharp tools or volatile
solvents. Avoid excessive pressure on
glass. Failure to comply may result
in damage to equipment.

1.   Open head by carefully lifting up top cover.

2.   With a dry cotton swab, wipe the two glass
     surfaces and surrounding area of head. If glass

cannot be cleaned thoroughly with a dry cotton swab, proceed with the following steps:

3. Prepare a cleaning solution of water and mild liquid detergent.

4. Wipe glass surfaces with clean cotton swab moistened with cleaning solution. Use solution sparingly and do not saturate area.

5. Rinse area with clean cotton swab moistened with clean water.

6. Wipe dry with soft clean cloth or dry cotton swab.

7. Inspect glass surfaces for cleanliness making certain that no residue is present. If required, repeat steps 3 through 7 until glass is thoroughly clean.

8. Close read head top section.

B. Lubrication.

No lubrication required.

C. Periodic Inspection.

Regularly examine the reader for any signs of mechanical or electrical malfunction. Check to see the read head cover moves up and down freely. Make sure connections are made securely and that wiring, cables, and components do not show unusual signs of wear or overheating.

D. Calibration.

The selection of LED's and phototransistors provides significant performance improvement reliability in transparent tape reading ability while using only 10 ma drive currents to the LED's. This level of drive current reduces the aging effect of the LED's, thus, calibration need not be performed except during periodic maintenance. Calibration once per year should be adequate.

Calibration is performed using the front panel controls. Turn the power off. While holding the load switch in the loop position and the rewind switch in the right (▶) position, turn the power switch back

on. The check (CHK) LED goes on during the calibra-
tion cycle and goes out at the successful completion
of the cycle.

Note

Tape must NOT be in the head during
calibration.

8-3. DIAGNOSTICS

The reader contains a firmware diagnostic routine that
checks the reader hardware for proper function. The
diagnostic routine is invoked during each power up. The
check (CHK) LED light is turned on at the start of the
diagnostic test. The light is turned off at the success-
ful completion of the test. Failure of any test causes
the (CHK) light to blink or stay continuously on. The
number of blinks signifies which major test has failed.
An optional two-digit diagnostic display module may be
used to display the failed test number in HEX format. The
test program loops on a failure thus enabling a test
technician to quickly locate the problem. See table 8-1.

Table 8-1. Diagnostic Indications.

"CHK" LED INDICATION	FAILURE	PROBABLE LOCATION
Light is on	EPROM checksum test	CPU PCB
1 Blink	Calibration	CPU PCB
	Phototransistor leakage exceeds maximum value	Read Head Assembly
	Non-volatile memory checksum test	CPU PCB
2 Blinks	A to D converter or -5 volt reference voltage	CPU PCB
3 Blinks	+5 volt or +24 volt	CPU PCB
4 Blinks	Servo	Servo PCB
5 Blinks	I/O	I/O PCB

8-4.   ADJUSTMENTS

   A.   Equipment Required

        1.   Mechanical movement voltmeter (Simpson 260 or
             equivalent).

        2.   Small screwdriver.

   B.   Servo PCB Adjustment

        To adjust the servo motor pots on the servo PCB:

        1.   Place switch S1(2) in the "0" position.

        2.   Clean and close the read head. (See paragraph
             8-2A).

        3.   Calibrate the reader (see paragraph 8-2D).

        4.   Turn power off.

        5.   Connect a voltmeter positive lead to test point
             (MRT) at center of Servo PCB. Connect the
             negative lead to test point (-MRT). (See figure
             8-1.)

        6.   Turn power on.

        7.   While right motor is turning, adjust R31 (right
             hand pot) for 4.2 + 0.2 volts.

        8.   Turn off power.

        9.   Place the LOAD DIRECTION switch (switch S1(2)
             figure 3-3) in the load left (LDR) position.

        10. Connect a voltmeter positive lead to test point
             (MLF) at center of servo PCB. Connect the
             negative lead to (-MLF). (See figure 8-1.)

        11. Turn on power.

        12. While left motor is turning, adjust R30 (left hand
             pot) for 4.2 + 0.2 volts.

        13. Turn off power and reset switches to appropriate
   settings. (See figure 3-3, 4-3, or 5-3.)

LEFT
MOTOR
SPEED

R30

+MLF -MLF +MRT -MRT

RIGHT
MOTOR
SPEED

R31
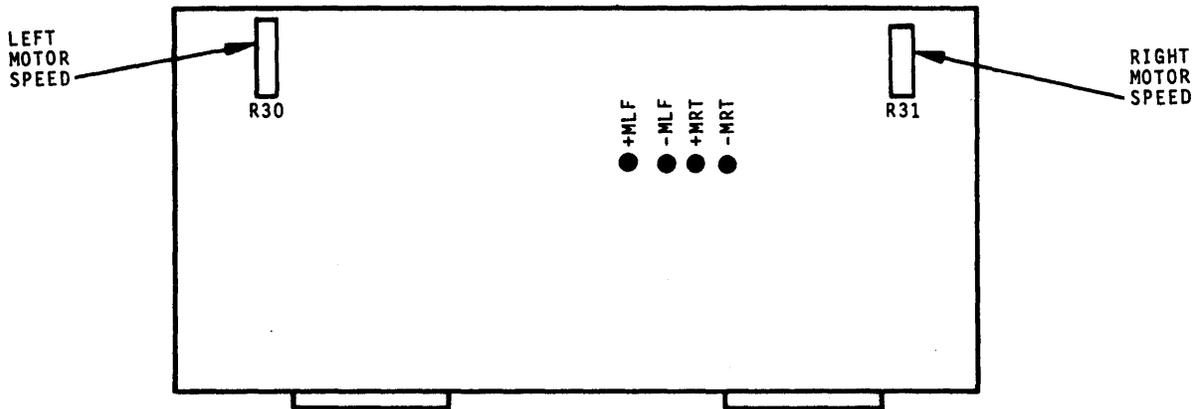
AI296

Figure 8-1. Servo PCB Test Points.
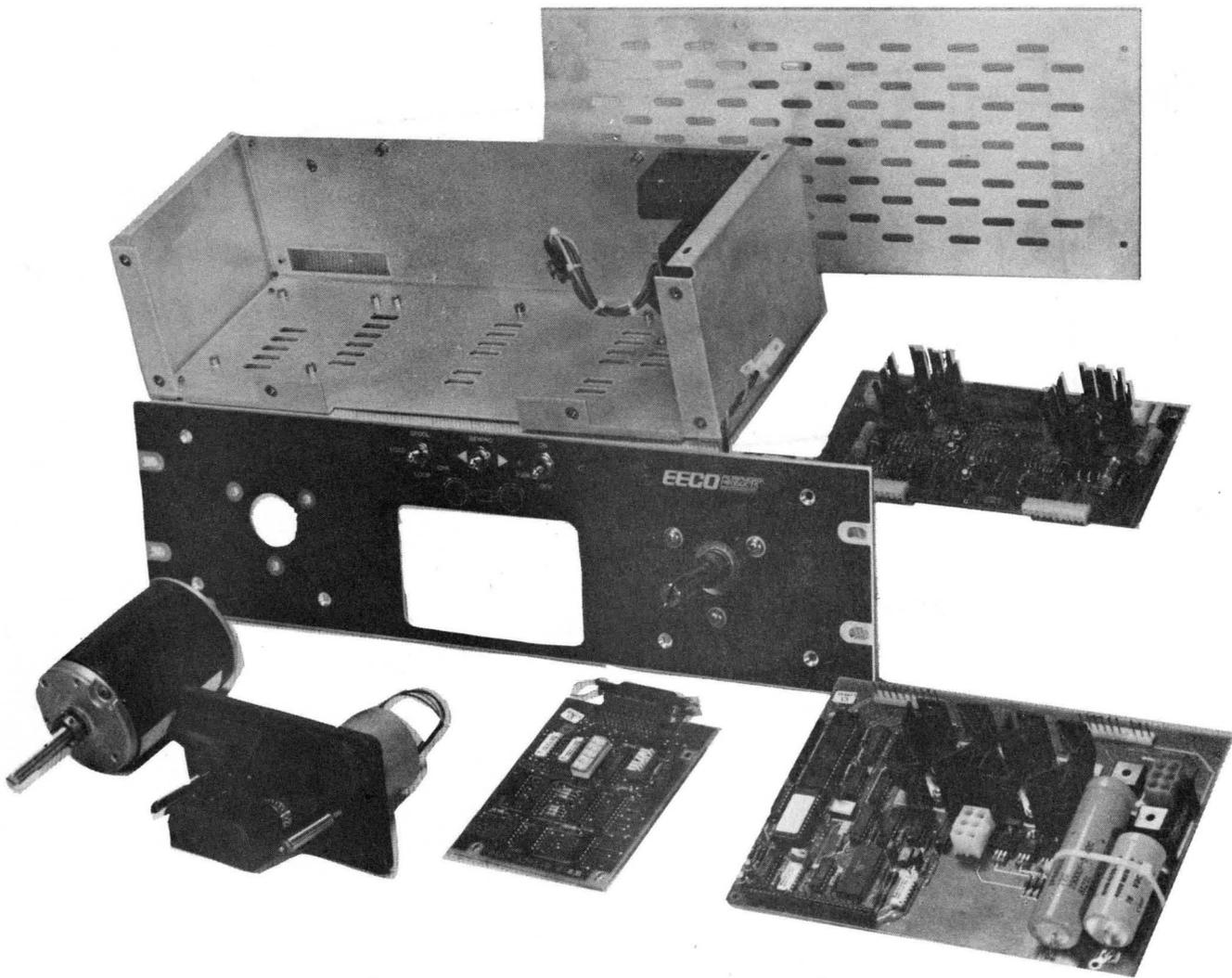
AI308

Figure 8-2. Reader Assemblies.

SECTION IX

REPLACEMENT PARTS

Table 9-1. Replacement Parts.

DESCRIPTION	READER OR READER/SPOOLER *P/N 230990-XX	PART NUMBER
CPU Printed Circuit Board Assembly	All	134538-01
Servo Printed Circuit Board Assembly	All	134543-01
I/O Printed Circuit Board Assembly	XX= -15	134548-01
	XX= -25	134648-01
	XX= -35	135653-01
Spooler Motor Assembly	All	135782-01
Read Head Assembly	All	134556-01
CPU-to-I/O Board Interconnecting Cable	All	135682-01
Front Panel to CPU Interconnecting Cable (Flex Circuit Assembly)	All	135783-01
LOAD Switch, S1	All	339210-04
REWIND Switch, S2	All	339210-04
POWER Switch, S3	All	339210-01
CHK LED Indicator, Red DS1	All	338112-23
PWR LED Indicator, Yellow DS2	All	338112-22
Power Connector	All	311714-01
1.5 Amp Slo-Blo Fuse	All	339051-03
0.75 Amp Slo-Blo Fuse	All	339051-36
Power Cord	All	346323-01

*See Table 1-1 for part number descriptions.

9-1.   FACTORY REPAIR INFORMATION

The reader may be returned to the factory for repairs.
To return either warranty or out-of-warranty readers or
components, prior authorization and a purchase order is
required.

Please call our Customer Service - Peripheral Repair Department (714-835-6000) for authorization and return instructions.

Address returned units to:

EECO Inc.
Customer Service - Peripheral Repair Department
1601 E. Chestnut Street
Santa Ana, CA 92702-0659