

**REMEX**

**THE DIRECTOR™**  
TAPE READER

TECHNICAL MANUAL  
REMEX SERIES 9000  
MODELS: RR900X/RRS900X

Peripheral  
Products

RRS7155  
BA1

# **THE DIRECTOR™**

**TAPE READER**

**TECHNICAL MANUAL**  
**REMX SERIES 9000**  
**MODELS: RR900X/RRS900X**

## **IMPORTANT INFORMATION**

Changes to the equipment which are made between manual printings are listed in an addendum at the rear of the manual. As a convenience, a list of change pages is given as the last page in the manual. It is recommended that each of these pages be marked "Refer to Addendum" so that these changes can be identified.

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Before undertaking any maintenance procedure, whether it be a specific troubleshooting or maintenance procedure described herein or an exploratory procedure aimed at determining whether there has been a malfunction, read the applicable section of this manual and note carefully the

**CAUTION**

contained therein.

**WARNING**

and

The equipment described in this manual contains voltages hazardous to human life and safety and may contain mechanical components capable of inflicting personal injury. The cautionary and warning notes are included in this manual to alert operator and maintenance personnel to the electrical and mechanical hazards and thus prevent personal injury and damage to equipment.

**CAUTION**

This equipment generates, uses and radiates radio frequency energy and if not installed and used in accordance with the instruction manual, (shielded interface cabling recommended) may cause radio communications interference. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 or FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct this interference.

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## SECTION I

### GENERAL DESCRIPTION

#### 1.1 SCOPE

This manual contains operation and maintenance information for all versions of the RR-900X Microprocessor Based Punched Tape Reader (reader) and the RRS900X 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 microprocessor control until needed for control of user equipment. 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 readhead 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 (stepper or spooler) is operational during any given operation. This feature results in low power consumption.

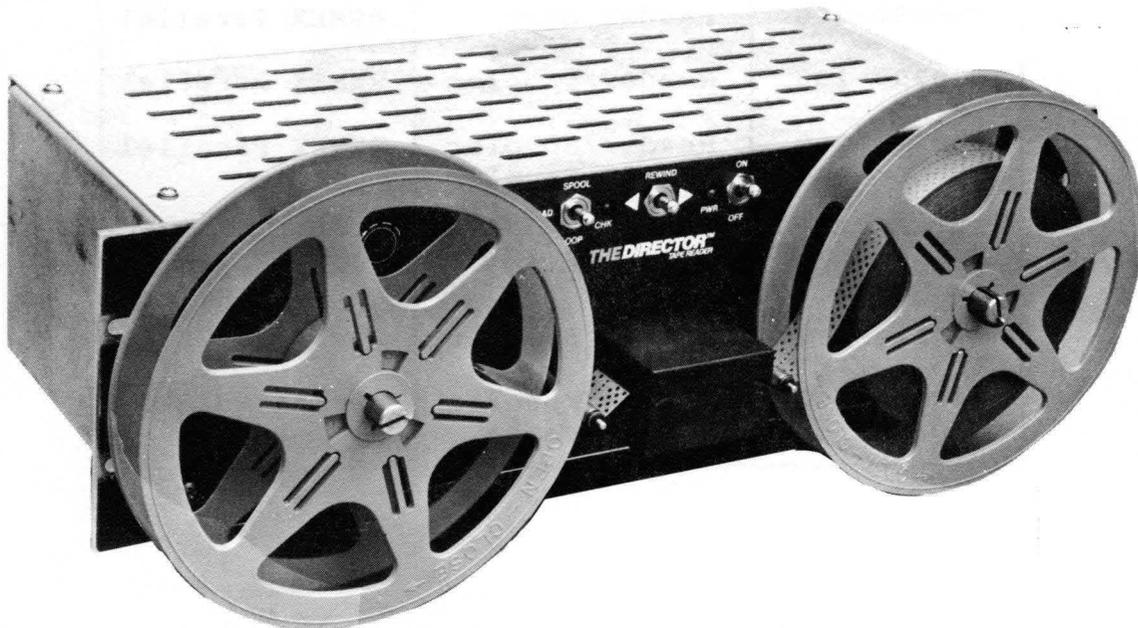


Figure 1-1. RRS900X Tape Reader/Spooler.

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	Configuration	I/O Type
830990-100	Reader Only	EECO Parallel
830990-150	Reader/Spooler	EECO Parallel
830990-160	Reader/Spooler 8 3/4" Panel	EECO Parallel
830990-200	Reader Only	REMEX Parallel
830990-250	Reader/Spooler	REMEX Parallel
830990-260	Reader/Spooler 8 3/4" Panel	REMEX Parallel
830990-300	Reader Only	Serial RS232C
830990-350	Reader/Spooler	Serial RS232C
830990-360	Reader/Spooler 8 3/4" Panel	Serial RS232C

**Table 1-2. Specifications**

Characteristics	Specifications
Speed	<p><u>Read Speed</u> (switch selectable): 201 characters per second maximum, or 402 characters per second maximum <b>NOTE:</b> 250 characters per second maximum in LOOP mode</p> <p><u>Rewind Speed I/O:</u> 402 characters per second maximum</p> <p><u>Front Panel:</u> 1000 characters per second typical (varies with amount of tape on reel)</p>
Dimensions	<p><u>Front Panel Width:</u> 19.00 inches (48.26 centimeters) maximum</p> <p><u>Front Panel Height:</u> 5.25 inches (13.34 centimeters) or 8.72 inches (22.15 centimeters) maximum</p> <p><u>Depth</u> (front to rear panel): 7.10 inches (18.03 centimeters) maximum</p>
Protrusion	<p><u>Readhead:</u> 2.20 inches (5.58 centimeters) maximum</p> <p><u>Hub:</u> 2.18 inches (5.54 centimeters) maximum</p>
Weight	17 pounds (7.71 kilograms)
Finish	<p><u>Front Panel:</u> Lexan overlay on aluminum base</p> <p><u>Chassis:</u> Clear chemical film on aluminum</p>

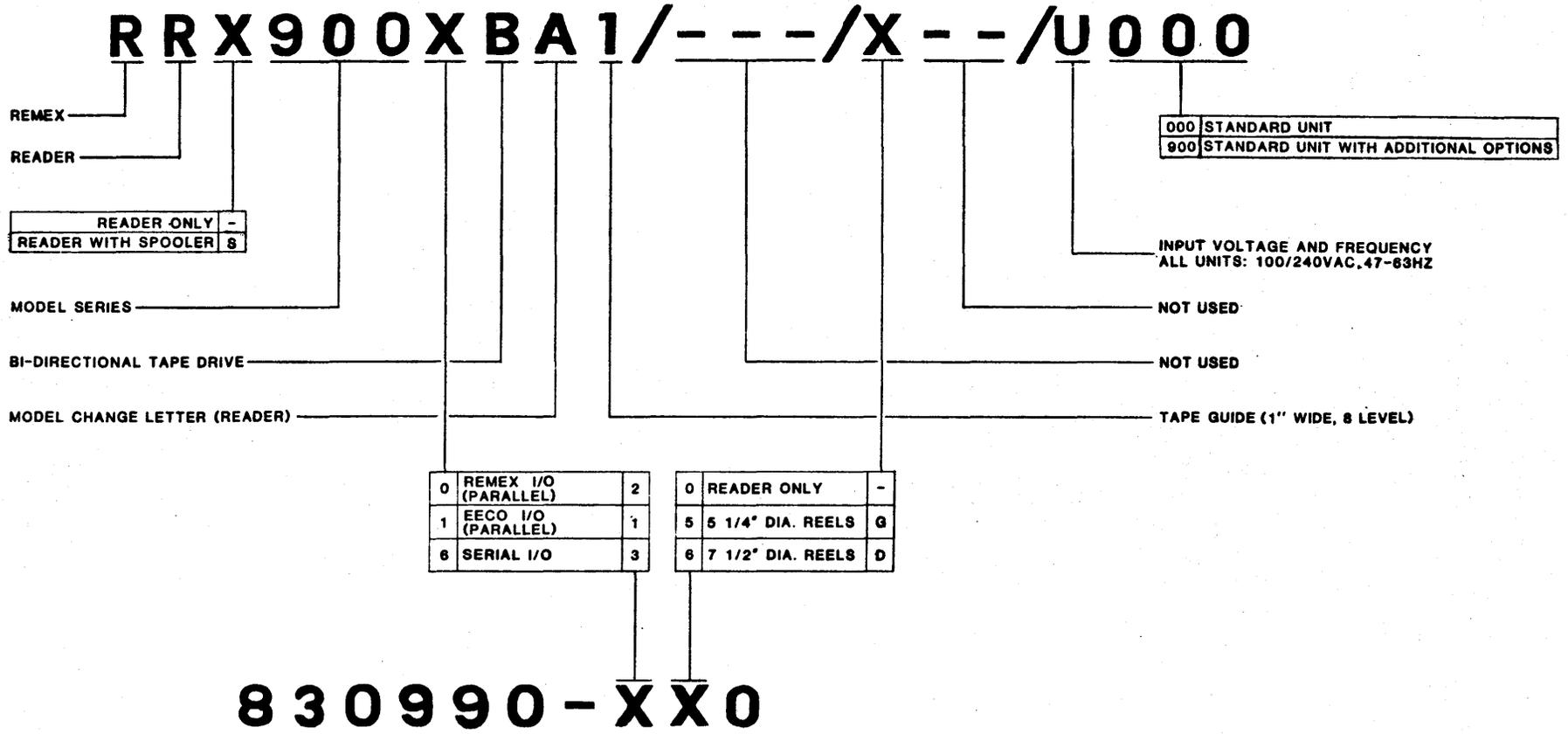
Table 1-2. Specifications (Continued)

Characteristics	Specifications										
Tape	<p><u>Material:</u> Paper, aluminum-Mylar, paper-Mylar or Mylar-aluminum</p> <p><u>Thickness:</u> Up to 0.0045 inches (0.1143 millimeters)</p> <p><u>Tolerance:</u> Tape punched per EIA Standard RS-277-A, ECMA, ANSI, or ISO</p> <p><u>Width/Levels:</u> 1.000 ± 0.003 inches (25.400 ± 0.076 millimeters) standard 8 track plus sprocket</p>										
Line Input Voltage	<table border="1"> <thead> <tr> <th data-bbox="708 821 862 884">Card Position</th> <th data-bbox="935 821 1110 884">Range (47-63Hz)</th> </tr> </thead> <tbody> <tr> <td data-bbox="748 915 805 940">100</td> <td data-bbox="976 915 1089 940">95-115</td> </tr> <tr> <td data-bbox="748 947 805 972">120</td> <td data-bbox="951 947 1089 972">105-130</td> </tr> <tr> <td data-bbox="748 978 805 1003">220</td> <td data-bbox="951 978 1089 1003">190-230</td> </tr> <tr> <td data-bbox="748 1010 805 1035">240</td> <td data-bbox="951 1010 1089 1035">210-260</td> </tr> </tbody> </table>	Card Position	Range (47-63Hz)	100	95-115	120	105-130	220	190-230	240	210-260
Card Position	Range (47-63Hz)										
100	95-115										
120	105-130										
220	190-230										
240	210-260										
Power	<p><u>Consumption:</u> 80 watts maximum. (50 watts typical)</p> <p><u>Peak Inrush Current:</u> 9 amperes at 115 VAC</p> <p><u>Fusing:</u> a. 1.5 ampere fuse, slo-blo at 115VAC b. 0.75 ampere fuse, slo-blo at 230VAC</p>										
Power Cord	3 conductor detachable cord, Switchcraft P/N P-2392 REMEX P/N 708000-110.										
Input/Output Connector	See paragraph 3.1, 4.1 & 5.1										
Environment	<p><u>Temperature:</u> Operating: 0 to +60° C Non-operating: -20 to +100° C</p> <p><u>Humidity:</u> 0 to 95% Relative humidity, non-condensing</p>										

**Table 1-2. Specifications (Continued)**

Characteristics	Specifications
Altitude	Operating: 0 to 10,000 ft. (0 to 3048 meters) Non-operating: 0 to 15,000 ft. (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
Isolation	<u>Chassis to Signal Ground:</u> ≤ 0.1 ohm with shorting screw installed.  100-500 ohm nominal without shorting screw installed. This low resistance is due to the readhead switch installed on a conductive readhead.

Figure 1-2. Family Drawing



## 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 readhead. 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.

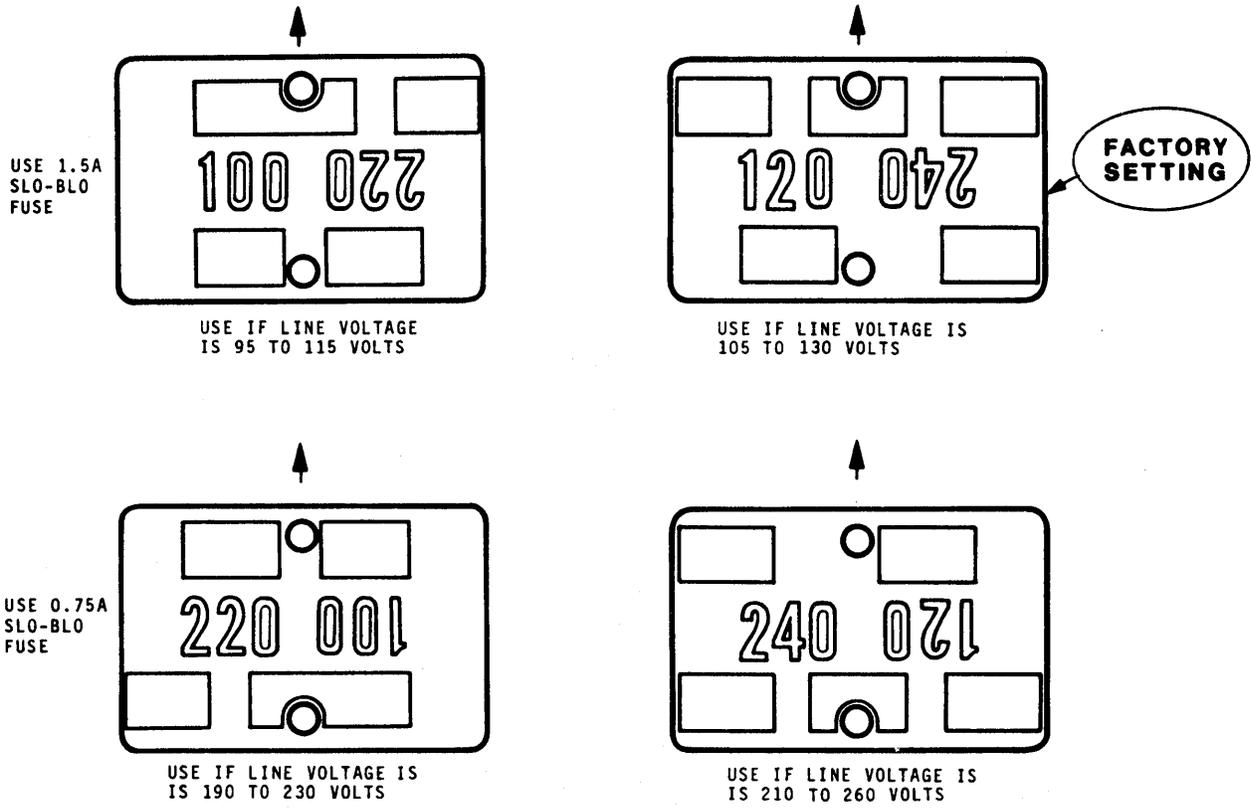
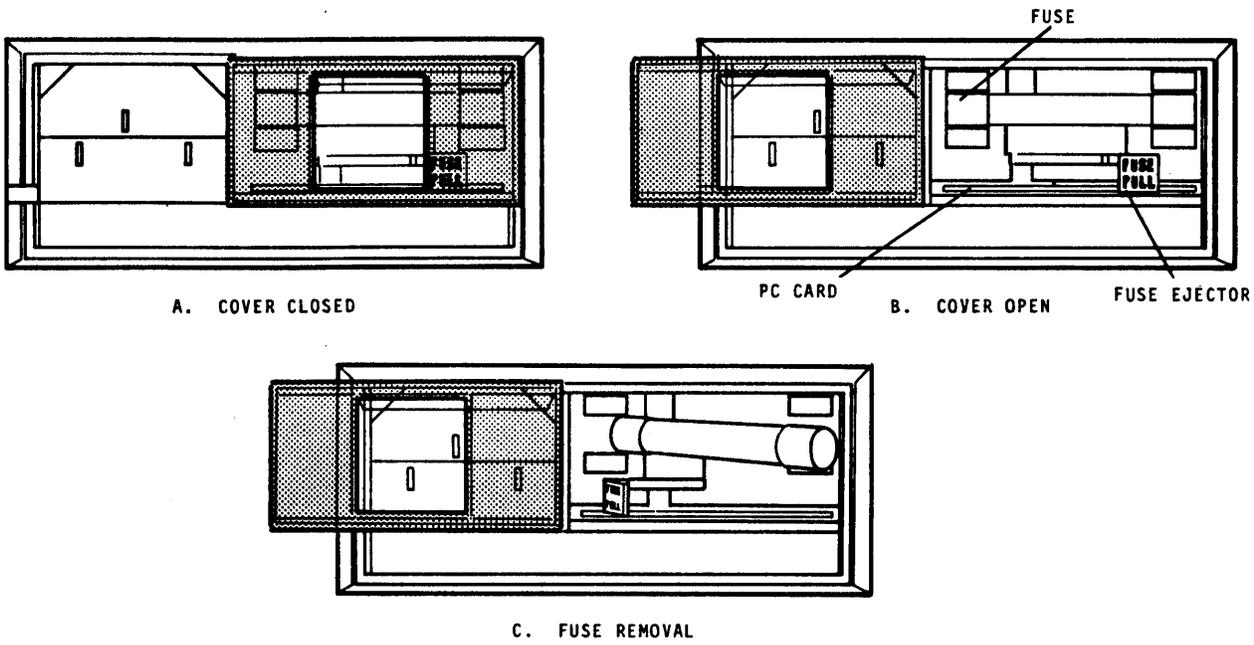
### **WARNING**

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.





**MMC 801** PC CARD POSITIONS. TOP VIEWS.  
 (ARROWS POINT TOWARD DIRECTION OF INSERTION INTO CONNECTOR ASSEMBLY).

**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 provide 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.

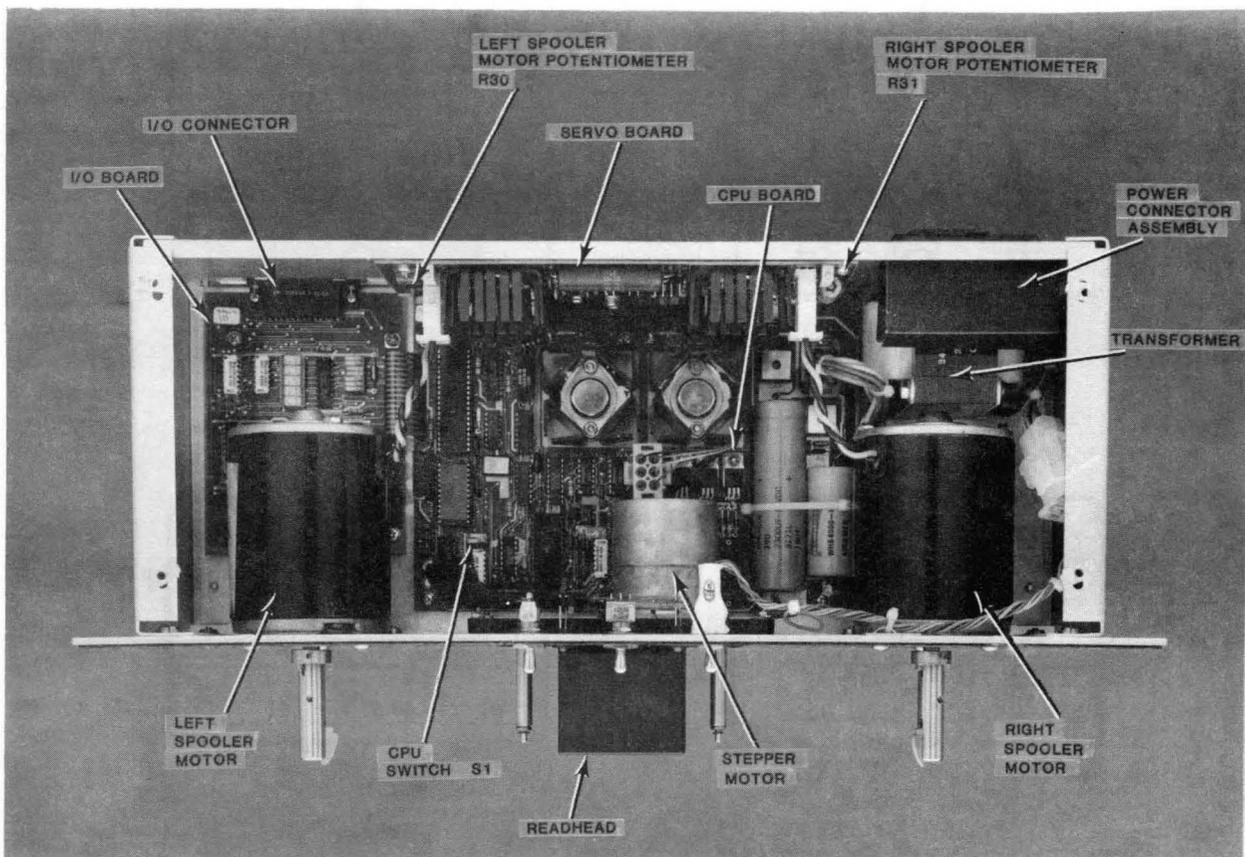


Figure 2-3. Internal Controls and Assemblies.

## SECTION III

### INTERFACE - REMEX COMPATIBLE PARALLEL I/O

#### 3.1 DESCRIPTION

The REMEX parallel I/O is designed to simulate the interface of the following REMEX models:

RRS7300BEX/660/DRB  
RR-7155BAI/660  
RRS7155BAI/660/G-A & D-A

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

#### 3.2 INTERFACE CABLE

To interface with other equipment, provide an appropriate cable using size 22AWG 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 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 removing the shorting screw (Figure 3-1). With the internal ground connection removed, it is especially important that chassis ground and system ground be externally connected by a low impedance at high frequencies; otherwise power line transients may develop chassis voltage disturbances sufficient to cause system malfunction. (See Table 1-2).

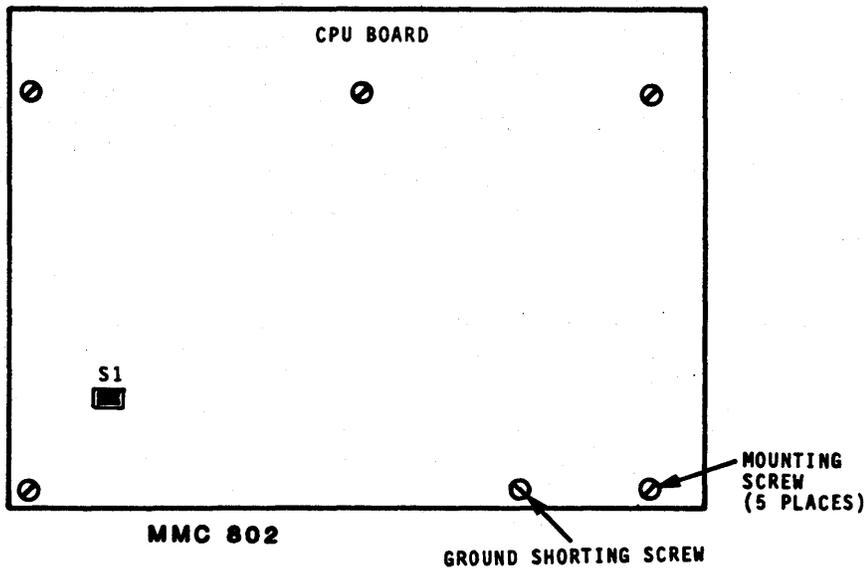


Figure 3-1. Ground Shorting Screw.

Table 3-1. Connector Pin List

Pin	Signal Name	Signal Function
1	Data Track 1	Output
2	Data Track 2	Output
3	Data Track 3	Output
4	Data Track 4	Output
5	Data Track 5	Output
6	Data Track 6	Output
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 milliamps	Power
24	Signal Ground	Signal Ground
25	Chassis Ground	Chassis Ground

\* +12V at 100 mA on 7155 Model

\*\* -12V at 100 mA on 7155 Model

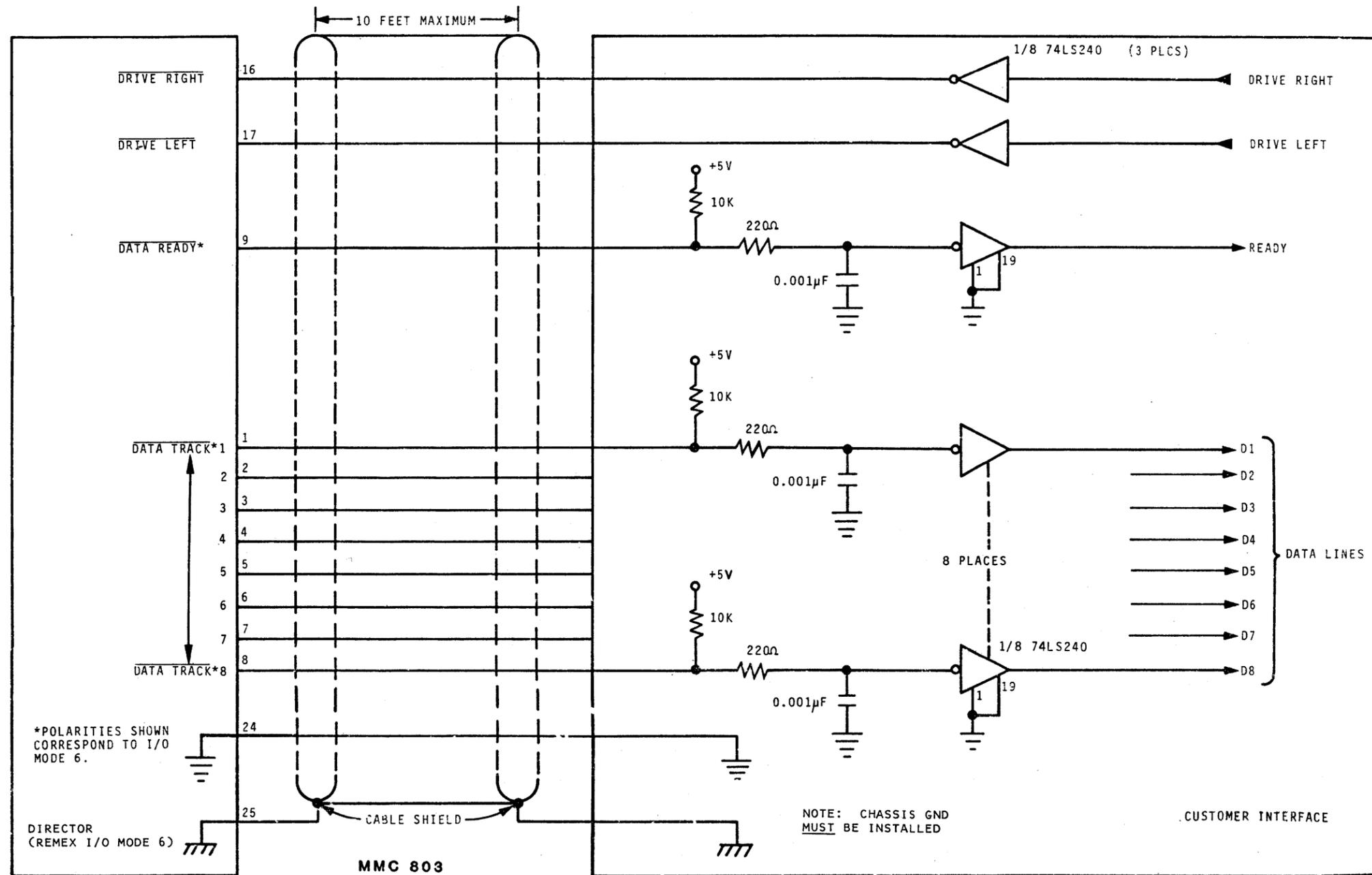
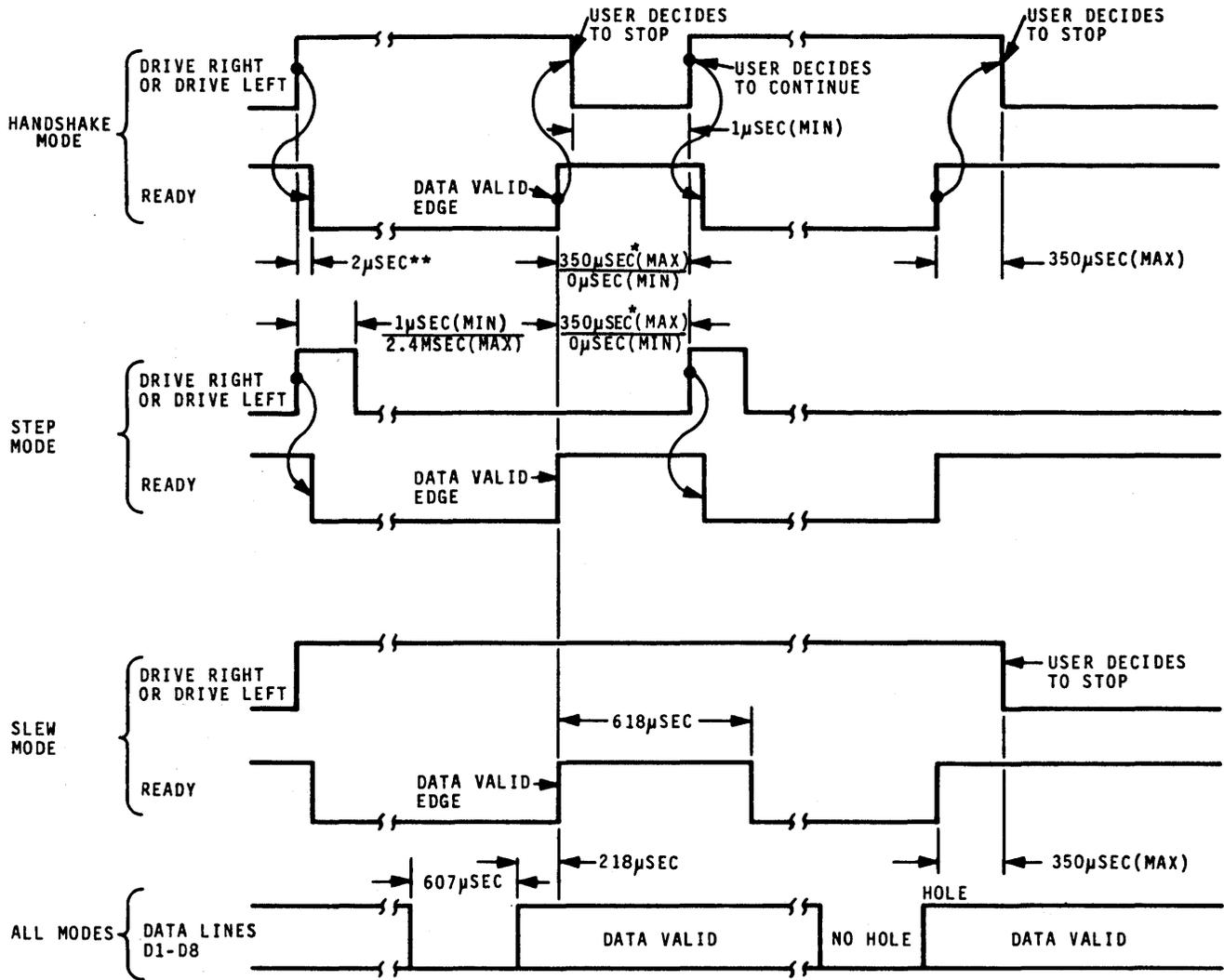


Figure 3-2. Recommended Customer Interface Circuit.



**MMC 804**

NOTES: ALL VALUES TYPICAL EXCEPT WHERE NOTED.  
TIMING IS FOR 400CPS. FOR 200CPS TIMING, REFER TO VALUES ON APPROPRIATE DRAWING.

\*IF THIS VALUE OF 350µSEC IS EXCEEDED, THE READER WILL SLOW DOWN TO LESS THAN 400CPS.

\*\*INCLUDES FILTER DELAYS OF BOTH READER AND CUSTOMER INTERFACE.

**Figure 3-3. Recommended Interface Timing Diagram.**

**Table 3-2. Logic Levels**

Input/Output	Level	Voltage Range	Max. Current
Input	+5V	+2.0 to +5.2 VDC	40.0 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	12.0 mA

**Table 3-3. Input/Output Signals**

Signal	Level		Definition
	Mode 5	Mode 6	
Data Track (1-8)	+5V 0V	0V +5V	Hole Condition No-Hole Condition
Data Ready	+5V 0V	0V +5V	Data is available and valid Data is not available
	Either Mode		
System Ready	0V		Reader is ready to receive commands
	+5V		Reader will not accept input command
Drive Right (-DR) or	0V		Pulse or level commands reader to output data
Drive Left (-DL)	+5V		Stops the output of data in the read mode
Rewind Right (-WR) or	0V		Command to output data at 400 cps (~ 200 cps in loop mode)
Rewind Left (-WL)	+5V		Stops the output of data in the rewind mode
Data Mode Select	0V		Specifies mode 5 output levels for DATA and DATA READY
	+5V		Specifies mode 6 output levels for DATA and DATA READY

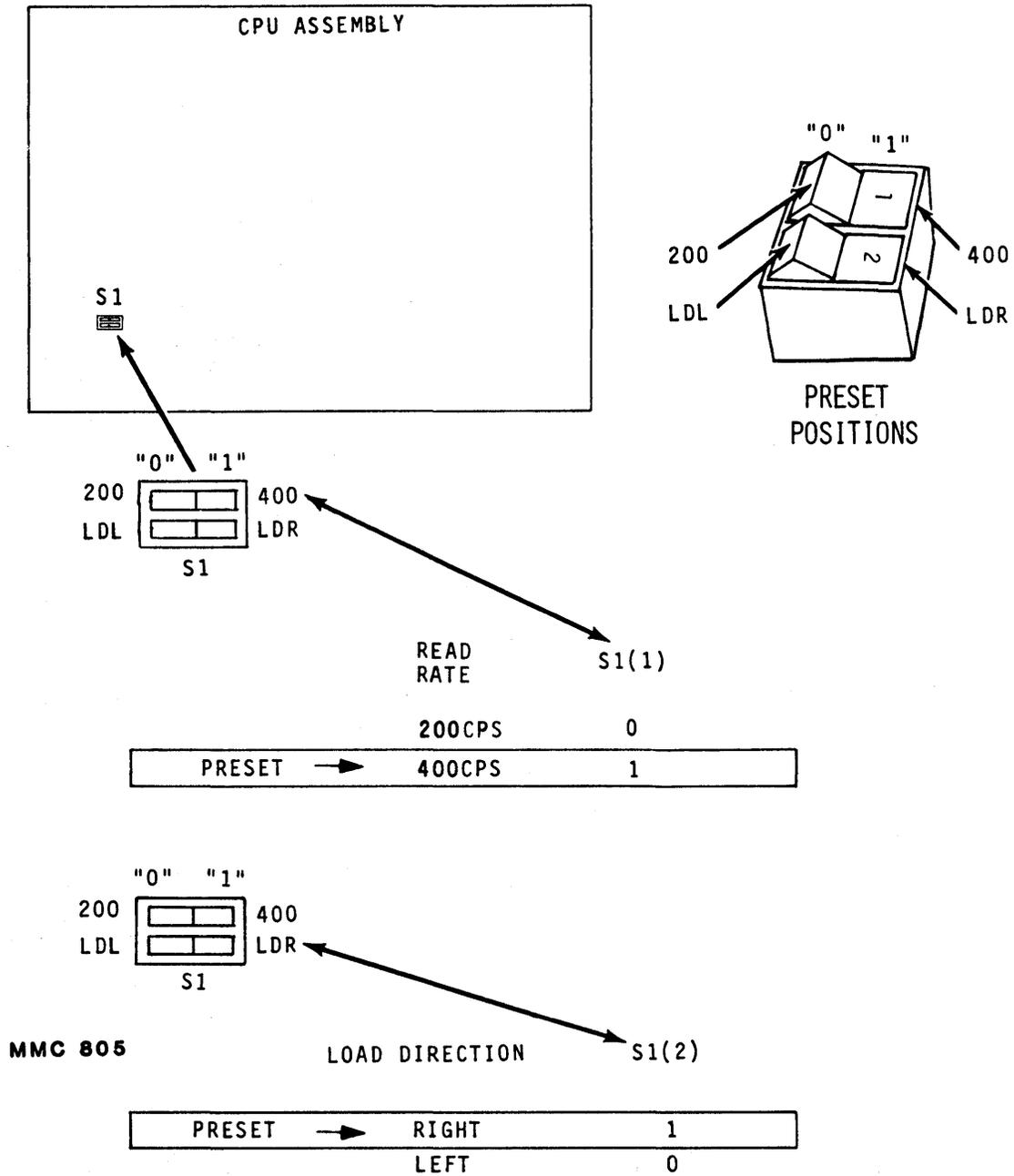
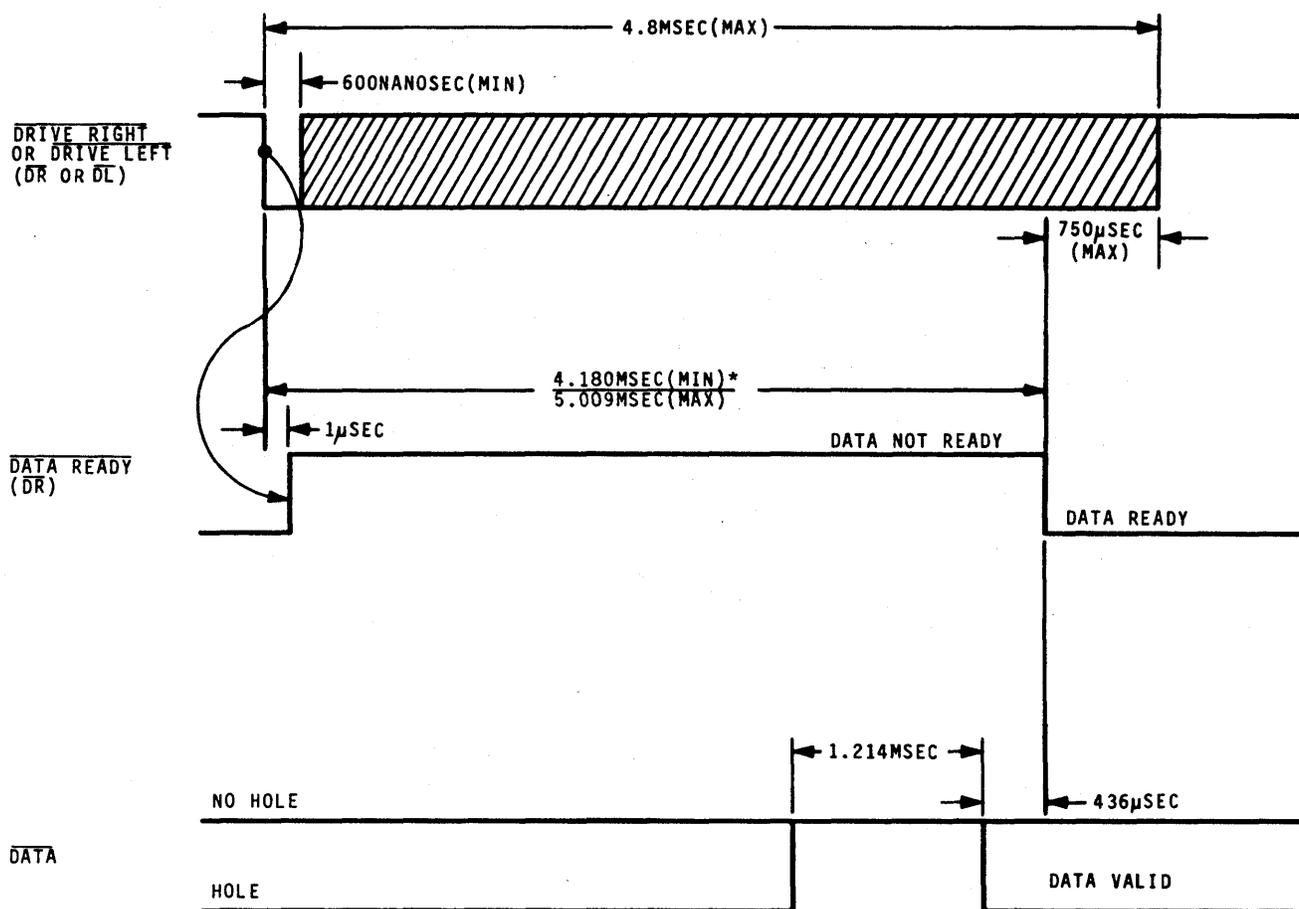


Figure 3-4. CPU Switch Settings.

### 3.3 SIGNAL AND STEP TIMING

(All signal name polarities shown correspond to I/O mode 6). A single DR or DL pulse causes the reader to output one character frame. Figure 3-5 shows the timing relationships between the control signals involved.



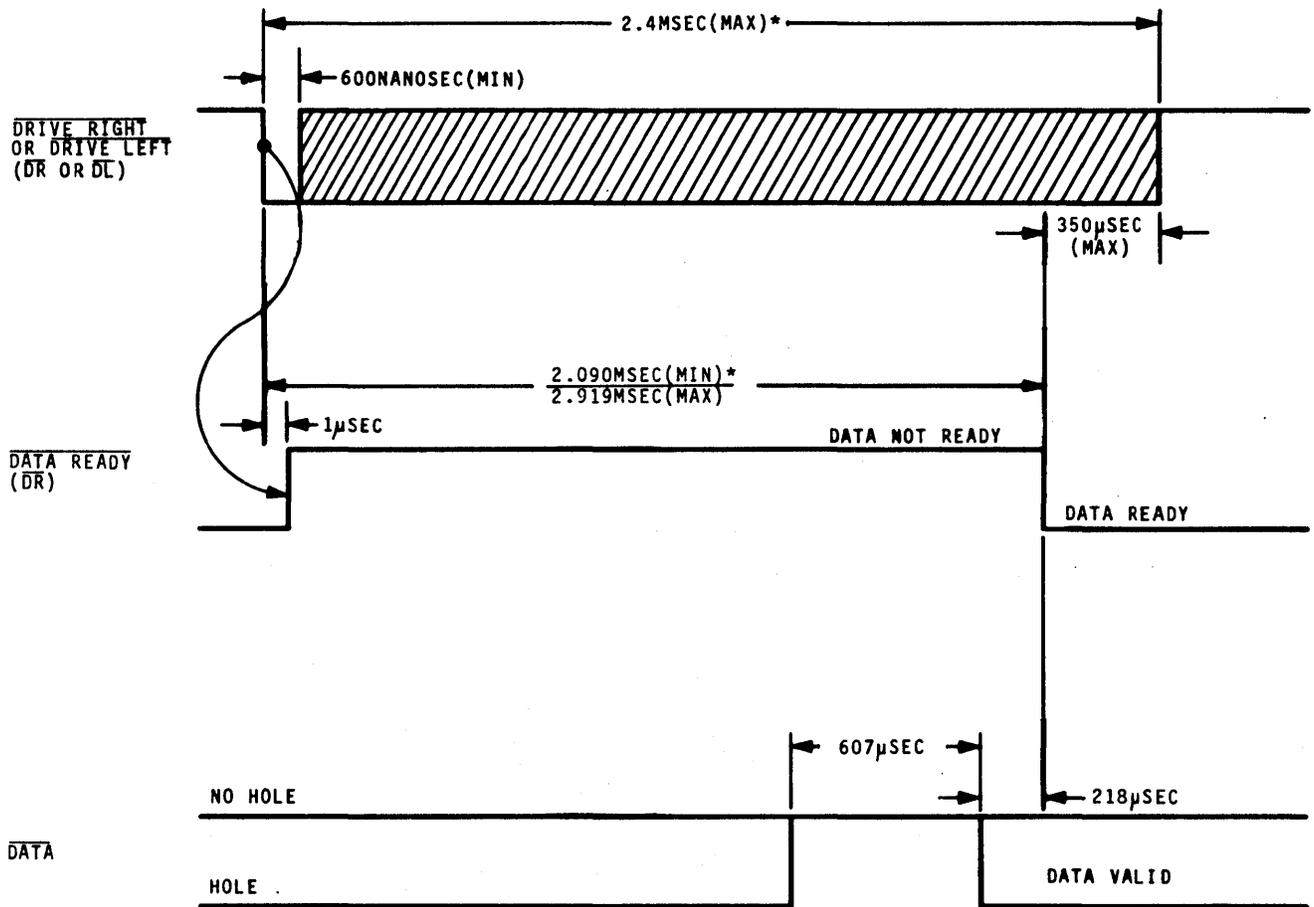
NOTE: MODE 6 SHOWN.

VALUES TYPICAL EXCEPT WHERE NOTED.

MMC 808

\*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.

Figure 3-5. Step Timing at 200 CPS.



MMC 807

NOTE: MODE 6 SHOWN.

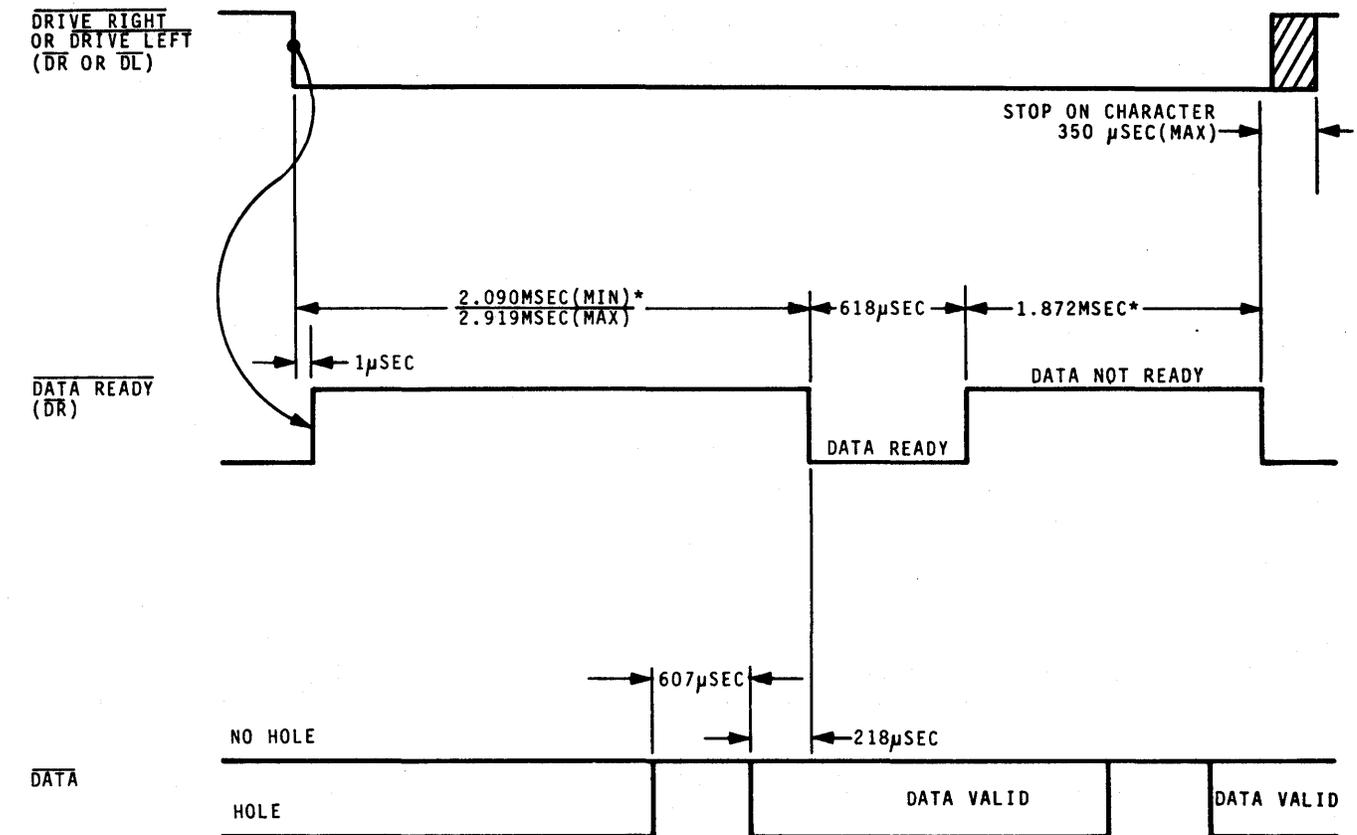
VALUES TYPICAL EXCEPT WHERE NOTED.

\*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.

Figure 3-6. Step Timing at 400 CPS.

### 3.4 SLEW TIMING

A DR or DL signal causes the reader to output data continuously. Figure 3-7 shows the timing relationships between the control signals involved.



MMC 808

NOTE: 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.

MODE 6 SHOWN.

Figure 3-7. Slew Timing.

### 3.5 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.

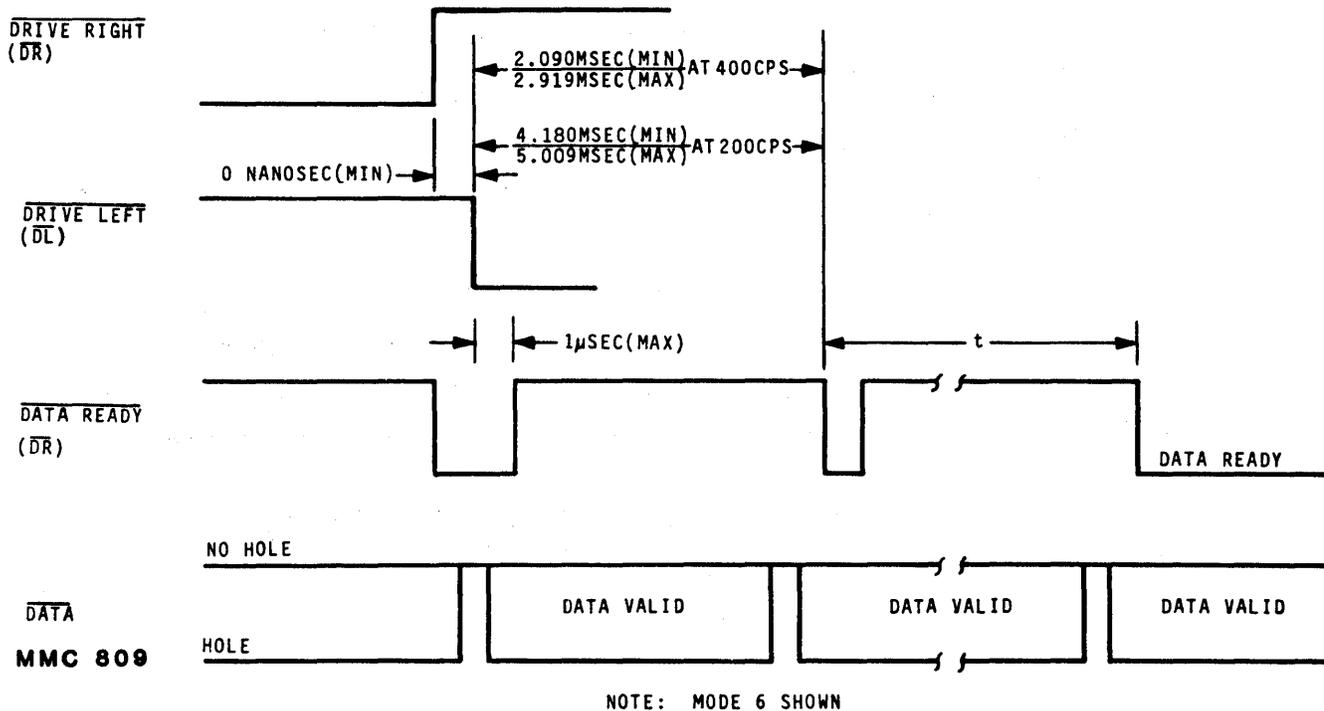
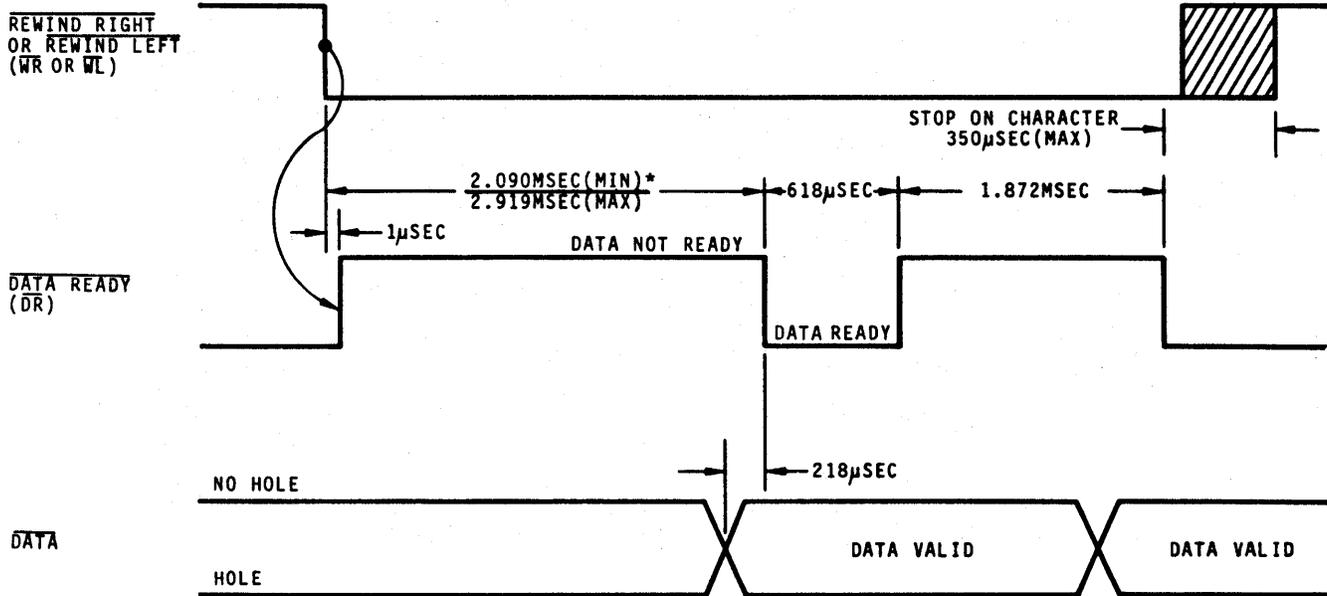


Figure 3-8. Turn Around Time.

### 3.6 REWIND (External)

Data is output at a maximum rate of 400 characters per second in response to a rewind command.



NOTE: ALL VALUES TYPICAL EXCEPT WHERE NOTED.

MMC 810

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.

MODE 6 SHOWN

Figure 3-9. Rewind (External)

### 3.7 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.

### 3.8 FRONT PANEL REWIND (Autostop)

Momentary actuation of the front panel rewind switch toward the load point causes the reader to rewind and stop automatically at the load point.

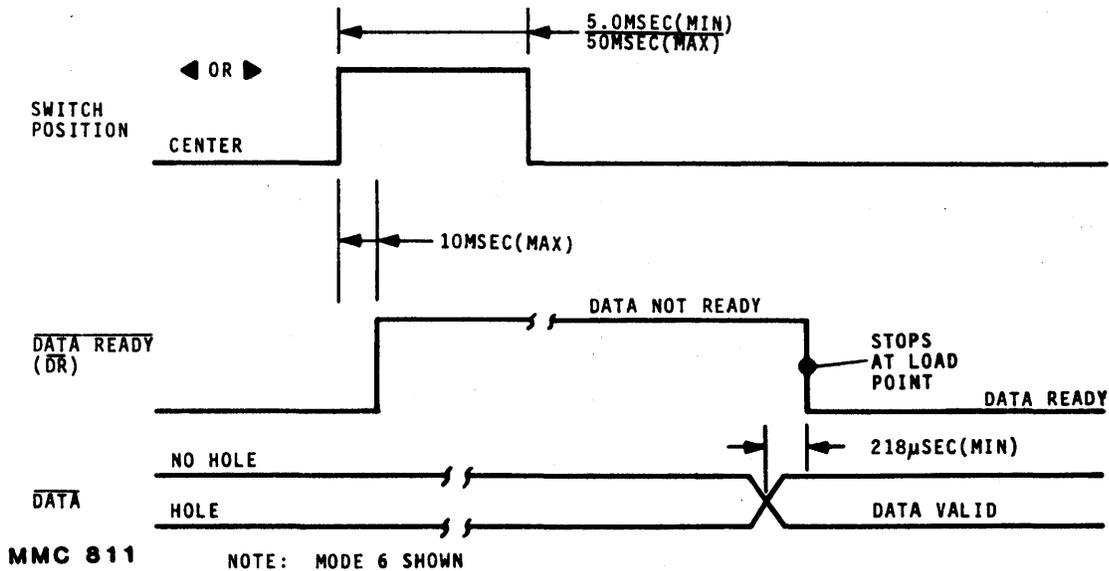
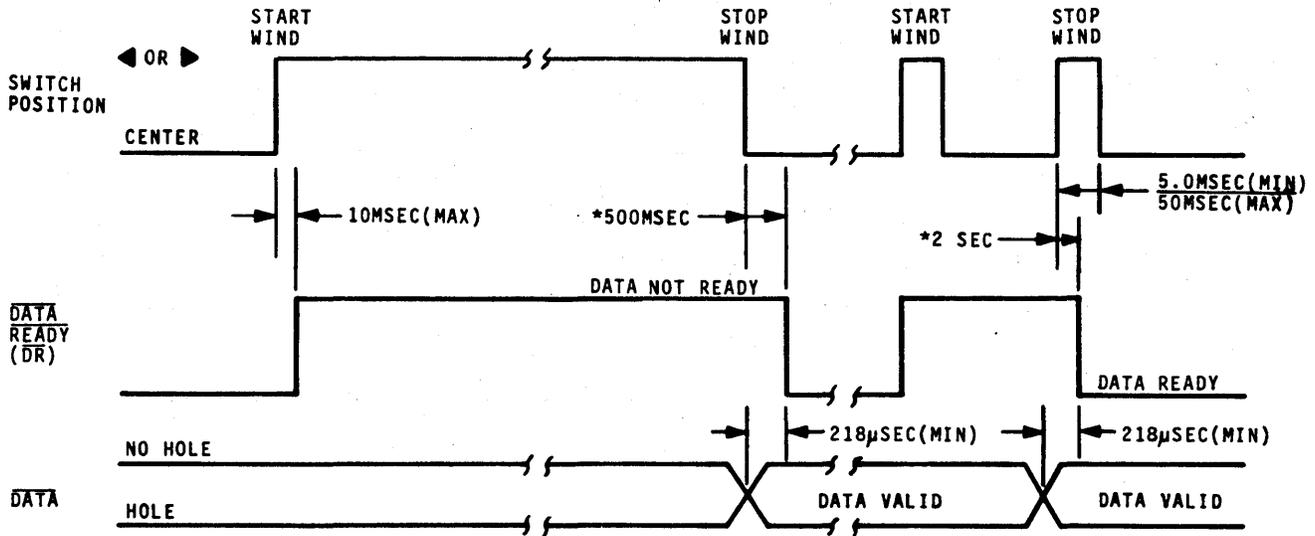


Figure 3-10. Rewind (Autostop)

### 3.9 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.

MODE 6 SHOWN.

MMC 812

Figure 3-11. Rewind (Manual).

## SECTION IV

### INTERFACE - EECO PARALLEL I/O

#### 4.1 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 selection of logic levels for all signals. Customer connection is through a DB25P connector located at 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 21.

#### 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 removing the shorting screw (Figure 4-1). With the internal ground connection removed, it is especially important that chassis ground and system ground be externally connected by a low impedance at high frequencies; otherwise power line transients may develop chassis voltage disturbances sufficient to cause system malfunction. (See Table 1-2).

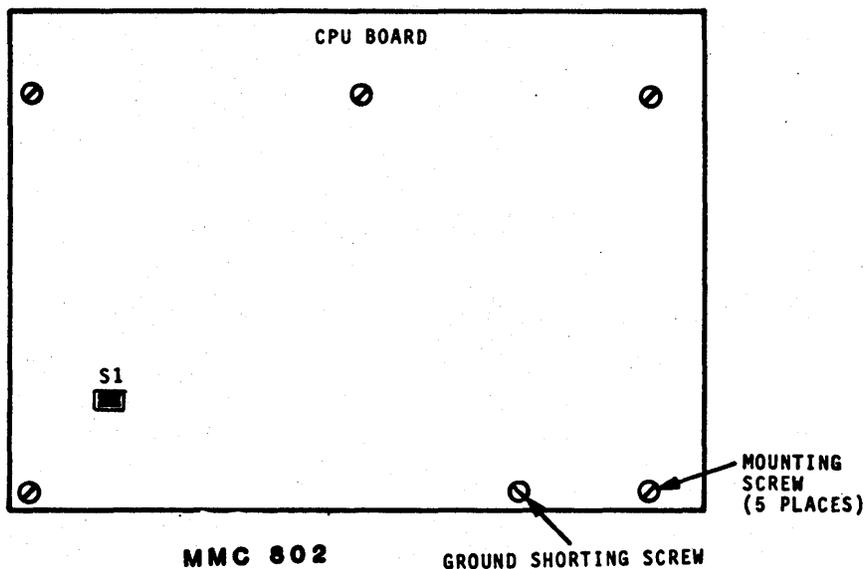


Figure 4-1. Ground Shorting Screw.

Table 4-1. Connector Pin List

Pin	Signal Name	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	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

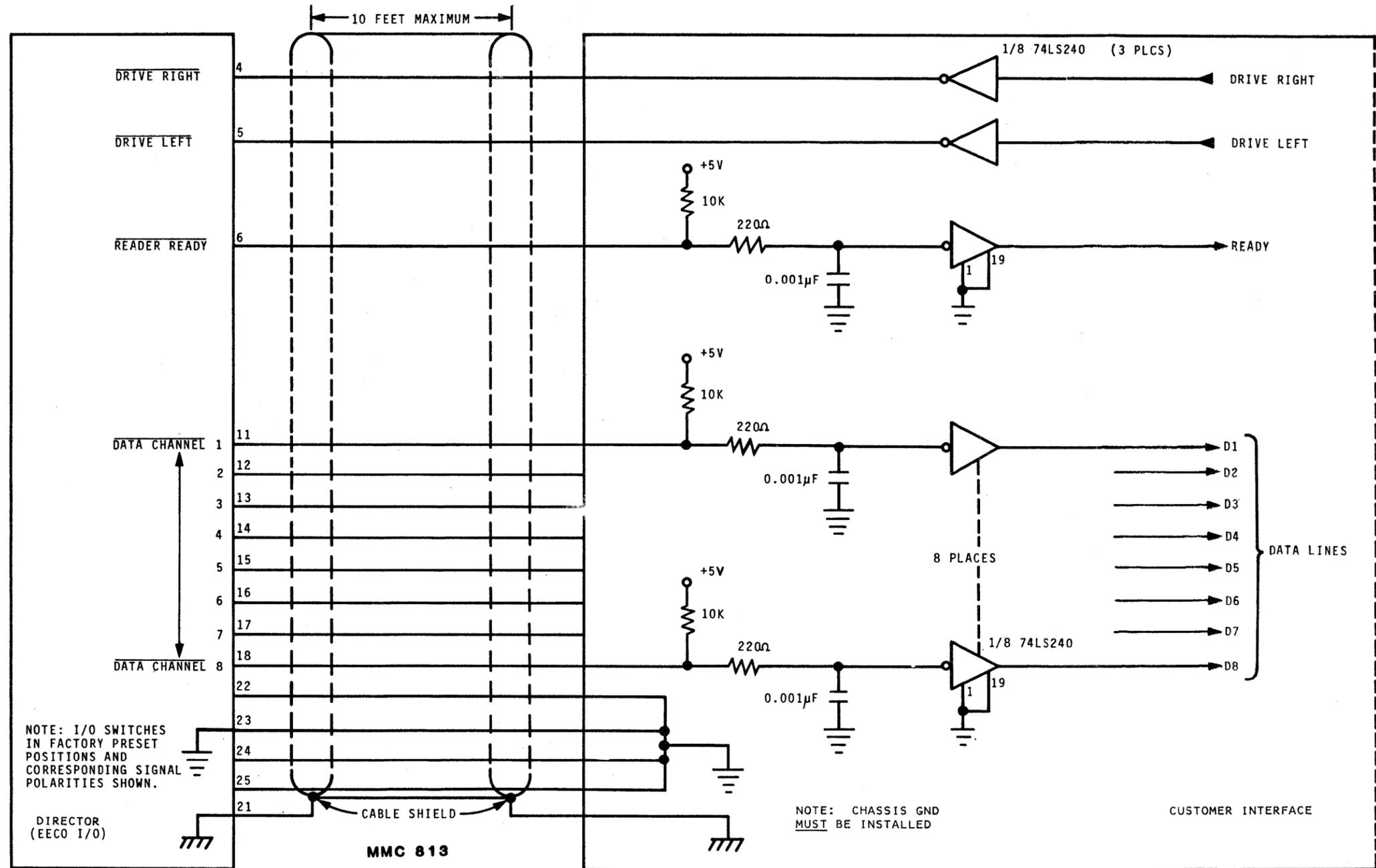
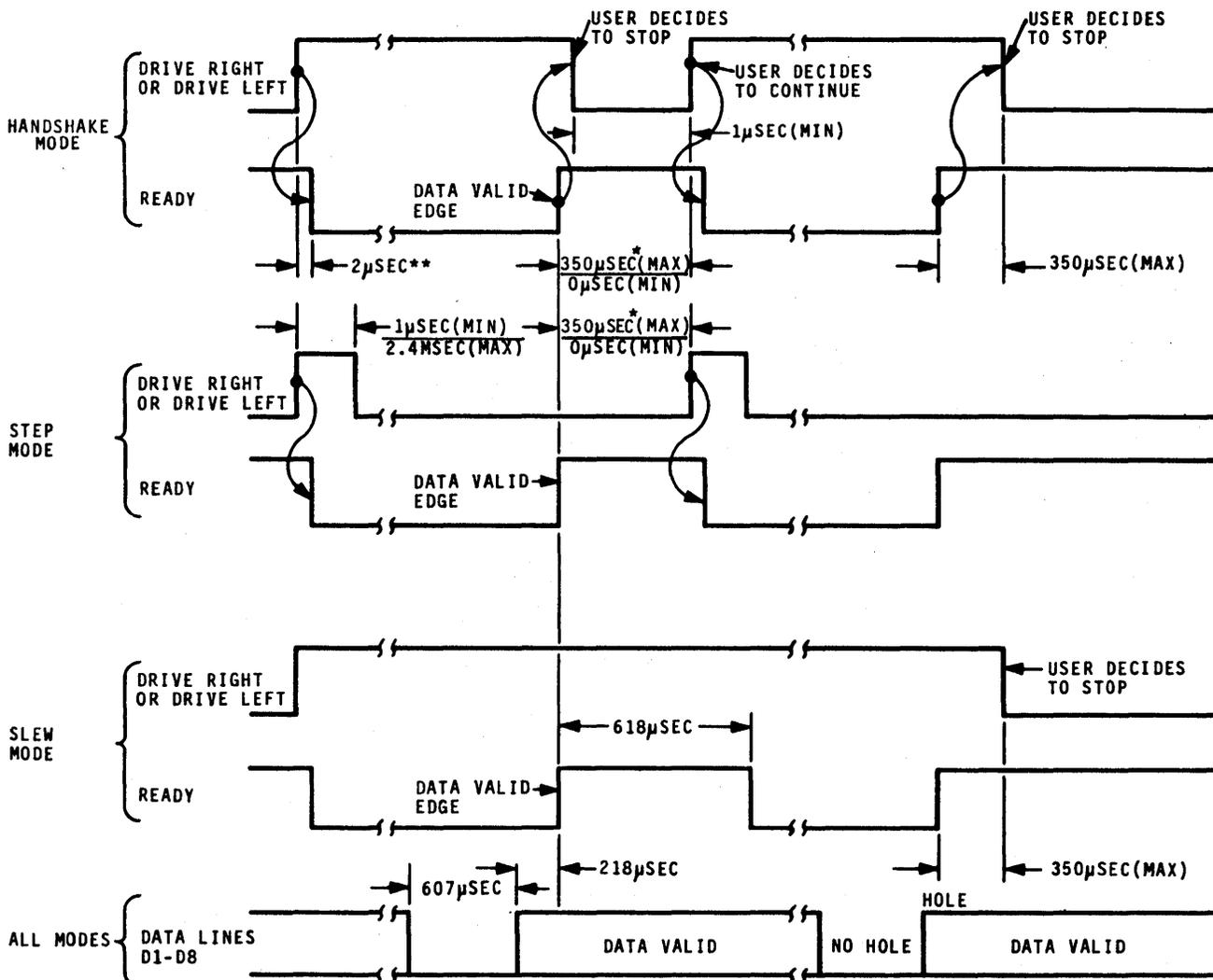


Figure 4-2. Recommended Customer Interface Circuit.



**MMC 804**

NOTES: ALL VALUES TYPICAL EXCEPT WHERE NOTED.  
 TIMING IS FOR 400CPS. FOR 200CPS TIMING, REFER TO VALUES ON APPROPRIATE DRAWING.

\*IF THIS VALUE OF 350µSEC IS EXCEEDED, THE READER WILL SLOW DOWN TO LESS THAN 400CPS.

\*\*\*INCLUDES FILTER DELAYS OF BOTH READER AND CUSTOMER INTERFACE.

**Figure 4-3. Recommended Interface Timing Diagram.**

### 4.3 LOGIC LEVELS

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

**Table 4-2. Logic Levels**

Input/ Output	Level	Voltage Range	Max. Current
Input	+5V	+2.0 to +5.2 VDC	40.0 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	12.0 mA

**Table 4-3. Input/Output Signals**  
(Defined for switches in Factory Preset Positions)

Signal	Level	Definition
Data (D1-D8)	0V	Hole Condition in punched tape. All data channels (D1-D8)
	+5V	No-Hole condition in punched tape.
Reader Ready (RR)	0V	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)	0V	Data on the data lines is available and valid.
	+5V	Data on the data lines is <u>not</u> available or is invalid.
Broken Tape (BT)	0V	Tape did not transport correctly through the readhead mechanism.
	+5V	Tape is transporting correctly.
Drive Acknowledge (DA)	0V	A 218-microsecond pulse response to a drive or rewind command (436 microseconds at 400 cps). This pulse is generated at the beginning

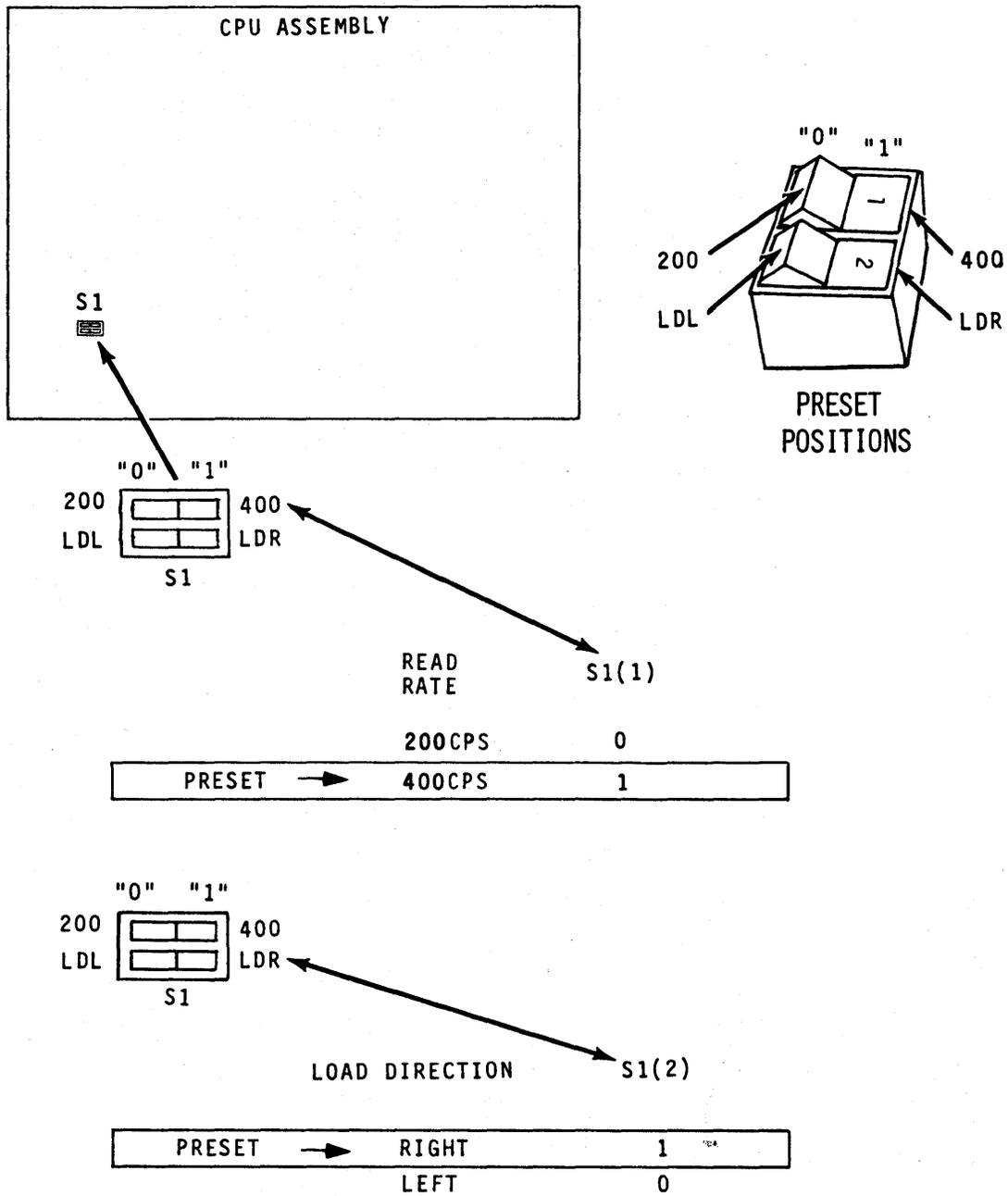
**Table 4-3. Input/Output Signals (Cont'd)**

Signal	Level	Definition
(DA cont'd)		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)	0V	Causes reader to output data at 400 cps in spool mode (.. 250 cps in loop mode).
	+5V	Disables the rewind mode.
Drive Right (DR)  or  Drive Left (DL)	0V	Pulse or level commands reader to output data from the reader memory.
	+5V	Commands the reader to stop outputting data.
Run Status (RS)	0V	Level informs user that readhead cover is closed, tape is loaded, and reader is ready to accept an input command.
	+5V	Level informs user that readhead 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.

**\*\*\* NOTICE \*\*\***

USE OF PUNCHED TAPE WITH TORN OR MISSING SPROCKET HOLES MAY RESULT IN THE LOSS OF RELATED CHARACTER DATA. THIS CAN CAUSE OPERATIONAL ERRORS ON SOME CONTROLS. EXTERNAL CIRCUITS FOR DETECTING TORN OR MISSING SPROCKET HOLES IN PUNCHED TAPE MAY NOT FUNCTION WITH THIS PRODUCT.



MMC 805

Figure 4-4. CPU Switch Settings.

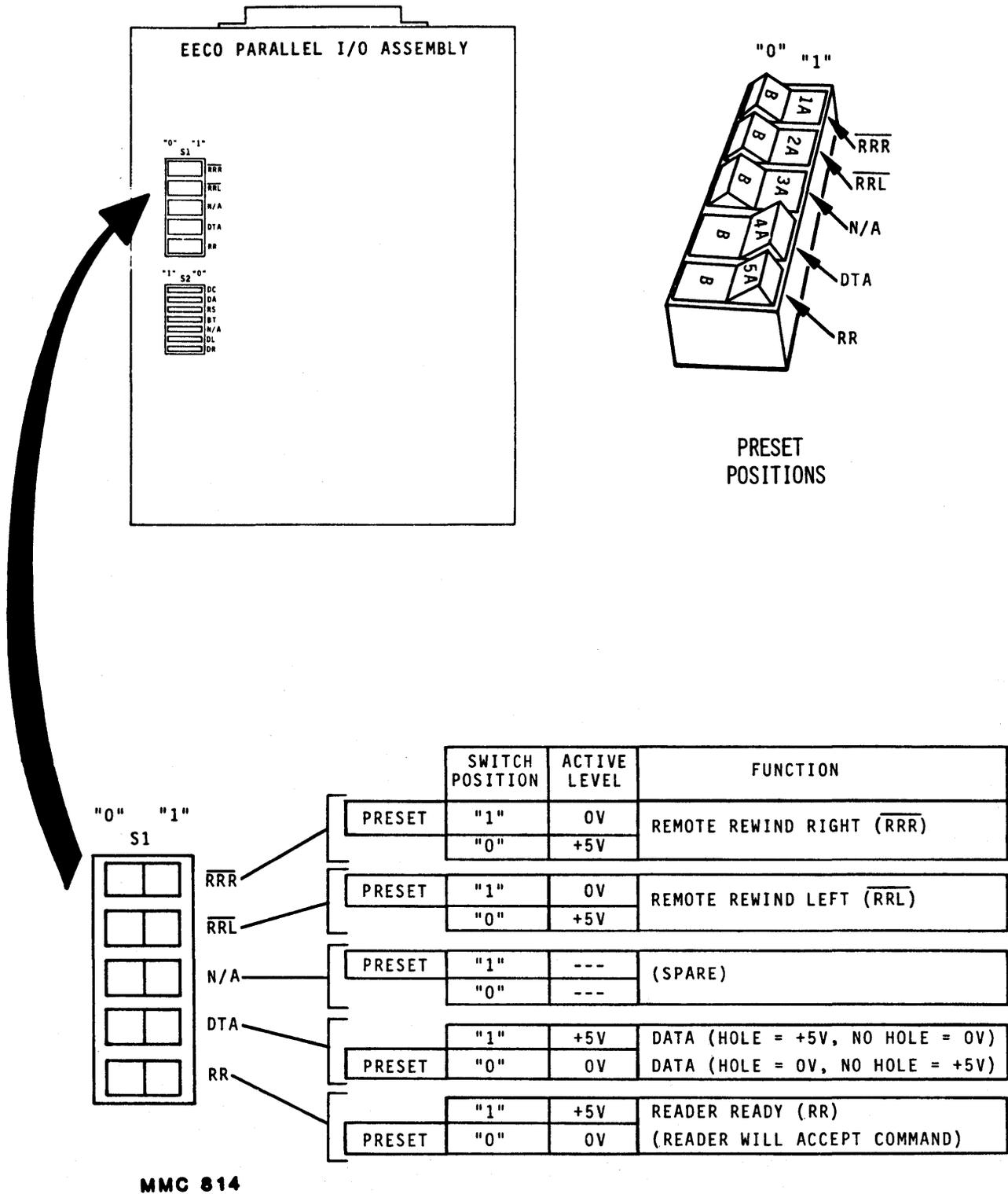
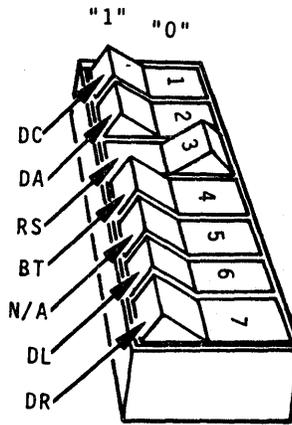
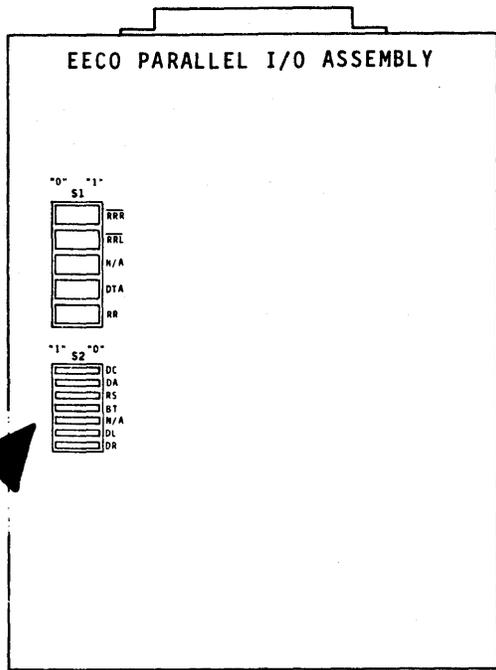


Figure 4-5. I/O Switch Settings - S1.



PRESET POSITIONS

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

MMC 815

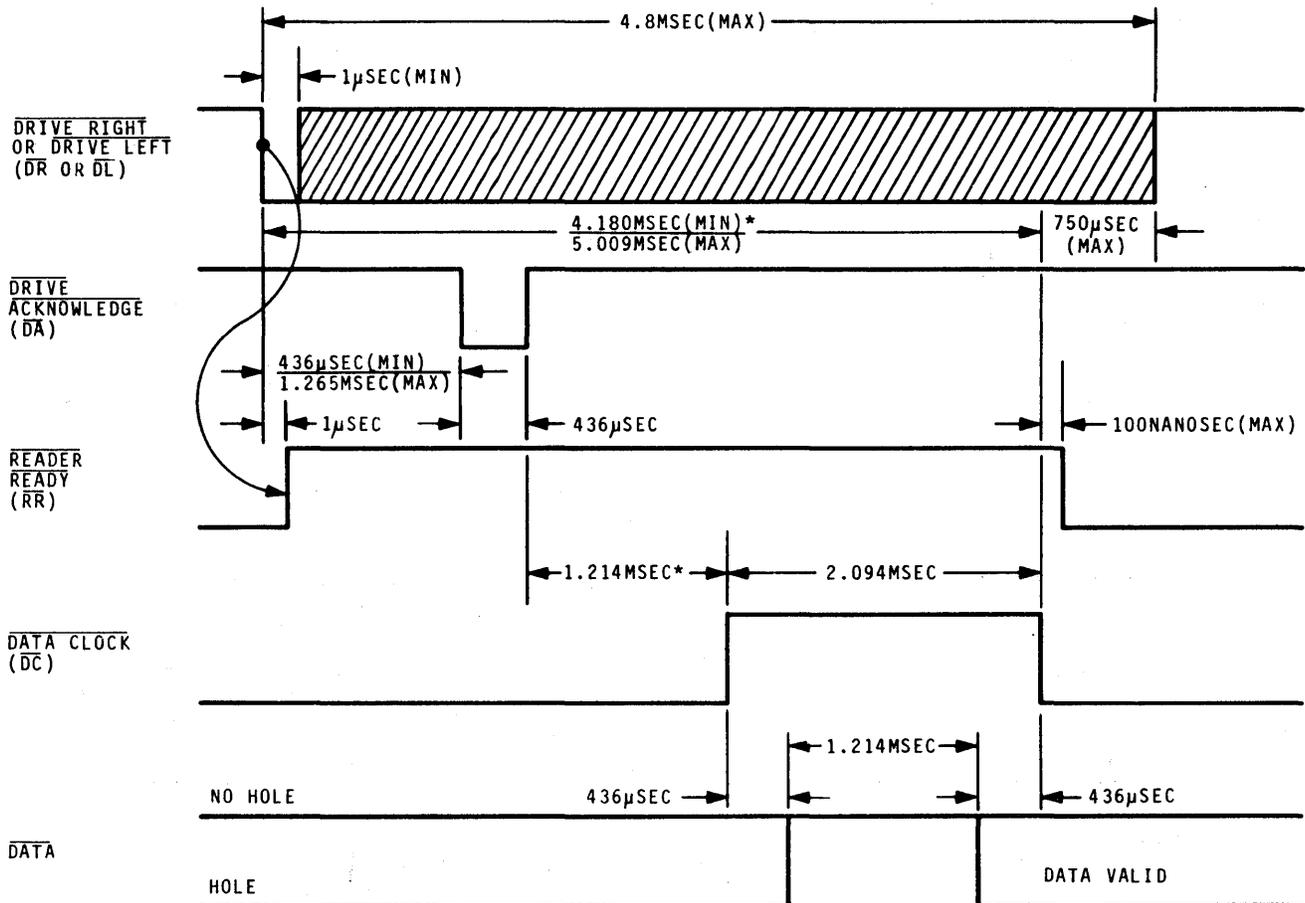
Figure 4-6. I/O Switch Settings - S2.

#### 4.4 SIGNAL TIMING

(All timing diagrams shown with switches in factory preset position. Signal name polarities shown correspond to factory preset positions).

#### 4.5 STEP TIMING

A single DR or DL pulse causes the reader to output one character. Figure 4-7 shows the timing relationships between the control signals involved.

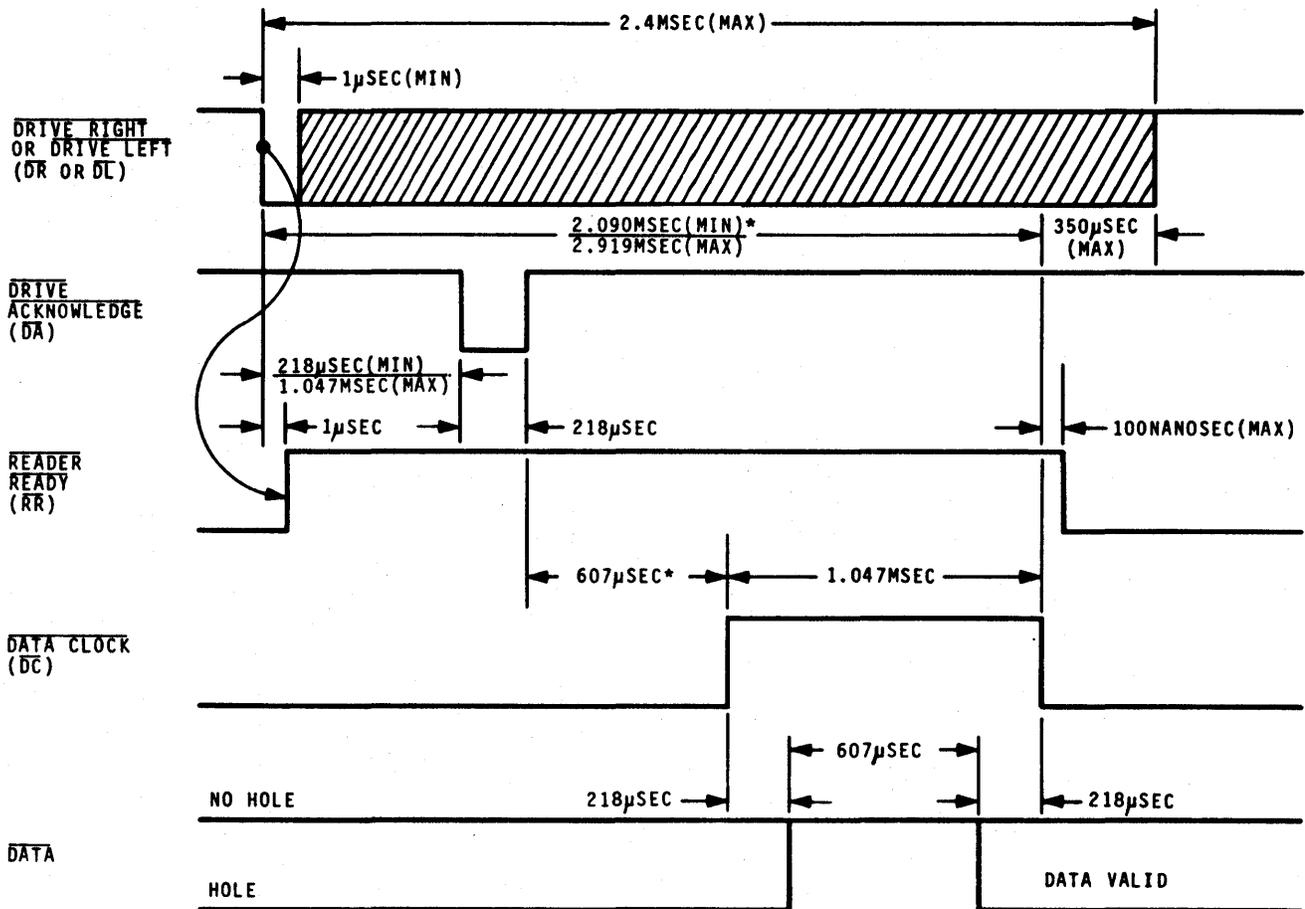


MMC 816

NOTE: ALL VALUES TYPICAL EXCEPT WHERE NOTED.

\*THIS VALUE 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.

Figure 4-7. Step Timing at 200 CPS.



MMC 817

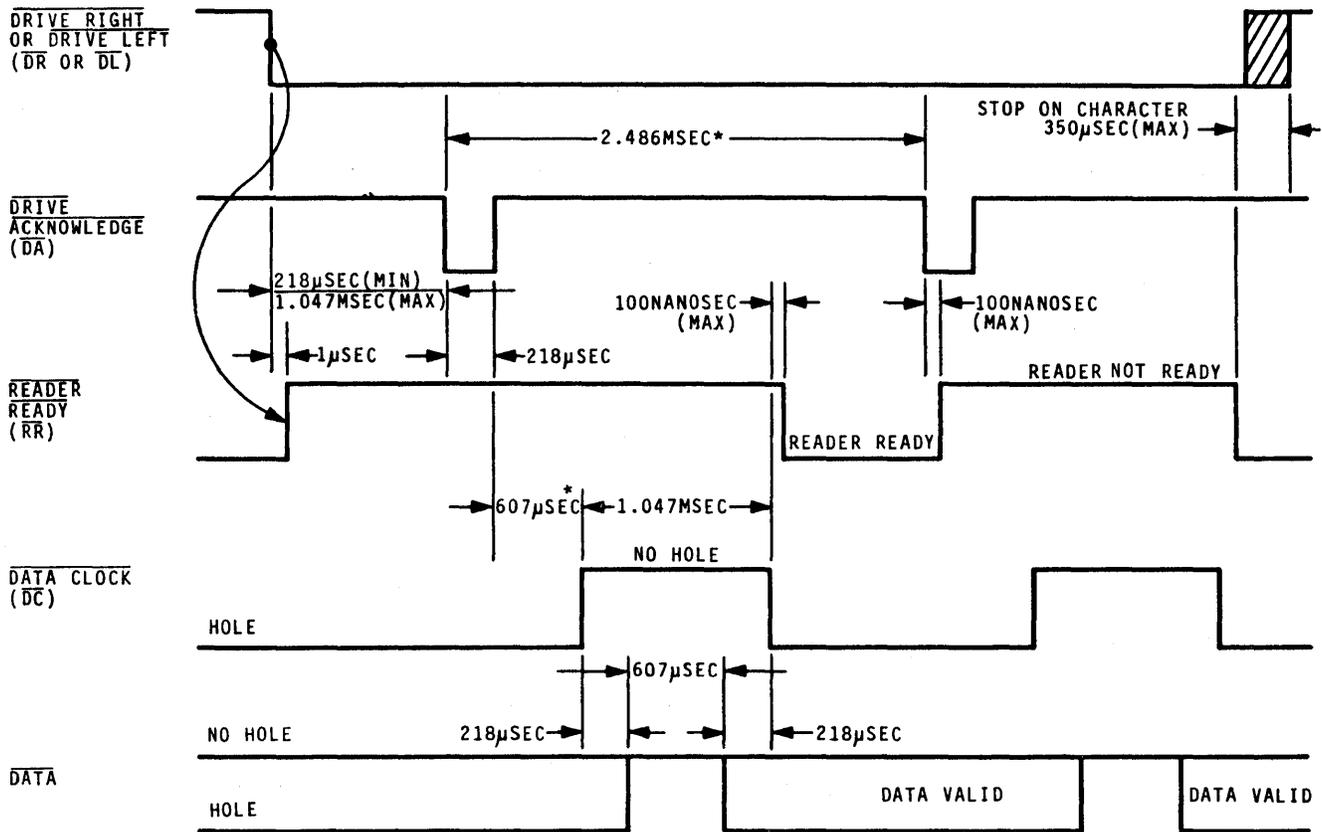
NOTE: ALL VALUES TYPICAL EXCEPT WHERE NOTED.

\*THIS VALUE 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.

Figure 4-8. Step Timing at 400 CPS.

#### 4.6 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 4-9 shows the timing relationships between the control signals involved.



NOTE: ALL VALUES TYPICAL EXCEPT WHERE NOTED.

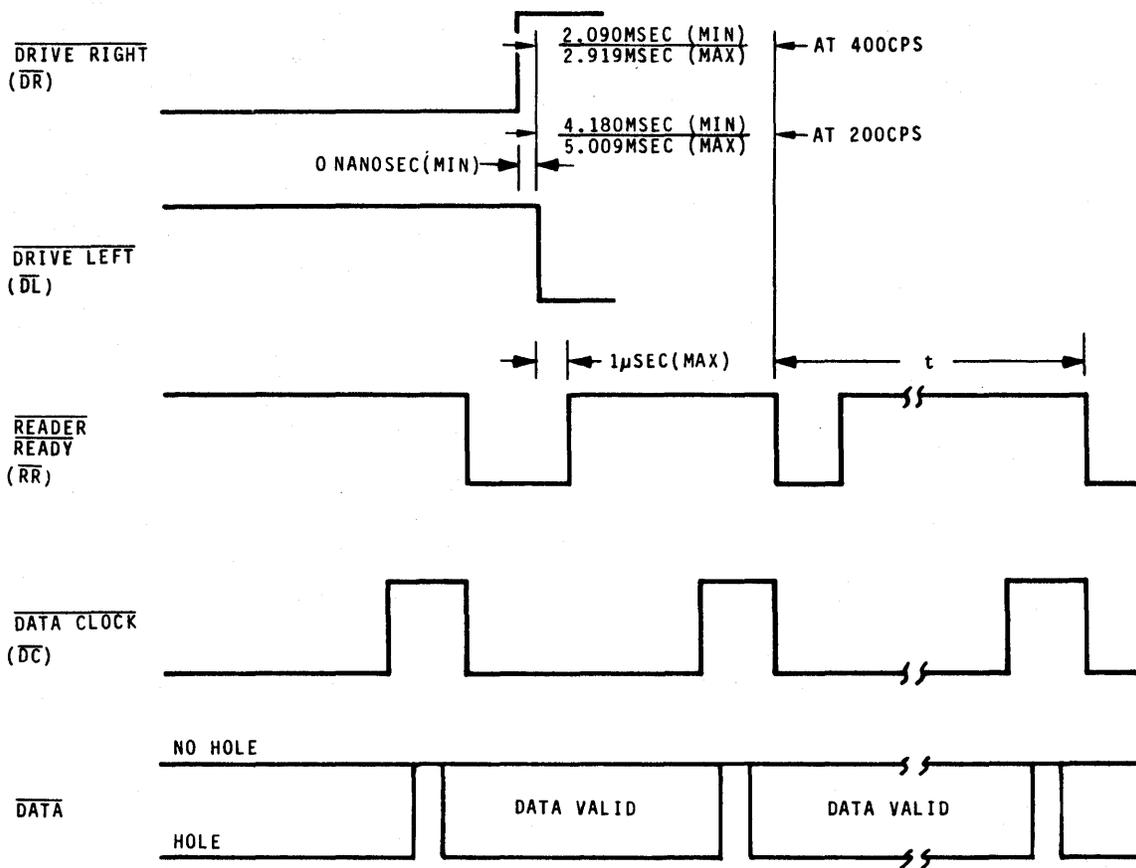
\*THESE VALUES WILL BE EXTENDED FOR THOSE CONDITIONS WHERE THE INTERNAL CHARACTER BUFFER IS EMPTY. IN THIS CASE THE NEXT CHARACTER OUTPUT TIMING WILL BE DETERMINED BY THE ARRIVAL OF THE TAPE AT THE NEXT CHARACTER.

MMC 818

Figure 4-9. Slew Timing.

#### 4.7 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. See Figure 4-10).

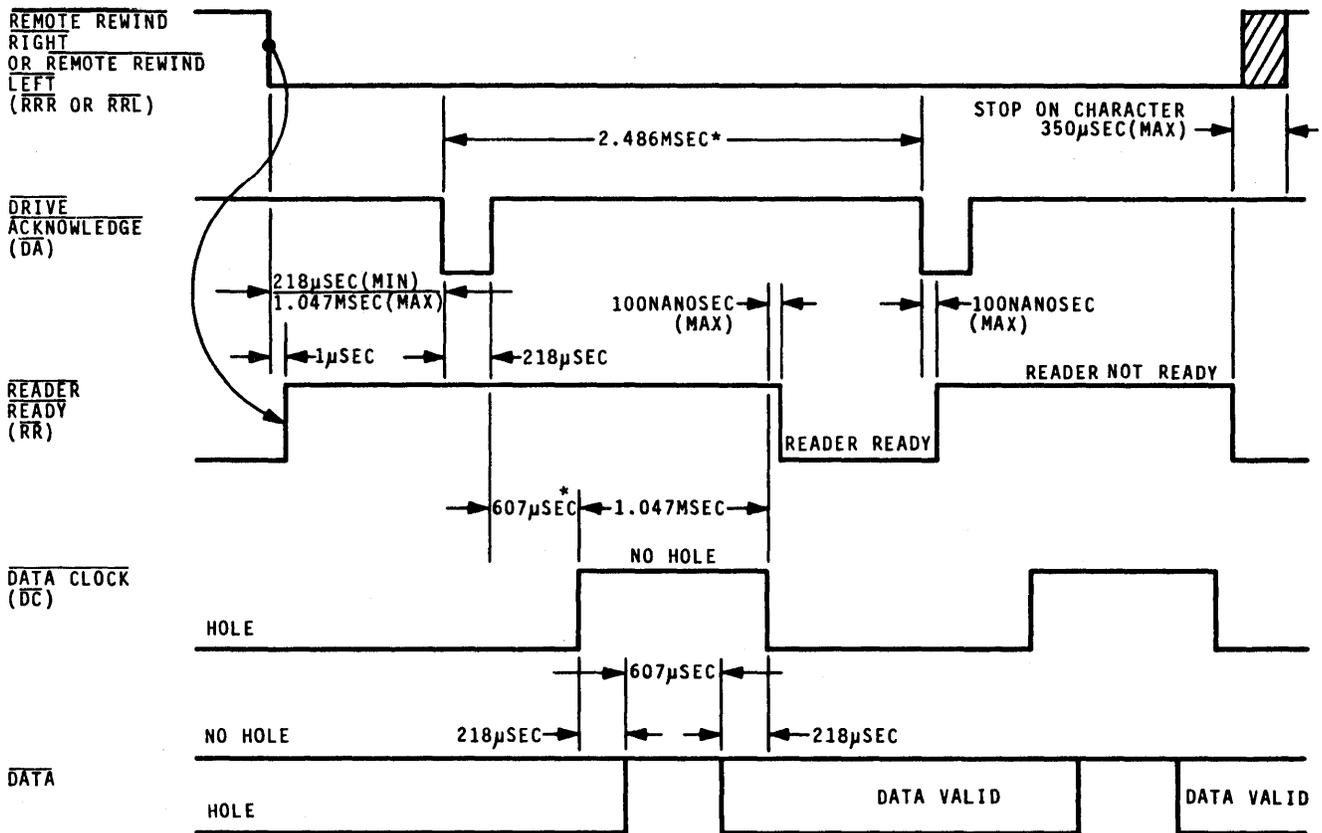


MMC 819

Figure 4-10. Turn Around Time.

#### 4.8 REWIND EXTERNAL

Data is output at a rate of 400 characters per second in response to a rewind command.



NOTE: ALL VALUES TYPICAL EXCEPT WHERE NOTED.

MMC 820

\*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.

Figure 4-11. Rewind (External).

#### 4.9 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.

#### 4.10 FRONT PANEL REWIND (Autostop)

Momentary actuation of the front panel rewind switch toward the load point causes the reader to rewind and stop automatically at the load point.

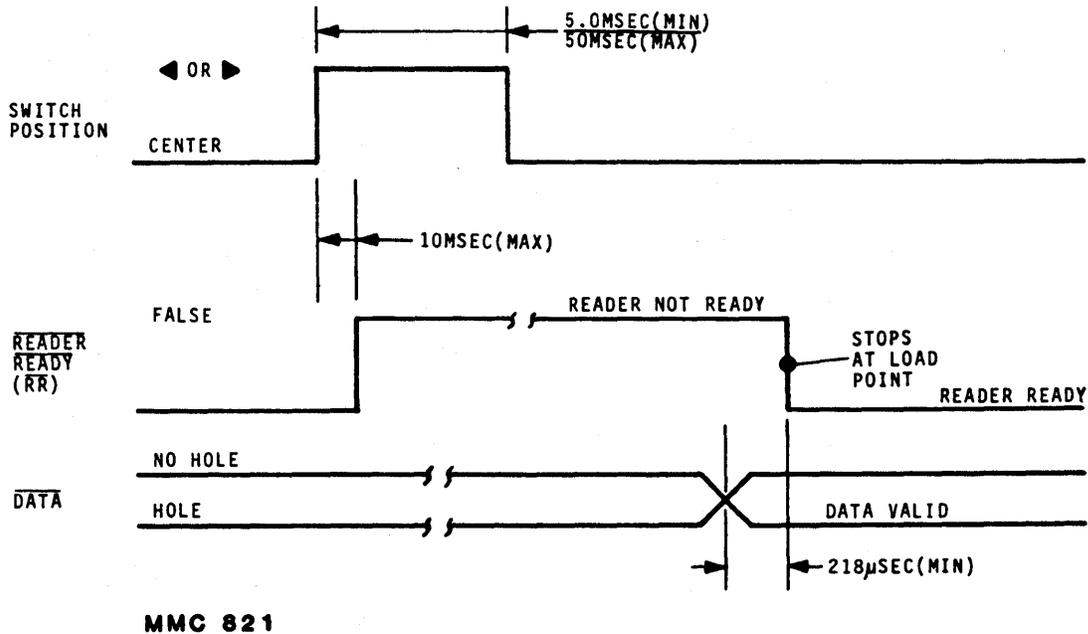
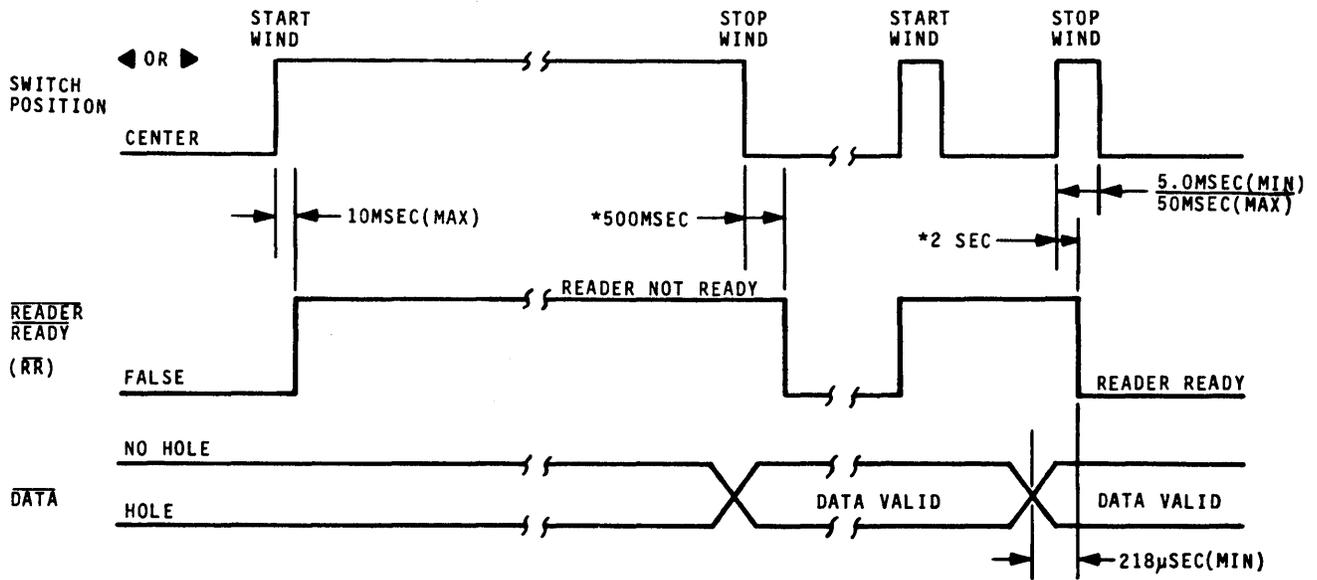


Figure 4-12. Rewind (Autostop).

#### 4.11 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.



MMC 822

NOTE: IF THE TAPE RUNS OFF THE END OF THE REEL A BROKEN TAPE SIGNAL WILL BE ISSUED, READER READY WILL STAY FALSE.

\*CAN VARY DUE TO REEL SIZE AND TAPE LOADING.

Figure 4-13. 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.

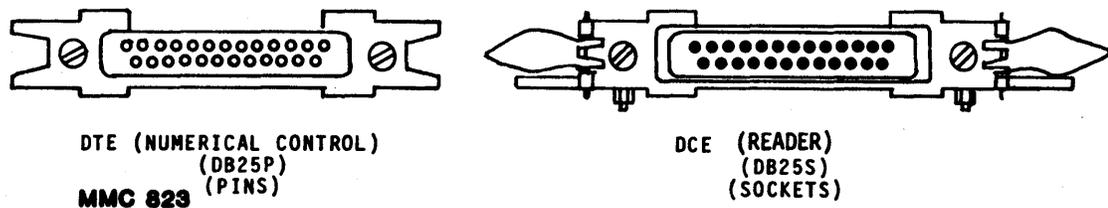
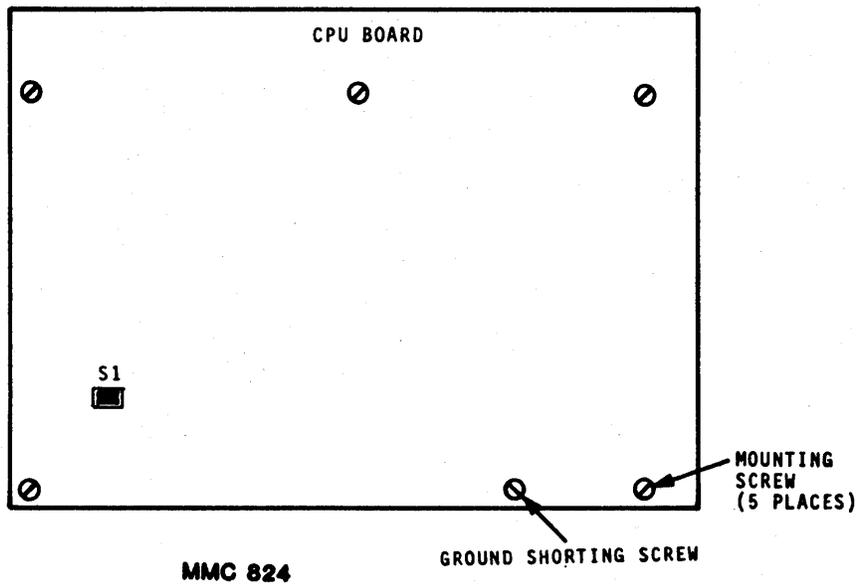


Figure 5-1. 25-Pin Connector.

**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 removing the shorting screw (Figure 5-2). With the internal ground connection removed, it is especially important that chassis ground and system ground be externally connected by a low impedance at high frequencies; otherwise power line transients may develop chassis voltage disturbances sufficient to cause system malfunction. (See Table 1-2).



**Figure 5-2. Ground Shorting Screw.**

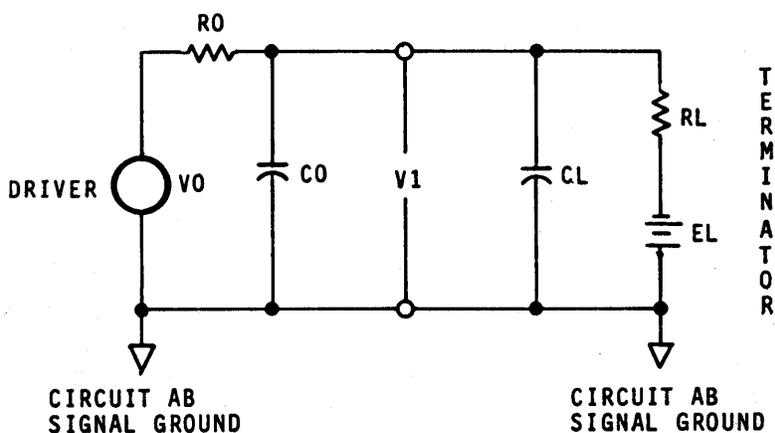
Table 5-1. Connector Pin List

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 interchanged by setting switch S3 in the appropriate position. The assignments shown are with S3 set in the "3" position.

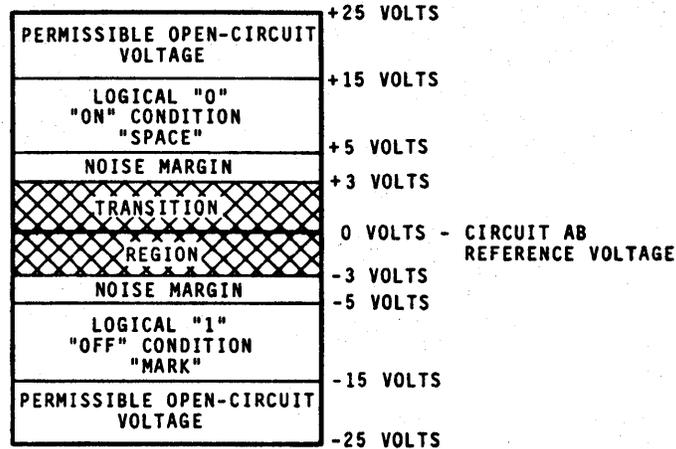
### 5.3 ELECTRICAL CHARACTERISTICS

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.



MMC 825

Figure 5-3. Equivalent Circuit.



MMC 826

Figure 5-4. Circuit Voltage Levels.

### 5.3.1 PARAMETERS

- (1) Open circuit voltage from the driver shall not be greater than  $\pm 25$  volts.
- (2) The open circuit voltage of the terminator shall not exceed  $\pm 2$  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 3k ohms and 7k ohms.
- (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 microsecond.

### 5.3.2 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.

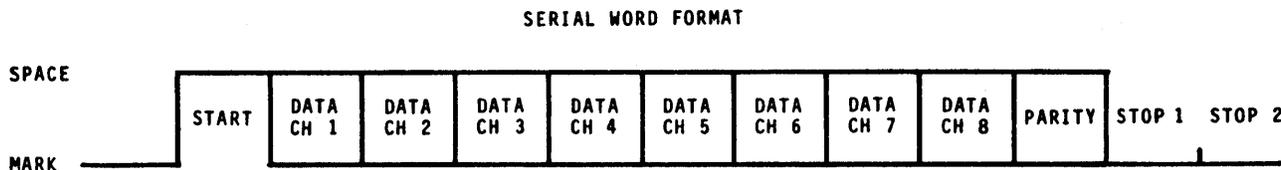
## NOTE

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.

### 5.3.3 TRANSITION REGION

- a. All interchange signals entering the transition region proceed to the opposite valid signal state and do not reenter the transition region until the next significant change in signal state.
- b. While in the transition region, the direction of the voltage change must not reverse.
- c. The time required for a control signal to cross the transition region must not exceed one millisecond.
- d. 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



**MMC827**

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 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**

### **5.5.1 SIGNAL GROUND - SG**

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

### **5.5.2 REQUEST TO SEND - RTS (Level I Protocol Only)**

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.

**READ: ON SERIAL I/O BOARDS (P/N 135653-01) REVISION E OR HIGHER, CHARACTER TRANSMISSION AFTER CHANGING "RTS" TO THE "OFF" CONDITION WILL BE LIMITED TO ONE CHARACTER OR LESS.**

### **5.5.3 DATA TERMINAL READY**

Reader input - not used.

### **5.5.4 DATA SET READY - DSR**

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 is "ON".

### **5.5.5 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.

### **5.5.6 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.

### **5.5.7 PROTECTIVE GROUND**

This is the chassis ground which is tied to the 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.

### 5.6.1 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 10k ohms in the SPACE condition. The receiver recognizes any current flow less than 1 mA as a SPACE.

### 5.6.2 SIGNAL DEFINITIONS

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

- a. Transmit. The transmit lines are:
  - Current loop send data A and
  - Current loop send data B.
- b. 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 (next page).

## 5.7 PROTOCOL

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

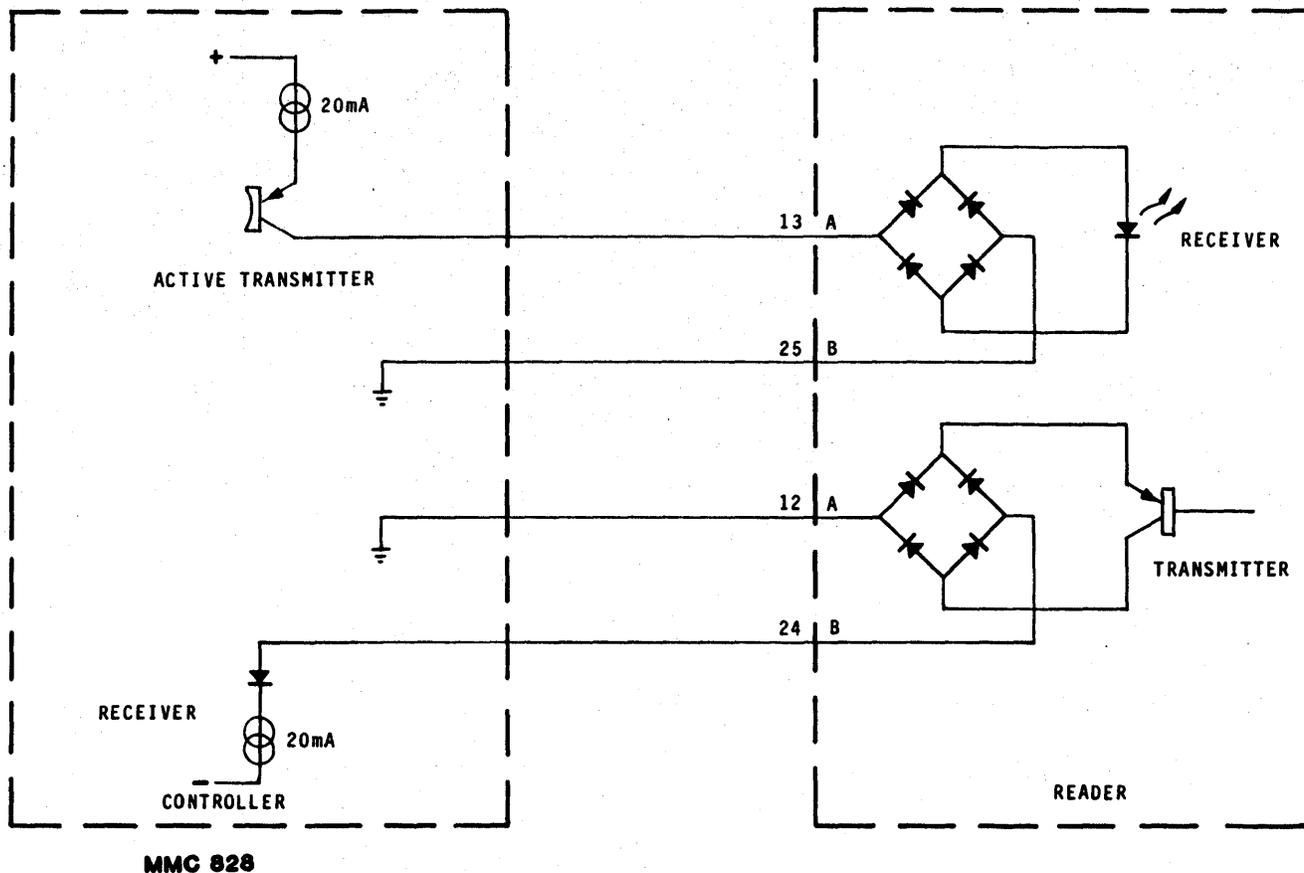


Figure 5-5. Current Loop Interconnector Diagram.

### 5.7.1 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.

#### 5.7.1.1 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. Refer to 5.5.2.

- 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.

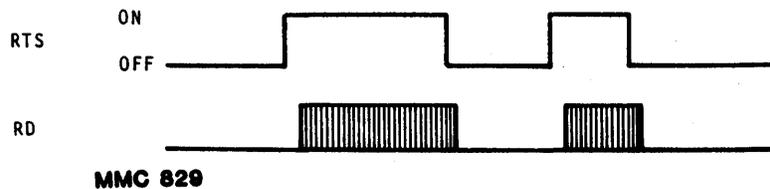


Figure 5-6. Level I Protocol.

#### 5.7.2 LEVEL II PROTOCOL

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. See Figure 5-7.

##### 5.7.2.1 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.

#### 5.7.2.2 Data Protocol

To Receive Data (Numerical Control):

- (1) 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 receive data.
- (2) The tape reader recognizes the DC1 as an indication that data may be sent and becomes the sending end as well as the responding end.
- (3) 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).

#### 5.7.2.3 Data Transmission

Sending End (Reader):

- (1) Following a DC1 input, the reader begins and continues to read and serially transmit tape data at the maximum character rate allowed by the baud rate and character length settings or 400 cps, whichever is lower. The reader continues to send data until a DC3 is received to terminate transmission.
- (2) Blank tape characters are transmitted when encountered.
- (3) If the reader should run out of tape or encounter a broken tape condition, transmission is suspended.

#### 5.7.2.4 Receiving End (Numerical Control)

The receiving end may transmit a DC3 at any time during a transfer. This indicates 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 characters 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 mechanism allows the receiving end to suspend 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.

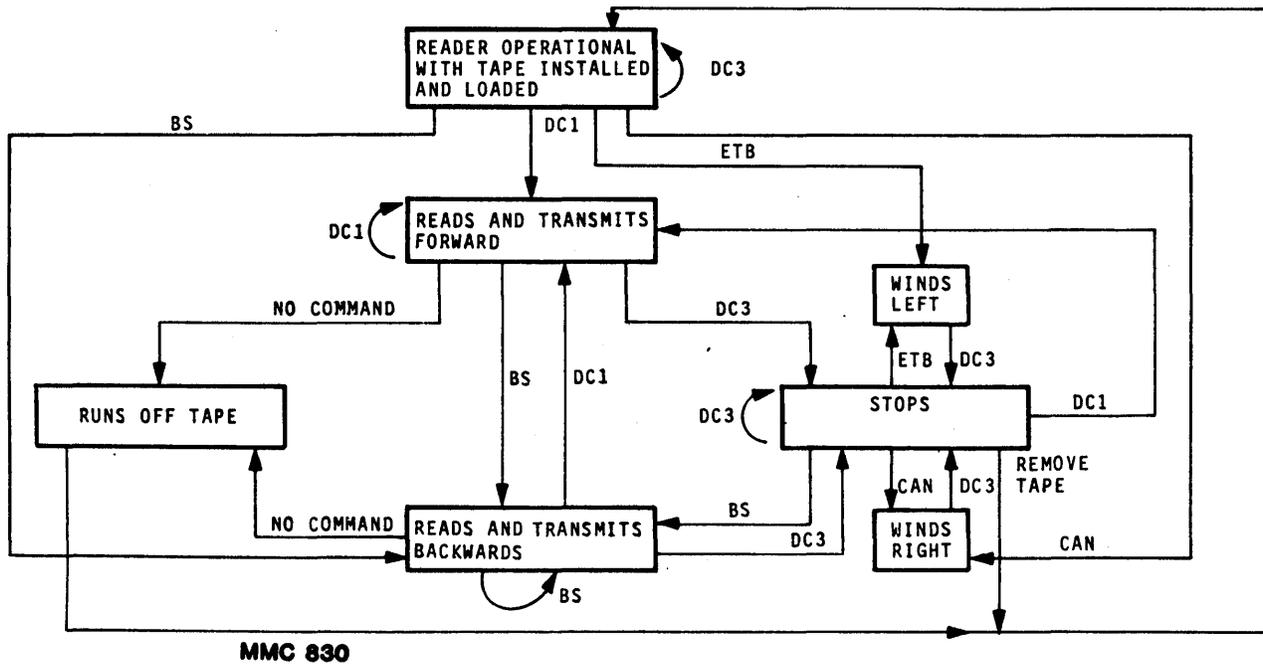
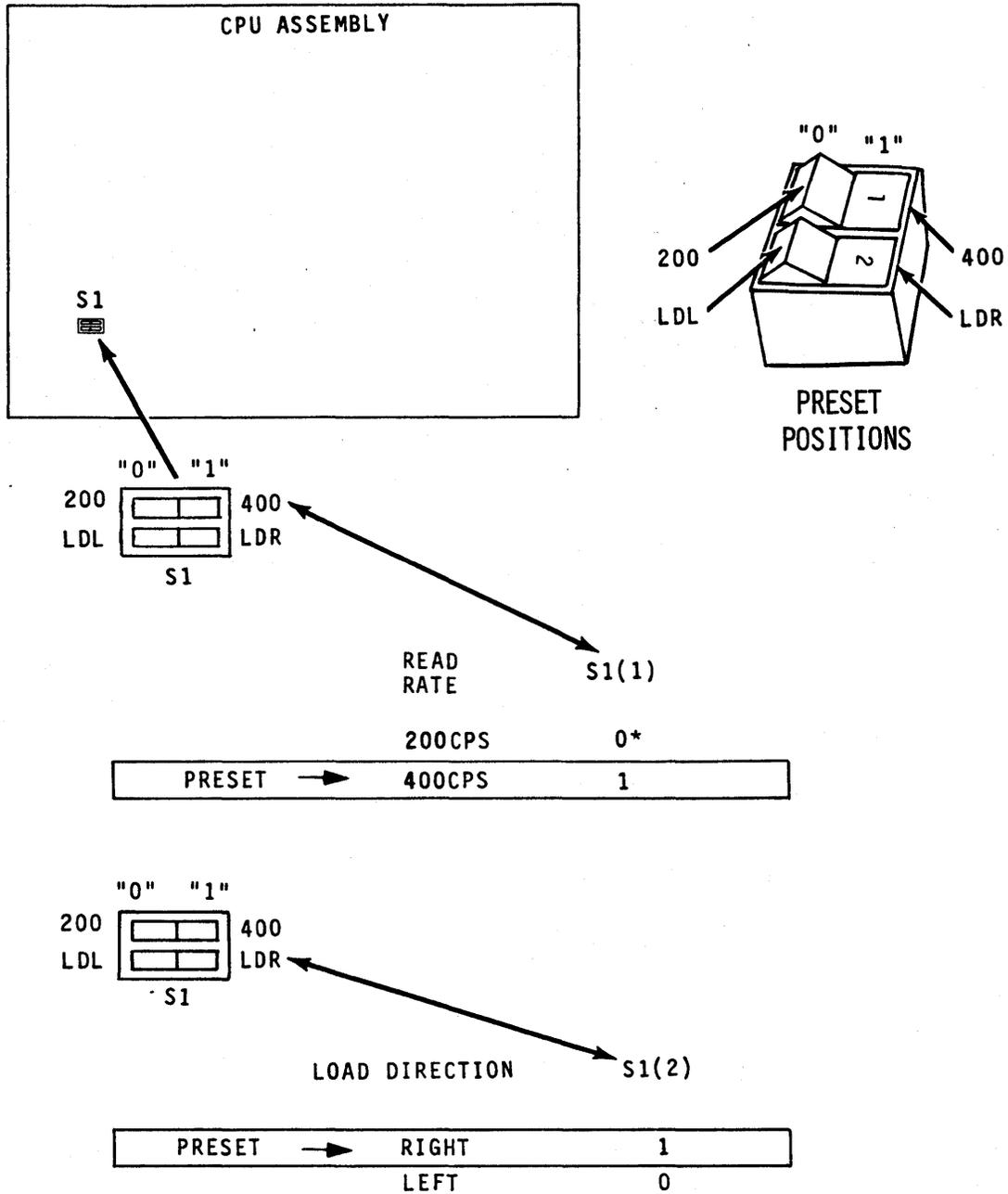


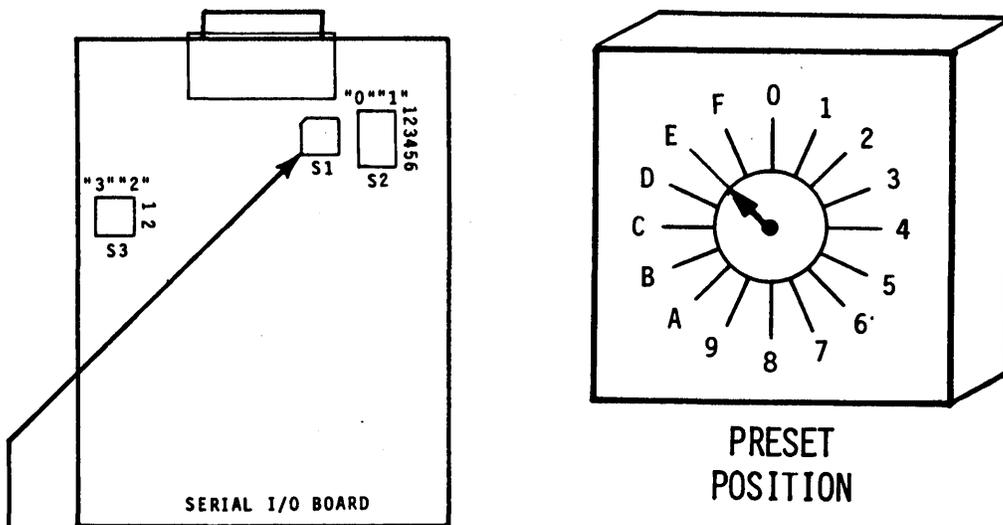
Figure 5-7. Level II Protocol.



\*THIS SWITCH POSITION IS NOT FUNCTIONAL FOR SERIAL I/O OPERATION.

**MMC 831**

**Figure 5-8. CPU Switch Settings.**



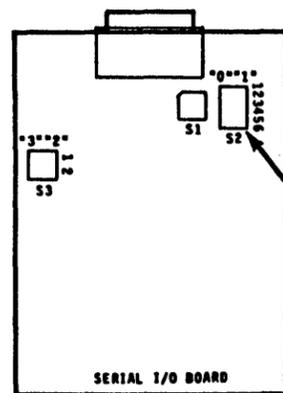
SWITCH SETTING	BAUD RATE	CHARACTER TRANSMISSION RATE CH/SEC.*
0	50	4.17
1	75	6.25
2	110	9.17
3	134.5	11.21
4	150	12.5
5	300	25.0
6	600	50
7	1200	100
8	1800	150
9	2000	167
A	2400	200
B	3600	300
C	4800	400
D	7200	400
PRESET → E	9600	400
F	19200	400

\* 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.

MMC 832

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



MMC 833

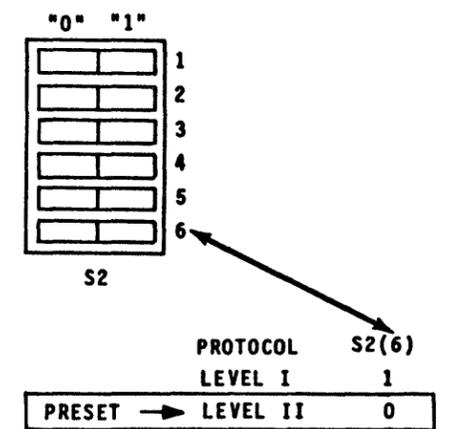
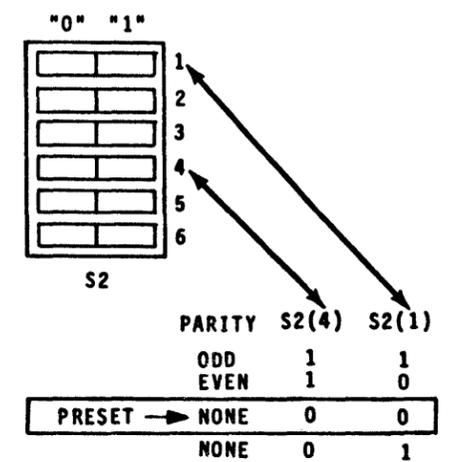
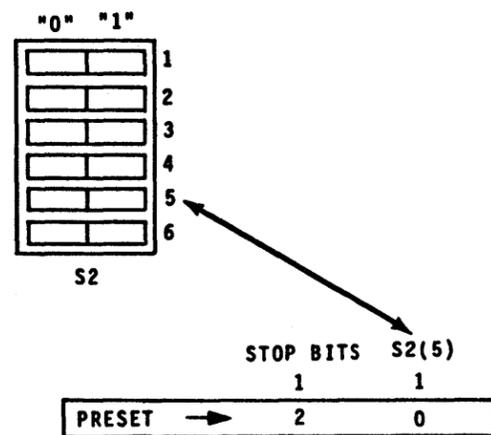
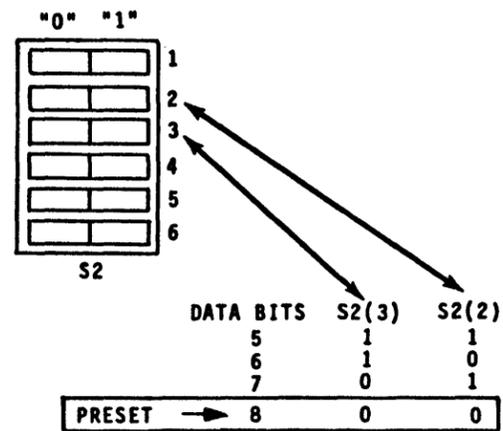


Figure 5-10. Data Configuration Switch Settings - S2.

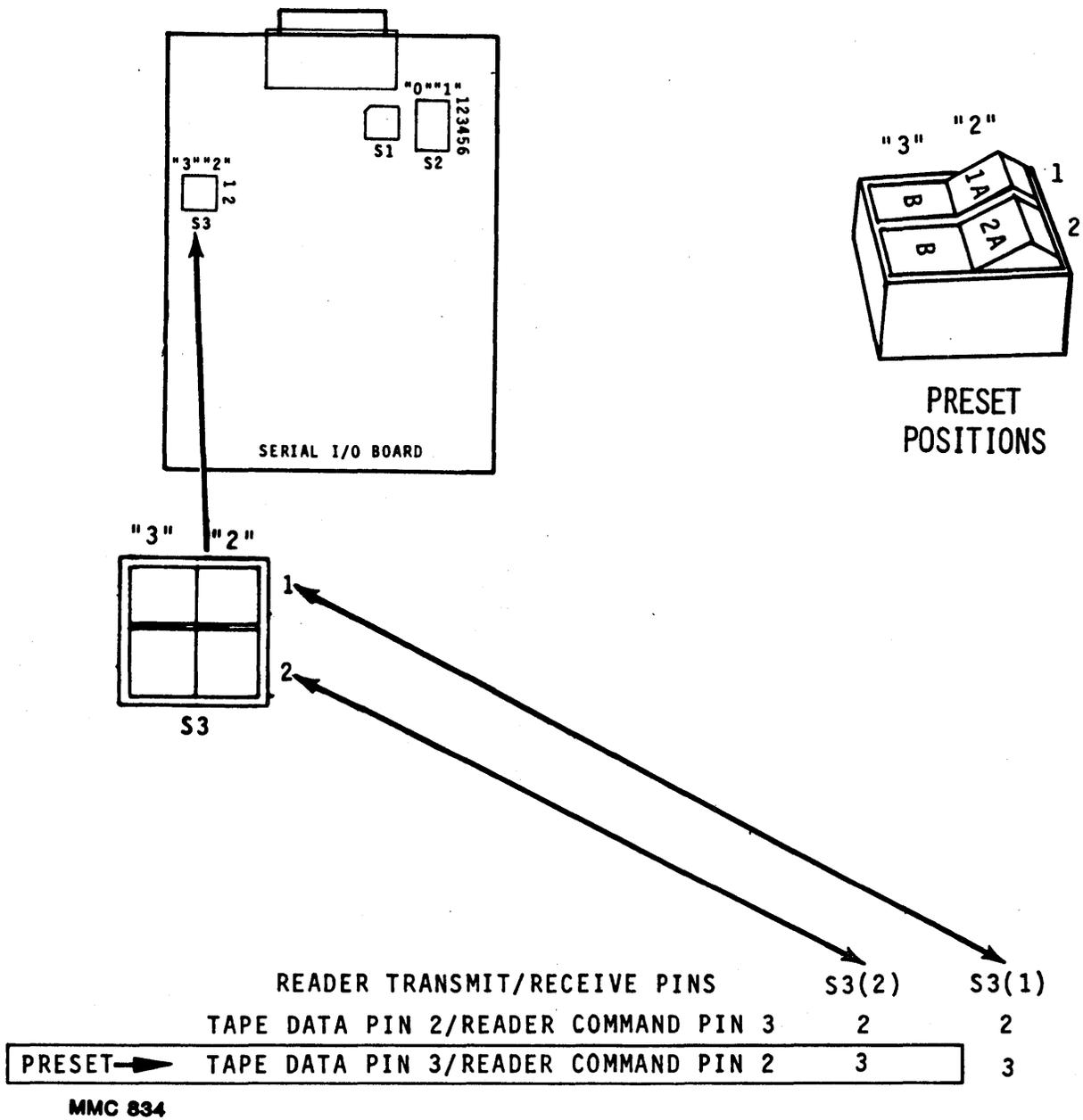


Figure 5-11. I/O Switch Settings - S3.

**TABLE 5-2. RS-232C Functions and Reader Applications**

Connector Pin No.	RS-232	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.	
10	Reserved for test.	
11	Unassigned.	
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.

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

**Table 5-2. RS-232C Functions and Reader Applications (Cont'd)**

Connector Pin No.	RS232	Reader
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.	
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.	

**Table 5-2. RS-232C Functions and Reader Applications (Cont'd)**

<b>Connector Pin No.</b>	<b>RS232</b>	<b>Reader</b>
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.	EQUIVALENT FORMS			
	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
BS	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
ETB	00010111	027	17	23
CAN	00011000	030	18	24
EM	00011001	031	19	25
SUB	00011010	032	1A	26
ESC	00011011	033	1B	27
FS	00011100	034	1C	28
GS	00011101	035	1D	29
RS	00011110	036	1E	30
US	00011111	037	1F	31
SP	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

ASCII CHAR.	EQUIVALENT FORMS			
	BINARY	OCT	HEX	DEC
+	00101011	053	2B	43
,	00101100	054	2C	44
MINUS	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

ASCII CHAR.	EQUIVALENT FORMS			
	BINARY	OCT	HEX	DEC
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
UNDER LINE	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
x	01111000	170	78	120
y	01111001	171	79	121
z	01111010	172	7A	122
{	01111011	173	7B	123
	01111100	174	7C	124
}	01111101	175	7D	125
~	01111110	176	7E	126
DEL	01111111	177	7F	127

## SECTION VI

### OPERATION

#### 6.1 FRONT PANEL SWITCHES

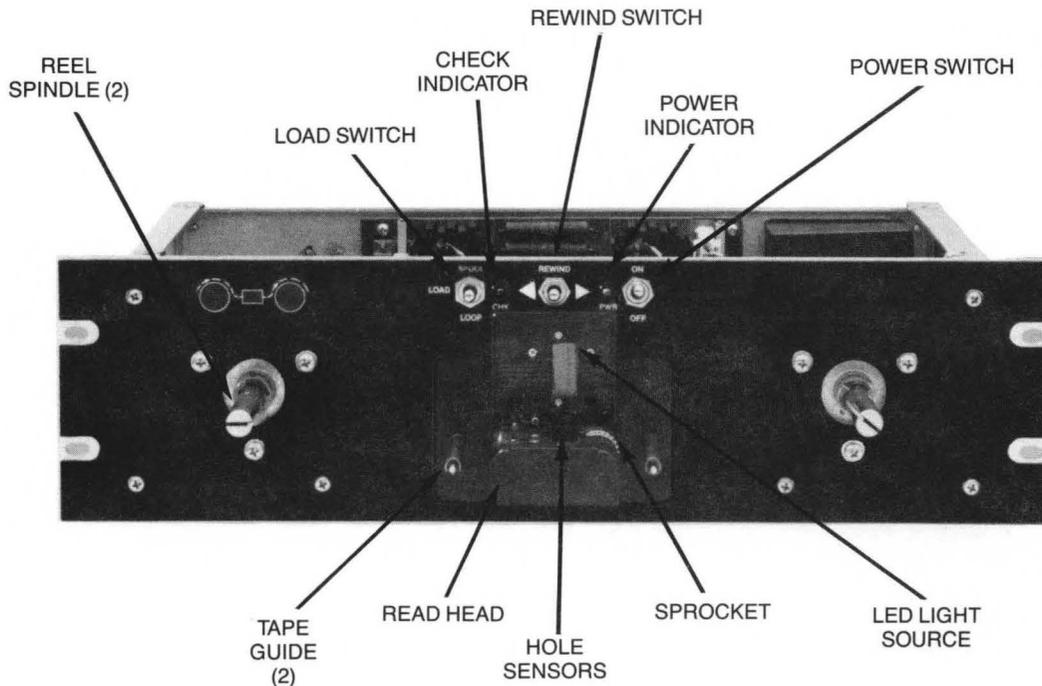


Figure 6-1. Front Panel Controls and Indicators.

##### 6.1.1 PWR

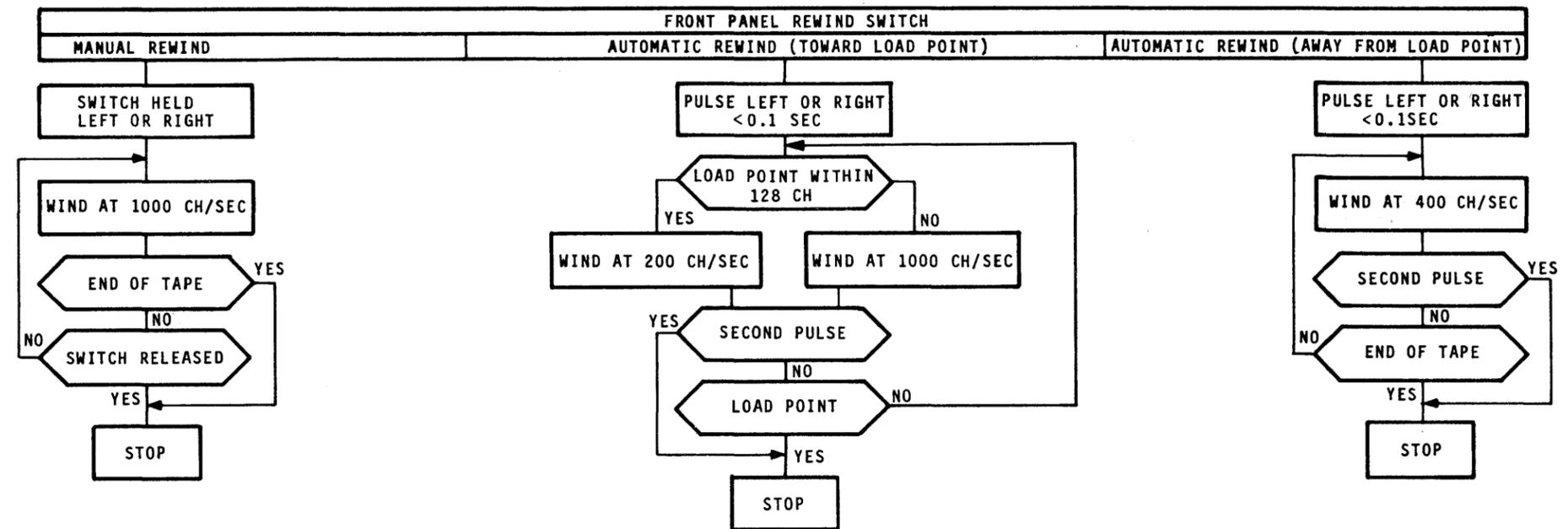
The PWR switch is a two-position toggle switch used to power the reader on and off.

##### 6.1.2 LOAD

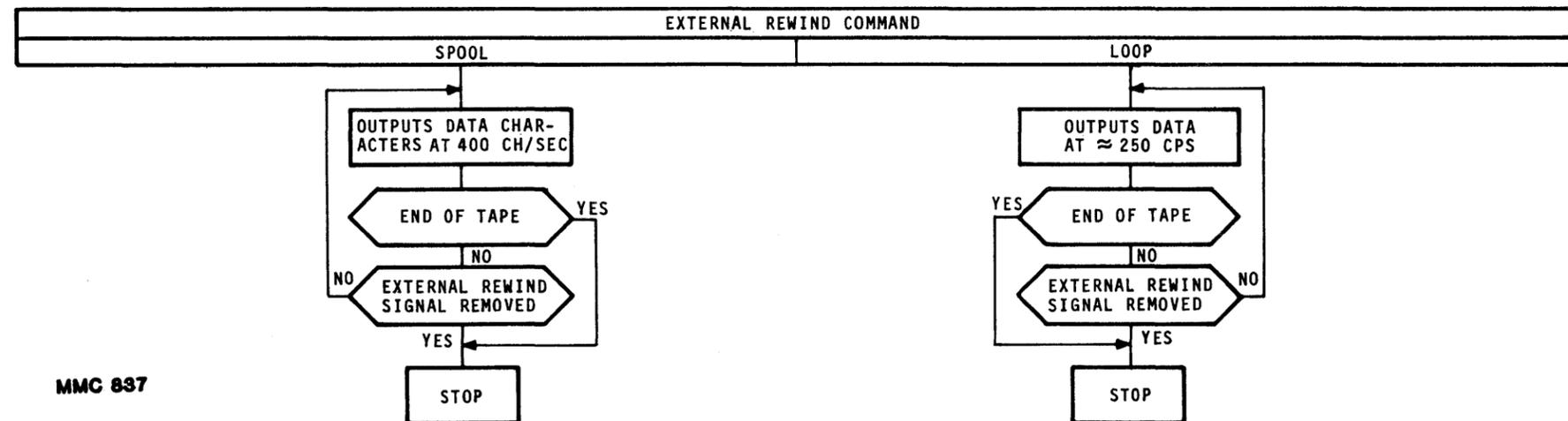
The LOAD switch is a two-position momentary toggle switch, which, when actuated in the loop direction, causes the reader to enter the loop mode of operation. Actuation in the spool direction causes the reader to enter the spool mode of operation.

##### 6.1.3 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.



REWIND LOGIC (FRONT PANEL SWITCH)



REWIND LOGIC (EXTERNAL SIGNAL)

MMC 837

Figure 6-2. Rewind Function

## 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.

### 6.3.1 LOADING THE READER (Spools)

- a. Install the tape spools onto the two tape spindles.
- b. Open the readhead, and thread the tape over the read sensors and under the tape guide rollers as shown on the front panel diagram.
- c. Be sure the sprocket holes align with the sprocket teeth in the readhead.
- d. Close the readhead.
- e. Momentarily push the LOAD switch in the SPOOL position. The reader will run in the direction selected by switch S1 (2) and stop after traveling approximately 16 inches.

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.

### 6.3.2 LOADING THE READER (Strip or Loop)

- a. Open the readhead and thread the tape over the read sensors. Be sure the sprocket holes align with the sprocket teeth in the readhead.
- b. Close the readhead.
- c. 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. 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.

### 6.3.3 CHANGING 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.

### 6.3.4 TAPE REWIND RIGHT OR LEFT

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 rewind 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 does not output during winding.

#### 6.3.4.1 Correcting Broken Tape Condition

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

- a. Splice tape if necessary.
- b. Reload tape into readhead.
- c. Press load spool or load loop, as applicable.
- d. Resume the desired operation.

#### 6.3.4.2 Tape Not Present

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

#### 6.3.4.3 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.

#### 6.3.4.4 Spooler Only Operation

To spool loose tape from a tumble tank onto an empty reel; the operator must guide the tape manually to prevent twisting. Alternately operate the REWIND switch on and off to regulate the speed of the spooling operation.

### 6.4 INTERNAL SWITCH SETTINGS

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

#### 6.4.1 SWITCH S1 (CPU PCB)

- a. Set S1 (1) to desired speed (200 cps or 400 cps). (See Figure 3-4).
- b. Set S1 (2) to the desired direction for load tape movement. (See Figure 3-4).

#### 6.4.2 I/O SWITCHES

See Sections IV and 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) Readhead - includes phototransistor/LED array, stepper 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. REMEX Parallel - emulates REMEX 7300 and 7155 series readers.
  - b. EECO Parallel - emulates EECO 9300 and 9200 series readers.
  - c. RS-232C Serial - provides RS-232C and current loop serial communications.

#### 7.2 FUNCTIONAL DESCRIPTION

Operation of the reader centers around the CPU with all other assemblies interconnected to it. Figures 7-1, 7-2 and 7-3 are the block diagrams which show this relationship.

##### 7.2.1 CPU BOARD

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

##### 7.2.1.1 Program Memory

The operating firmware is located in EPROM (U6). A checksum byte is stored here and is recalculated during powerup diagnostics, then compared to the stored byte. This verifies program integrity.

#### 7.2.1.2 Address Latch

The data bus from the CPU is time multiplexed with both address and data information. The address information is demultiplexed by the address latch (U2).

#### 7.2.1.3 Decoder

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

#### 7.2.2 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:

REMEX Parallel, EECO Parallel or RS-232 Serial.

##### 7.2.2.1 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 interprets the REMEX mode line to provide mode 5 and mode 6 operation.

##### 7.2.2.2 EECO Parallel

The EECO parallel interface is designed 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.

##### 7.2.2.3 Serial I/O

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

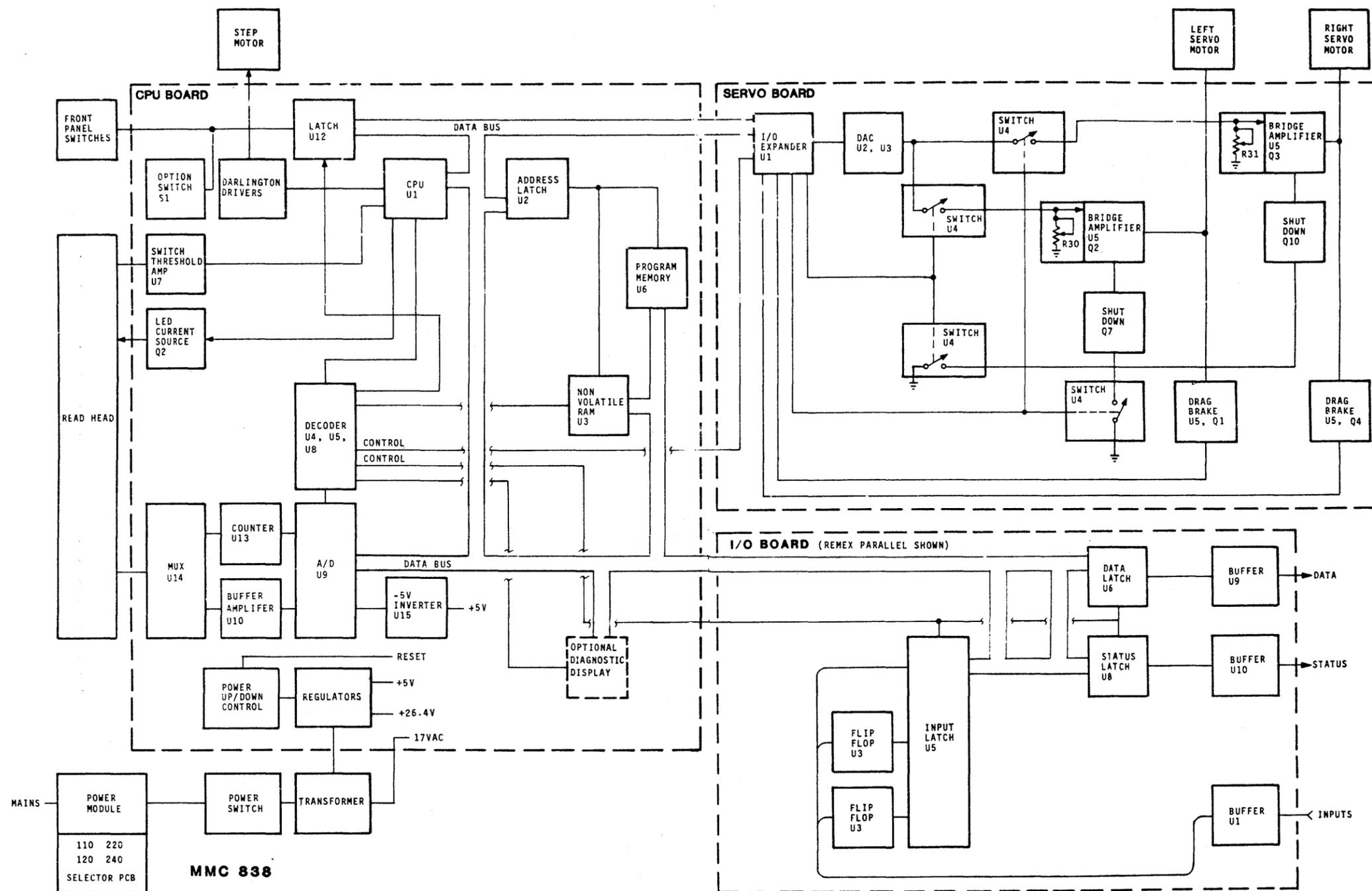


FIGURE 7-1. Tape Reader Block Diagram (REMEX Parallel I/O)

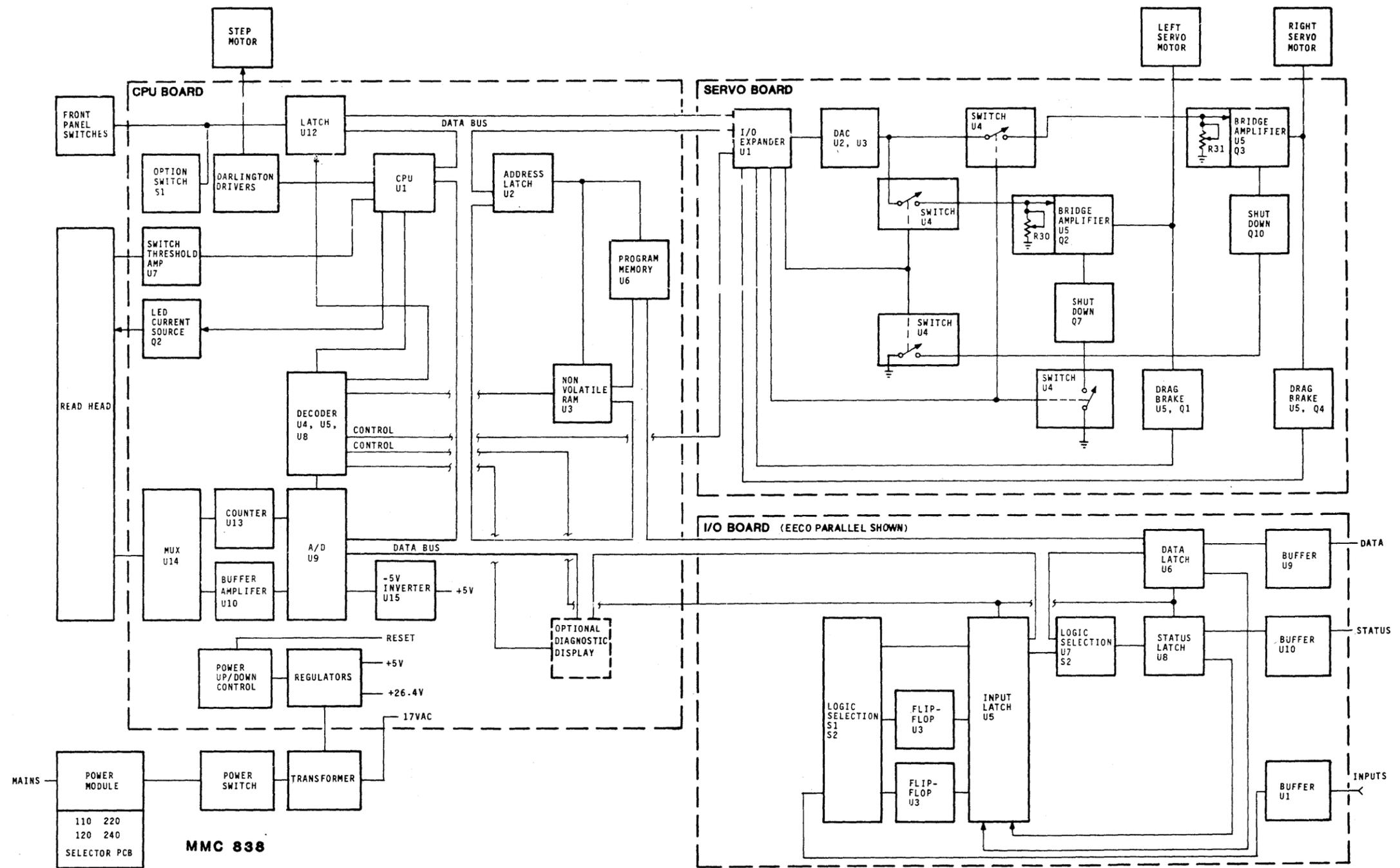


Figure 7-2. Tape Reader Block Diagram (EECO Parallel I/O)

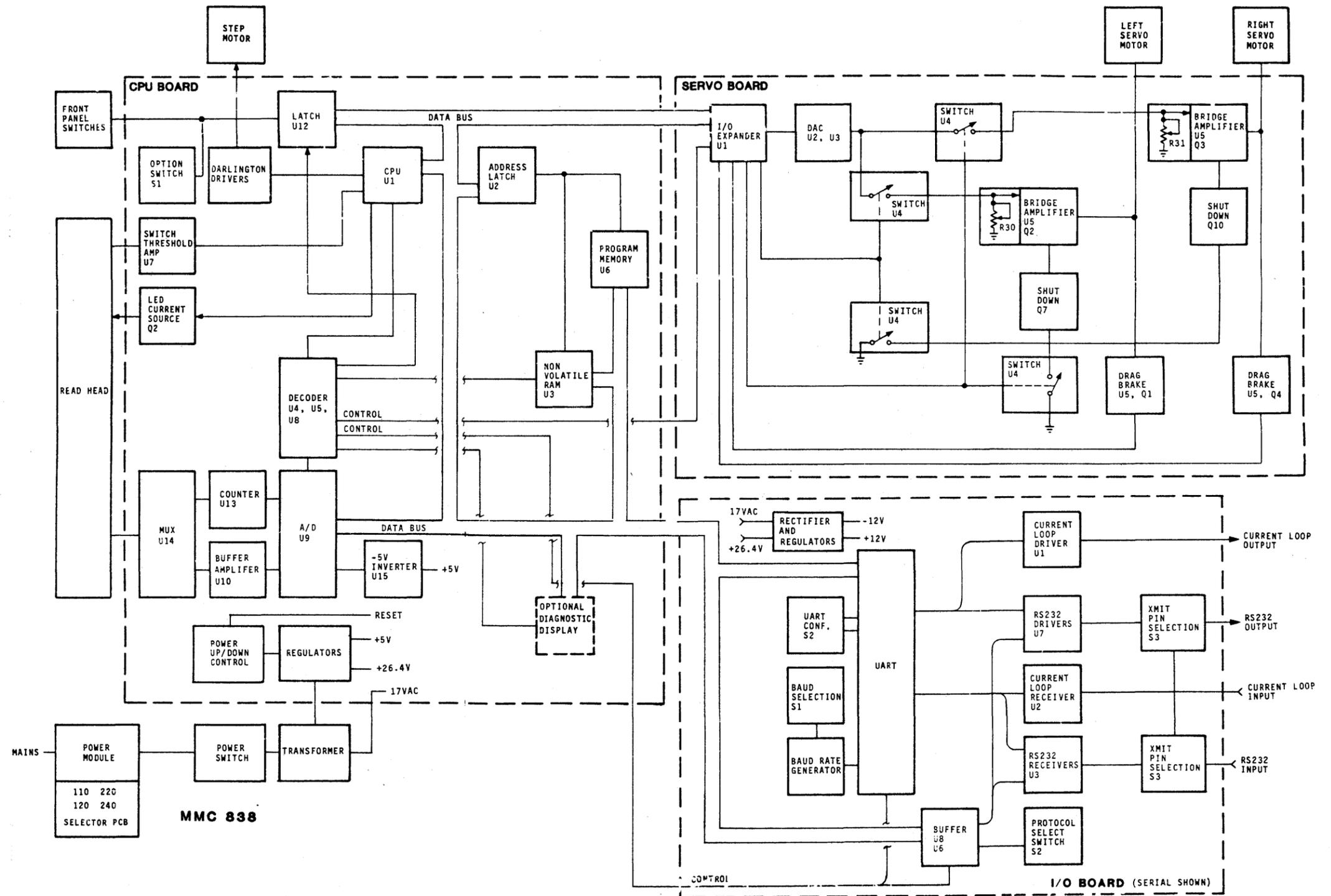


Figure 7-3. Tape Reader Block Diagram (Serial I/O)

### 7.2.3 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.

### 7.2.4 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 readhead 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.

### 7.2.5 READHEAD

The readhead 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 by the processor to read the data and to calculate the tape speed.

### 7.2.6 ANALOG 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 individually adjusted amplifier circuits for each input channel.

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

### 7.2.7 MINUS FIVE (-5) 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.

### 7.2.8 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 function. All subsequent tape movement is made with the servo motors. Pushing the switch down initiates 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 whenever a fault condition is sensed (See "Diagnostics", Paragraph 9.3. 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 connected to a buffer (U12). The processor monitors the switch status by periodically reading the output of the buffer.

### 7.2.9 NON-VOLATILE MEMORY

The total elimination of adjustments in the readhead electronics is due to the use of a non-volatile memory. Data representing the electronic trip point between a hole and no-hole condition is stored in this memory.

Before the reader is operational it must be calibrated. 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 distinguishes 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 the blinking check (CHK) LED.

#### 7.2.10 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. Regulated output voltages are 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 winding is rectified on the I/O board to provide the drive voltages when an RS-232 interface is specified.

## SECTION VIII

### REPLACEMENT PARTS

Table 8-1. Replacement Parts

Description	Reader or Reader/Spooler *P/N 830990-XX	Part Number
CPU Printed Circuit Bd Assy	All	134538-02
Servo Printed Circuit Bd Assy	All	134543-01
I/O Printed Circuit Bd Assy	XX- -150 XX- -160 XX- -250 XX- -260 XX- -350 XX- -360	134548-01 134548-01 134658-01 134658-01 135653-01 135653-01
Spooler Motor Assy	All	135782-01
Readhead Assy	All	134556-02
CPU-to-I/O Bd Interconnect Cable	All	135682-01
Front Panel to CPU Interconnecting Cable (Flex Circuit Assy)	All	135783-02
LOAD Switch, S1	All	399990-02
REWIND Switch, S2	All	399990-02
POWER Switch, S3	All	399990-01
CHK LED Indicator, Red DS1	All	338112-23
PWR LED Indicator, Yellow DS2	All	338112-22
Power Connector	All	706500-397
1.5 Amp Slo-Blo Fuse	All	705710-121
0.75 Amp Slo-Blo Fuse	All	705710-116
Power Cord	All	708000-110

\* 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.

The reader may be returned to the factory or our Factory Authorized Service Center for repairs or module exchanges. All parts are available from:

**REMEX<sup>®</sup>** DIVISION  
SEYMOUR ELECTRONICS AND AUTOMATION, INC.  
1335 S. ACACIA, P.O. BOX 34034  
FULLERTON, CA 92634-9434  
(714) 535-4160    TELEX 183 040

**SECTION IX**  
**MAINTENANCE**

**WARNING**

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

**9.1 GENERAL**

This section contains information for maintaining the Micro-processor Based Punched Tape Reader. The instructions include preventive maintenance, diagnostic tests and adjustments.

**9.2 PREVENTIVE MAINTENANCE**

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

**9.2.1 CLEANING**

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

**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:
  - a. Prepare a cleaning solution of water and mild liquid detergent.
  - b. Wipe glass surfaces with clean cotton swab moistened with cleaning solution. Use solution sparingly and do not saturate area.
  - c. Rinse area with clean cotton swab moistened with clean water.

- d. Wipe dry with soft clean cloth or dry cotton swab.
- e. Inspect glass surfaces for cleanliness making certain that no residue is present. If required, repeat steps a. through d. until glass is thoroughly clean.
- f. Close readhead top section.

### 9.2.2 PERIODIC INSPECTION

Regularly examine the reader for any signs of mechanical or electrical malfunction. Check to see the readhead 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.

### 9.2.3 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 calibration cycle and goes out at the successful completion of the cycle.

#### NOTE

Tape must NOT be in the head during calibration.

### 9.3 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 successful 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 9-1.

**Table 9-1. 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	Readhead 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

**9.4 ADJUSTMENTS**

**9.4.1 EQUIPMENT REQUIRED**

- a. Mechanical movement voltmeter (Simpson 260 or equivalent).
- b. Small screwdriver.
- c. One 7.5 inch reel full of mylar tape.

**9.4.2 SERVO PCB ADJUSTMENT**

To adjust the servo motor pots on the Servo PCB:

- a. Place switch S1 (2) in the "0" position (See Figure 3-4).
- b. Clean and close the readhead. (See Paragraph 9.2.1).
- c. Calibrate the reader (See Paragraph 9.2.3).
- d. Turn power off.
- e. Place full reel of mylar tape on right hub.

- f. Connect a voltmeter positive lead to test point (+MRT) at center of Servo PCB. Connect the negative lead to test point (-MRT). (See Figure 9-1).
- g. Turn power on.
- h. Press LOAD SPOOL switch.
- i. While right motor is turning, adjust R31 (right hand pot) for  $4.2 \pm 0.2$  volts. Repeat steps h. and i. as necessary.
- j. Turn off power.
- k. Place full reel of mylar tape on left hub (was on right hub).
- l. Place switch S1 (2) in the "1" position (See Figure 3-4).
- m. Connect a voltmeter positive lead to test point (+MLF) at center of servo PCB. Connect the negative lead to (-MLF). (See Figure 9-1).
- n. Turn on power.
- o. Press LOAD SPOOL switch.
- p. While left motor is turning, adjust R30 (left hand pot) for  $4.2 \pm 0.2$  volts. Repeat steps o. and p. as necessary.
- q. Turn off power and reset switches to appropriate settings. (See Figure 3-4, 4-4 or 5-8).

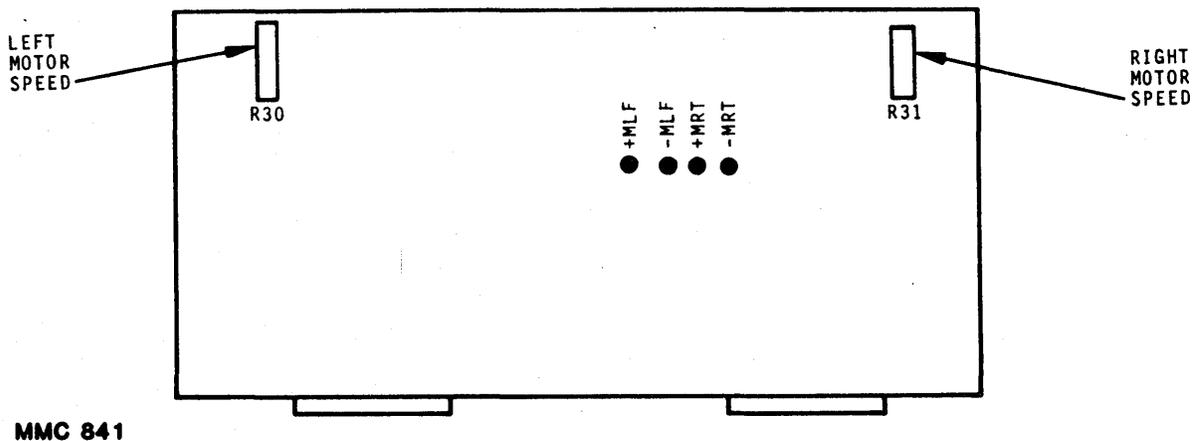
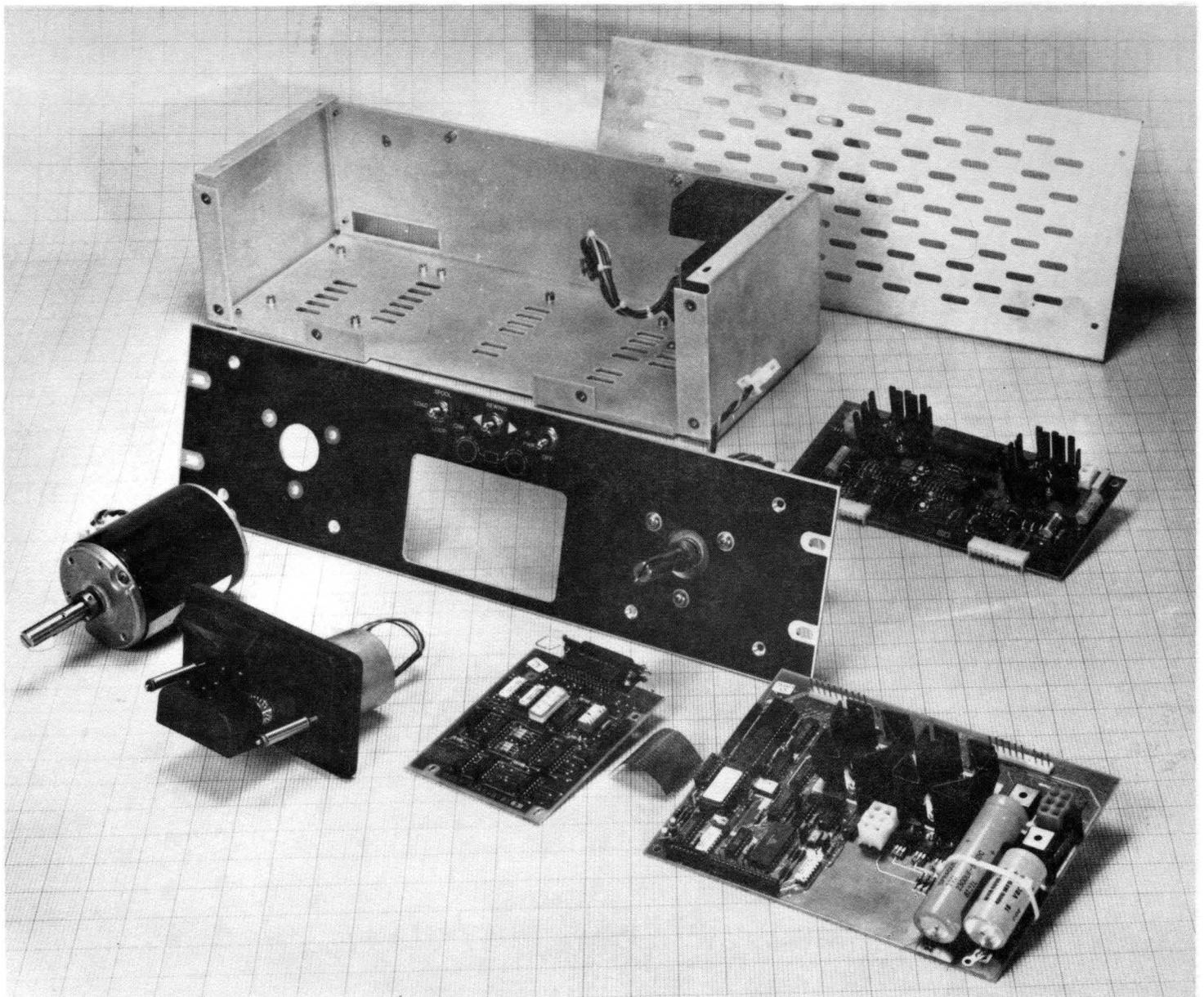


Figure 9-1. Servo PCB Test Points.



**Figure 9-2. Reader Assemblies.**

**THE DIRECTOR Tape Reader Subassembly Modules  
(Top Cover Optional — Order EMR0008)**

SECTION X

SCHEMATIC DRAWINGS

<u>FIGURE</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
10-1	System Schematic for Model RRX900X	10-3/10-4 10-5/10-6
10-2	Schematic for P/N 134538 PCB	10-7/10-8 10-9/10-10 10-11/10-12
10-3	Schematic for P/N 134543 PCB	10-13/10-14
10-4	Schematic for P/N 134548 PCB	10-15/10-16
10-5	Schematic for P/N 135653 PCB	10-17/10-18 10-19/10-20 10-21/10-22
10-6	Schematic for P/N 135658 PCB	10-23/10-24

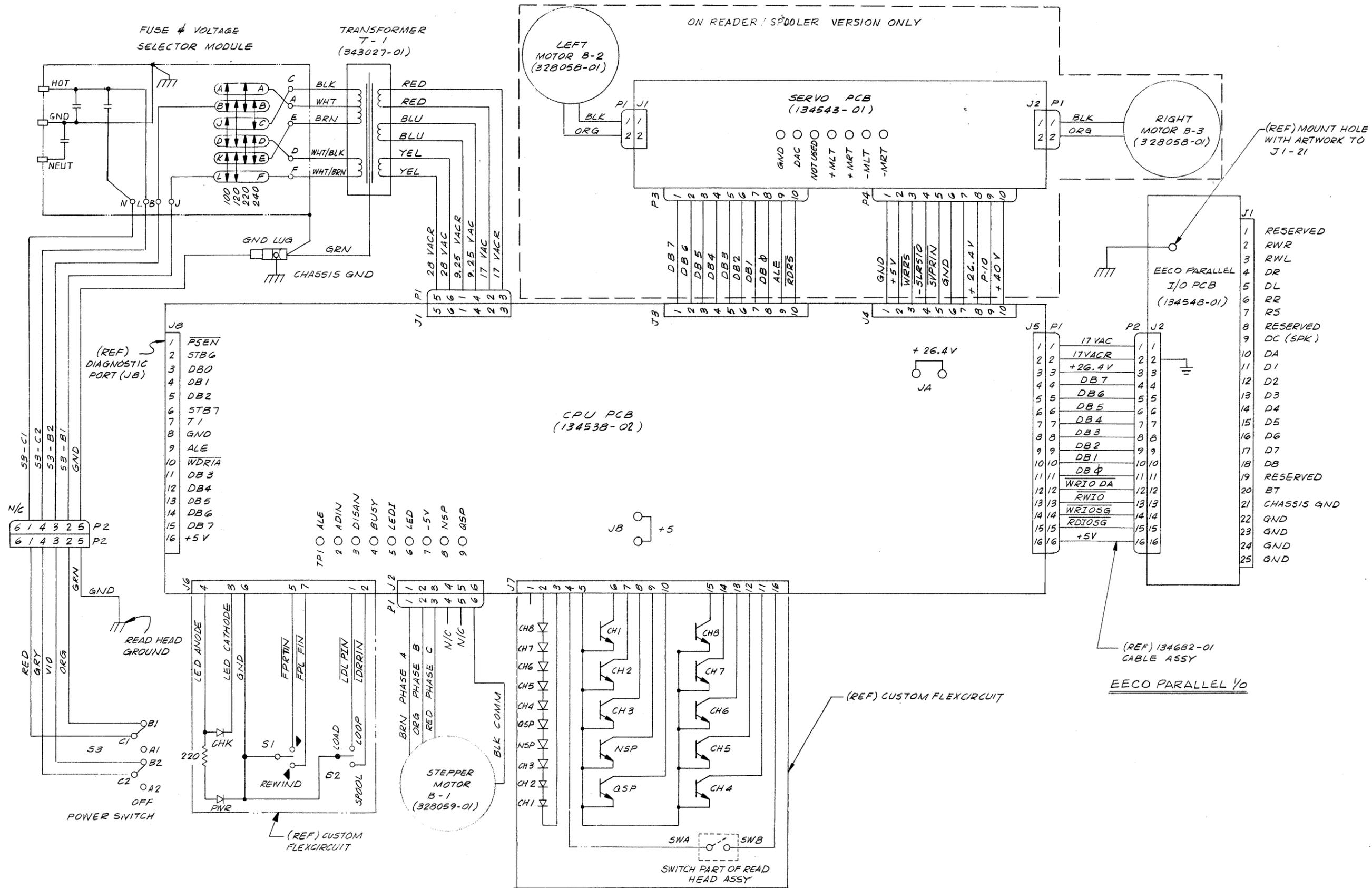
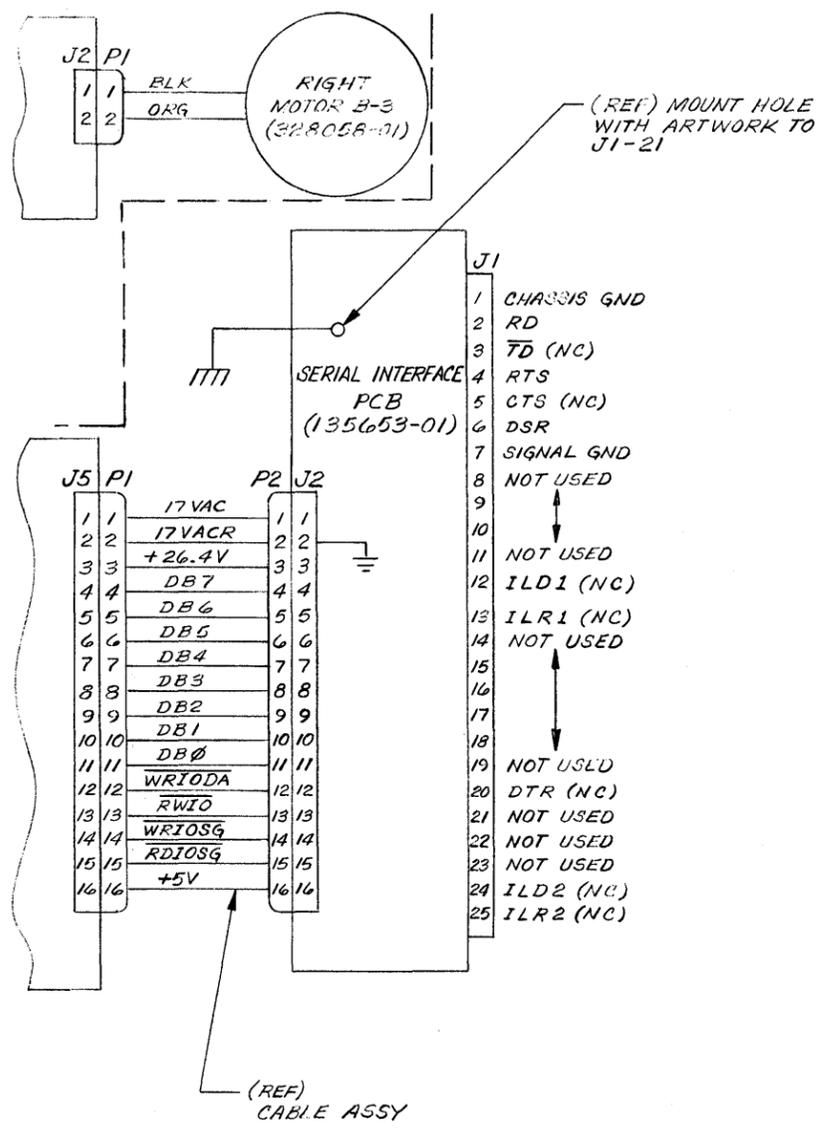
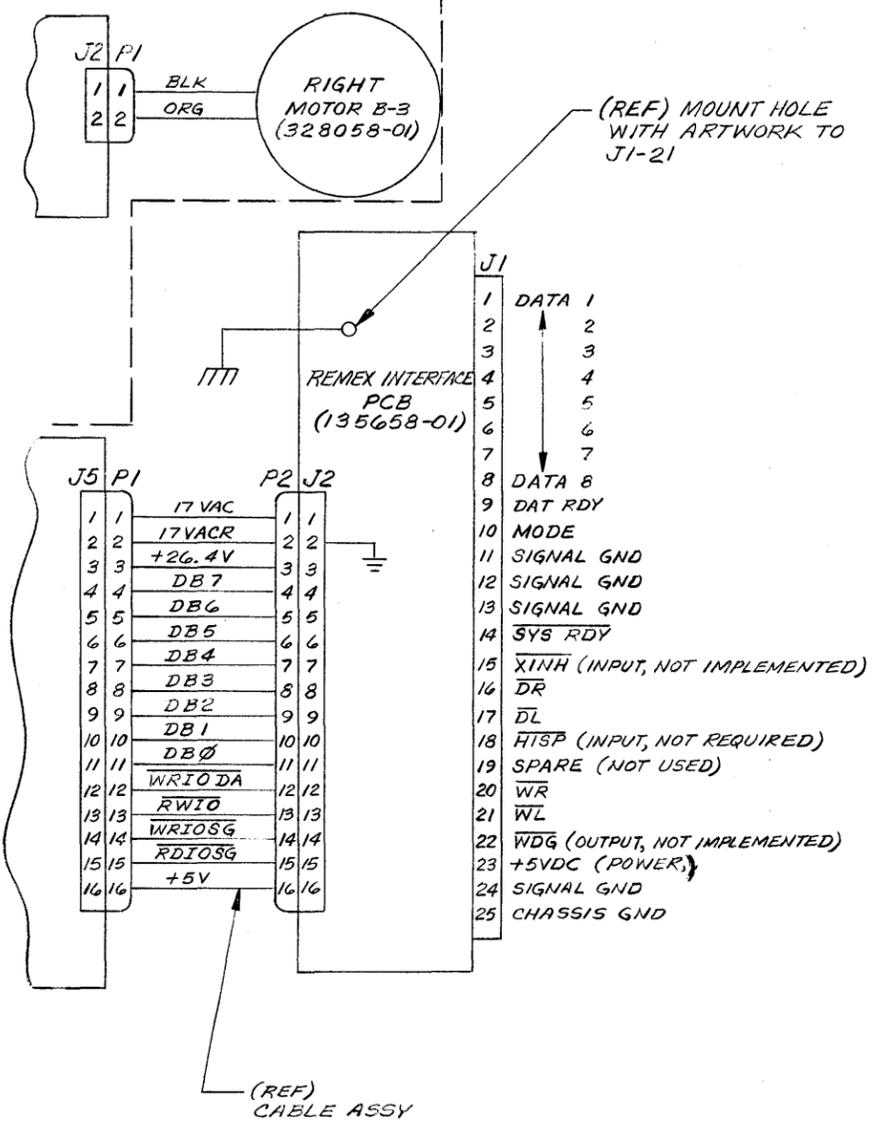


Figure 10-1. Schematic for Model RRX900X.

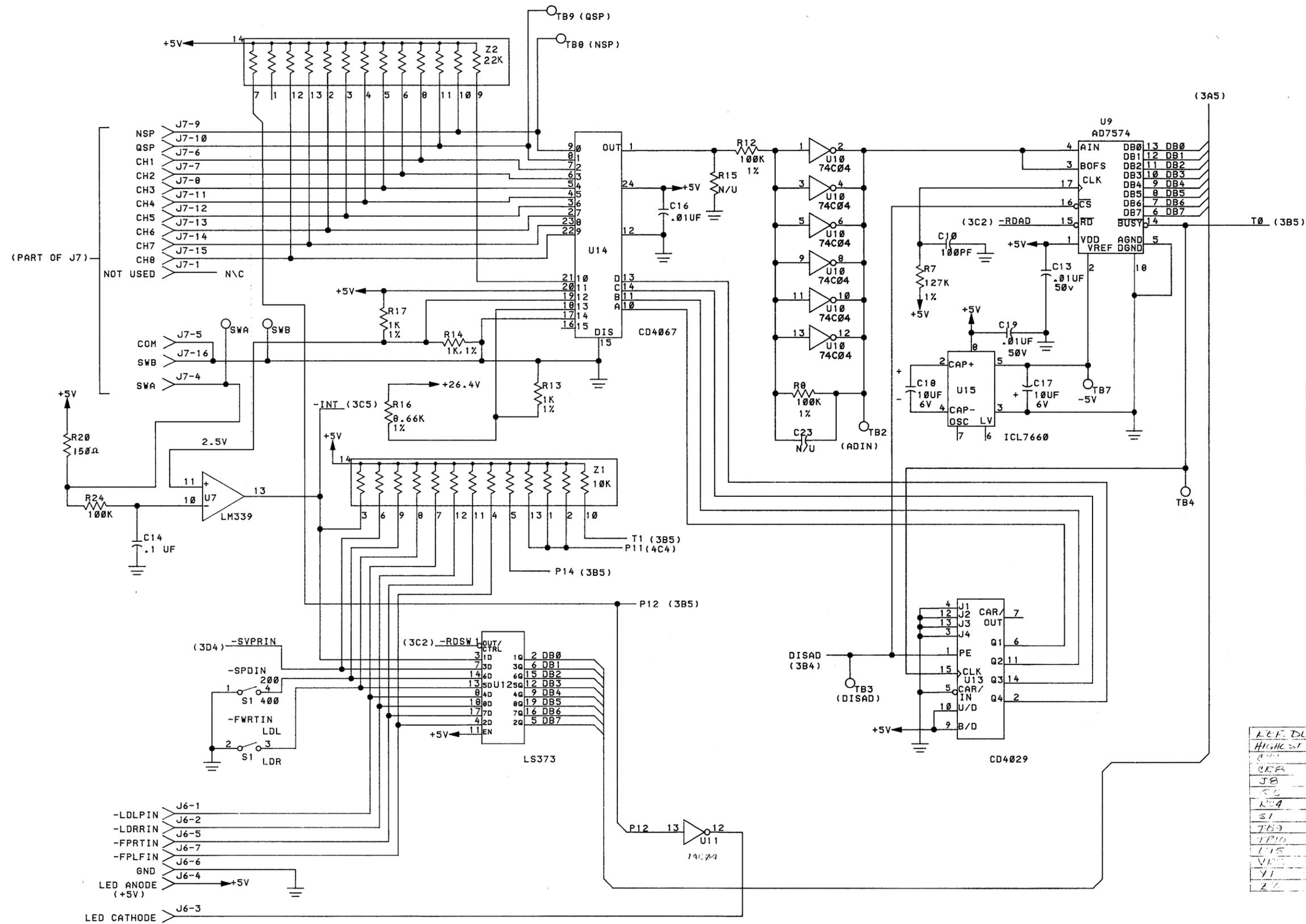


SERIAL I/O



REMEX PARALLEL I/O

Figure 10-1. Schematic for Model RRX900X (cont'd).



POWER-TABLE			
GND	REF	PWR	
1		+5V	
20	U1	40	
10	U2	20	
8	U3	18	
7	U4	14	
8	U5	16	
12	U6	24	
12	U7	3	
8	U8	16	
18	U9	1	
7	U10	14	
10	U12	20	
8	U13	16	
3	U15	8	

REF.	DESIGNATION	HIGHEST	NOT D.L.D
Q1	Q1	20, 23	
J8	J8		
R24	R5, R6, R15		
S1			
TB3			
TB10	TB1, 9		
U15			
VREF			
Y1			
Z1			

Figure 10-2. Schematic for P/N 134538 PCB.

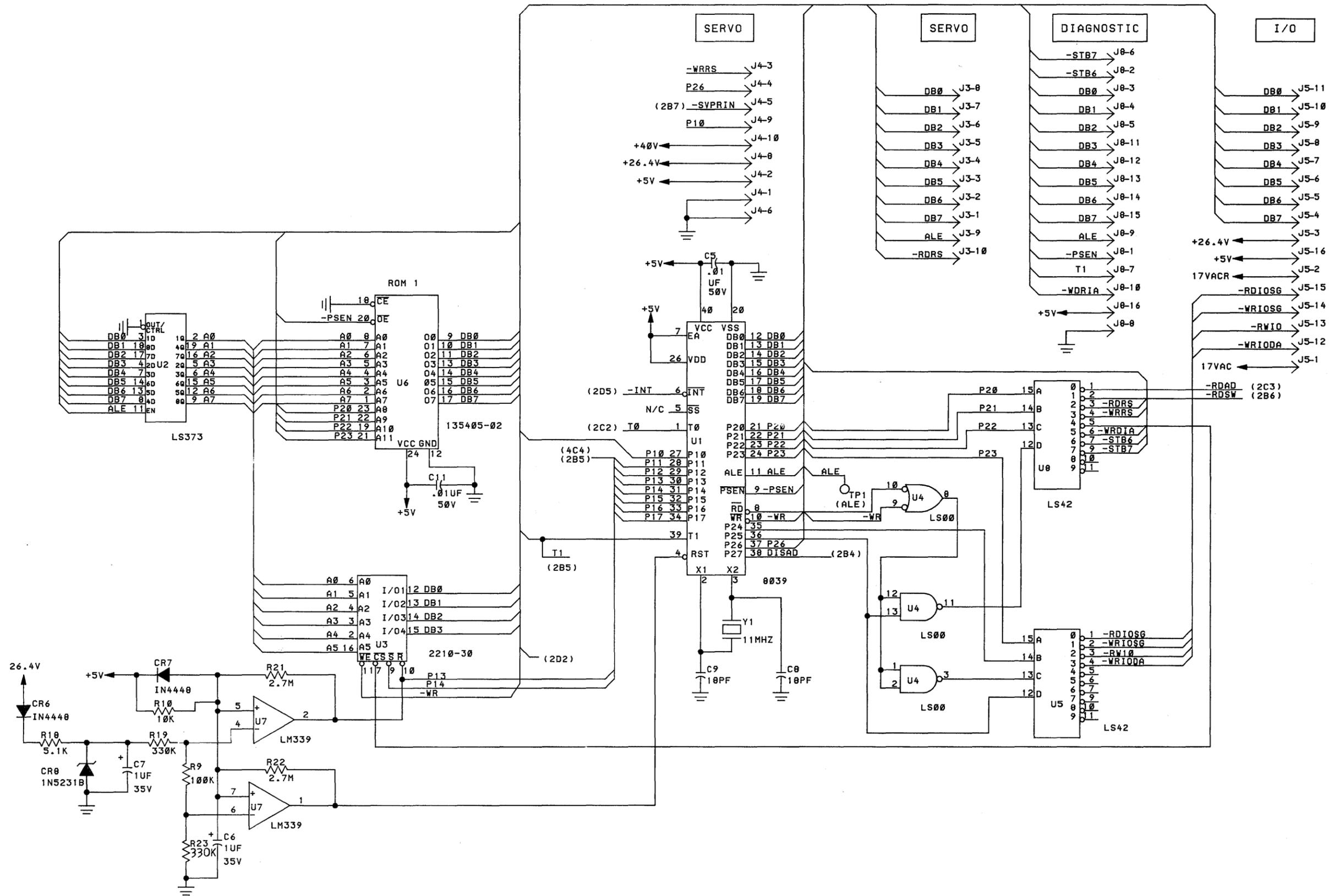
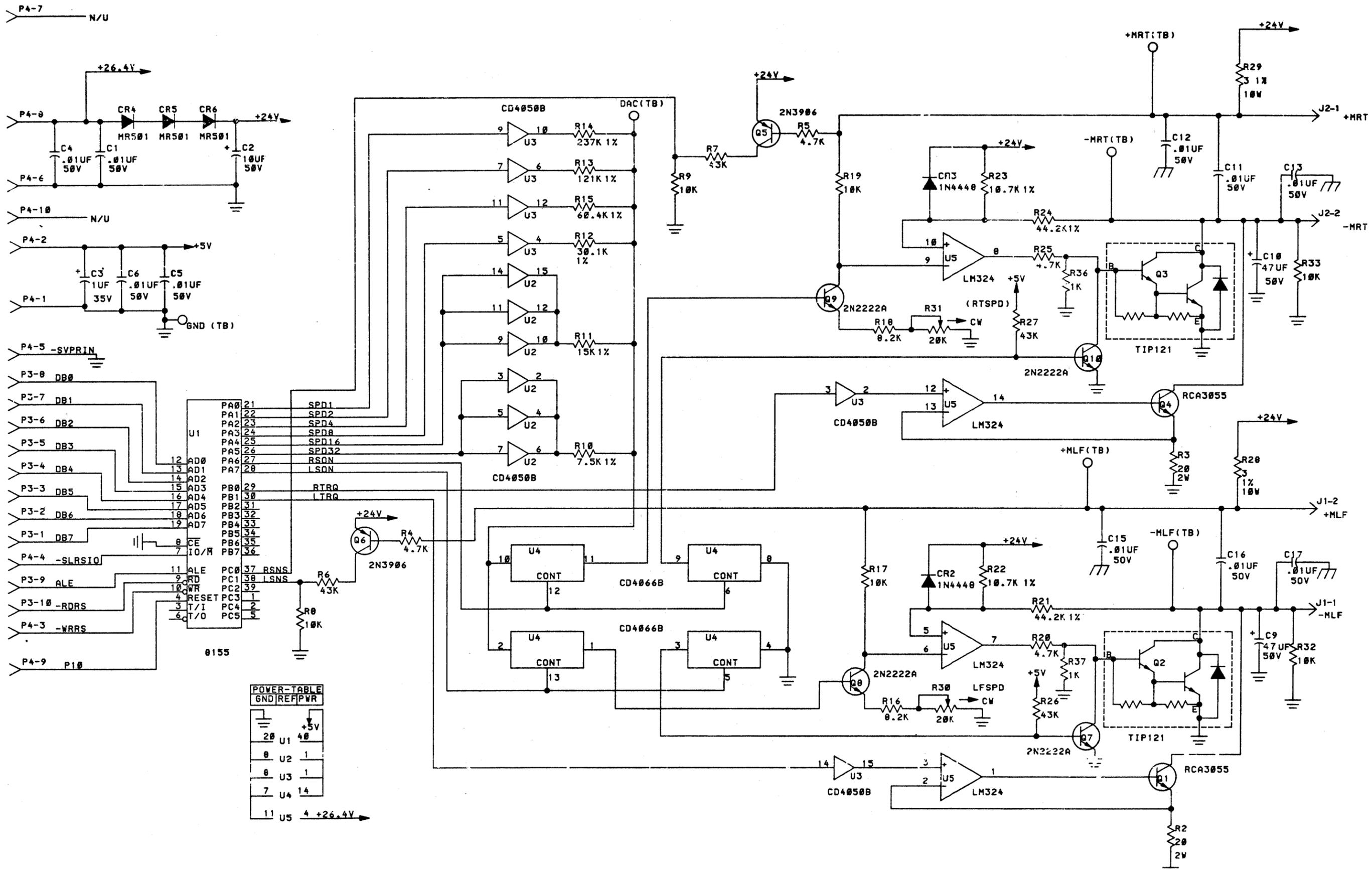


Figure 10-2. Schematic for P/N 134538 PCB (cont'd).





POWER-TABLE		
GND	REF	PWR
20	U1	40 +5V
8	U2	1
8	U3	1
7	U4	14
11	U5	4 +26.4V

Figure 10-3. Schematic for P/N 134543 PCB.

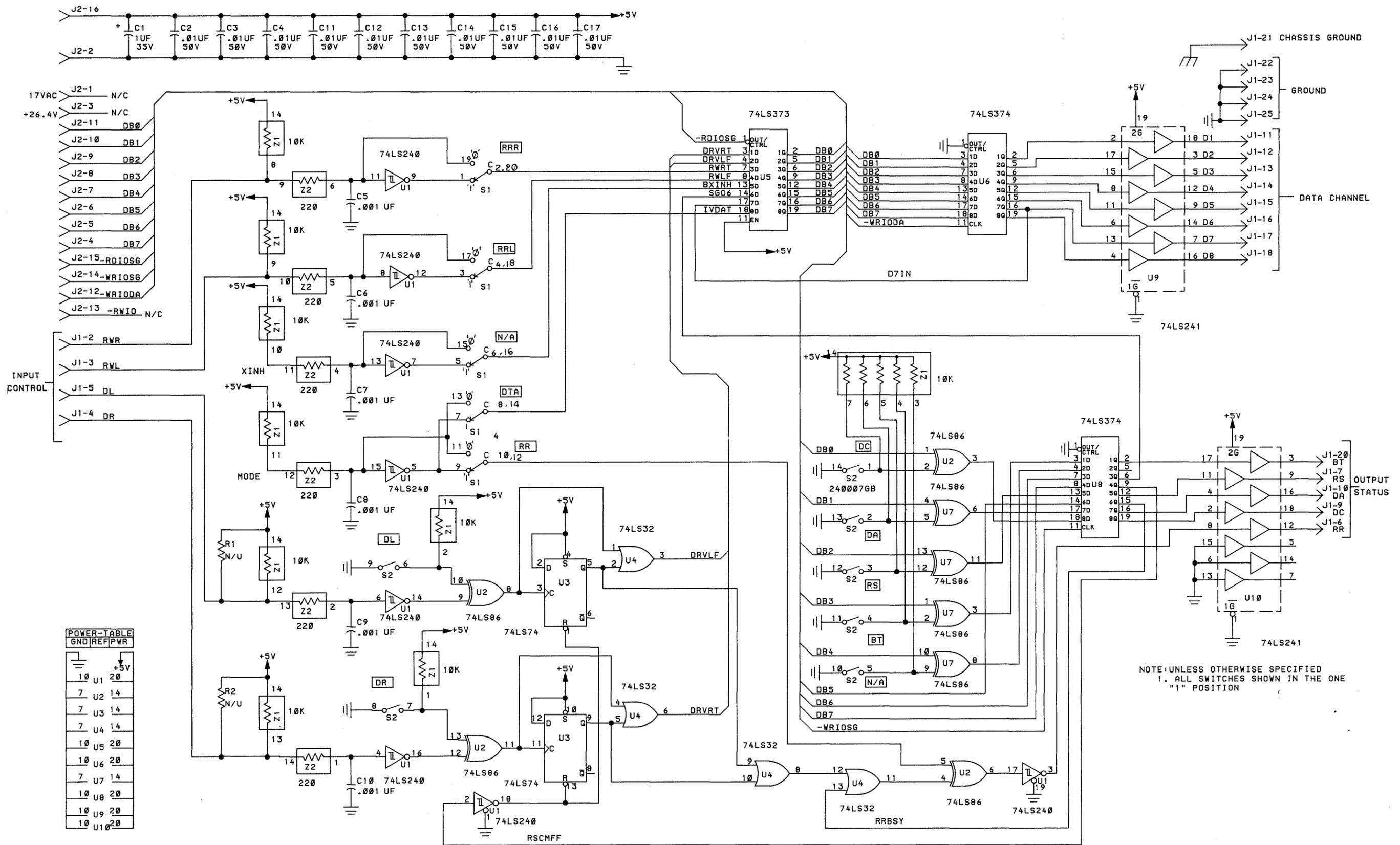
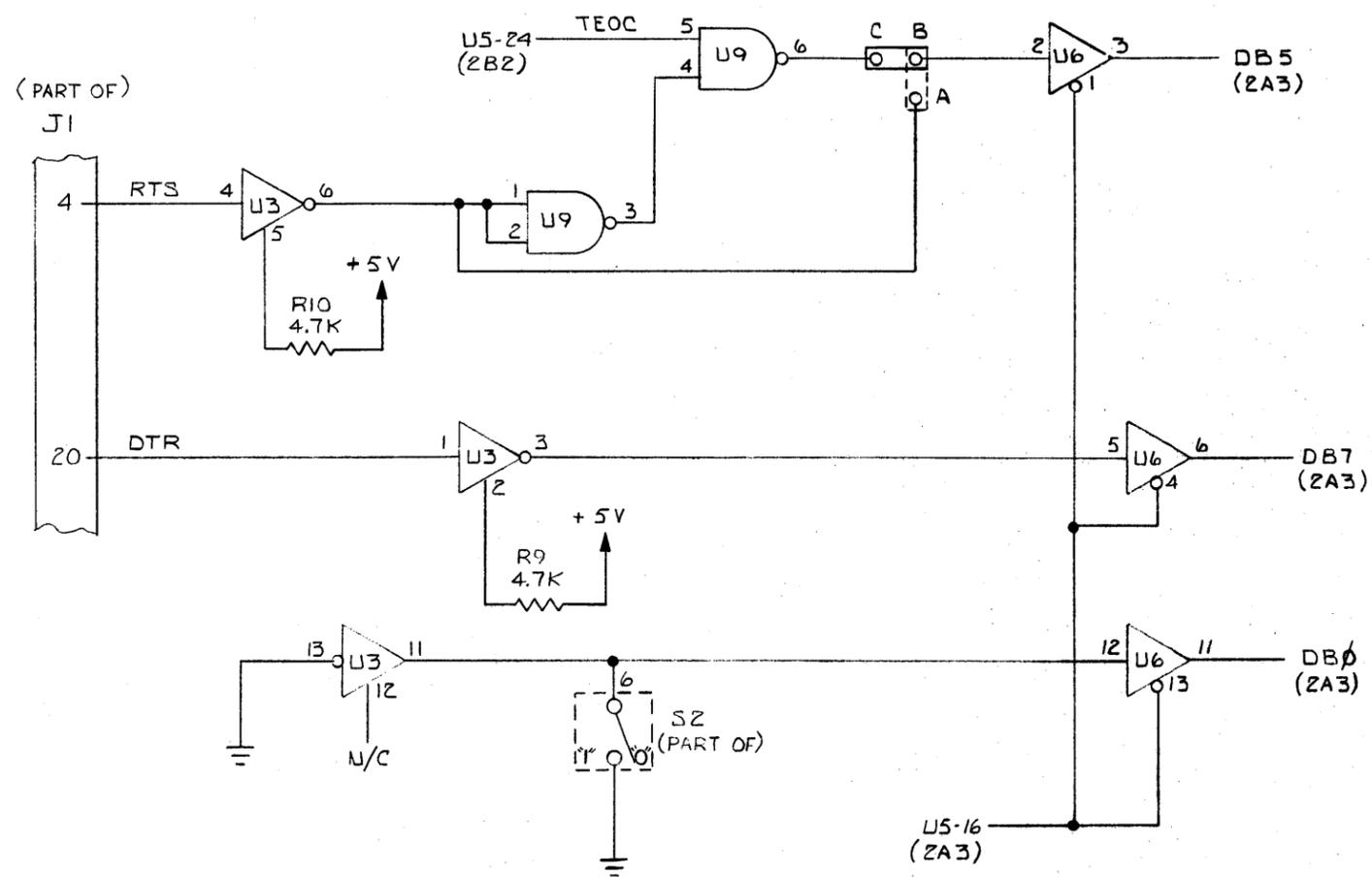


Figure 10-4. Schematic for 134548 PCB.



IC POWER TABLE						
REF DES.	MFG. NO.	GND	+5V	+12V	-12V	# PINS
U1, U2	TIL 117					6
U3	1489	7	14			14
U4	8126	5	3			14
U5	8017	3	1			40
U6	74LS125	7	14			14
U7	1488	7		14	1	14
U8	74LS175	8	16			16
U9	74LS00	7	14			14

REV. STATUS		
ASSY	SCH	FAB
F	E	E
G	E <sup>1</sup>	E
H	E <sup>2</sup>	E

3. HIGHEST REF. DES. USED.  
 C7 Q1 S3 Y1 CR5  
 J2 R11 U9 BR2

2. CAPACITANCE VALUES ARE IN MICROFARADS.

1. RESISTANCE VALUES ARE IN OHMS, 1/4W, ± 5%.

NOTES: UNLESS OTHERWISE SPECIFIED.

Figure 10-5. Schematic for P/N 135653 PCB.

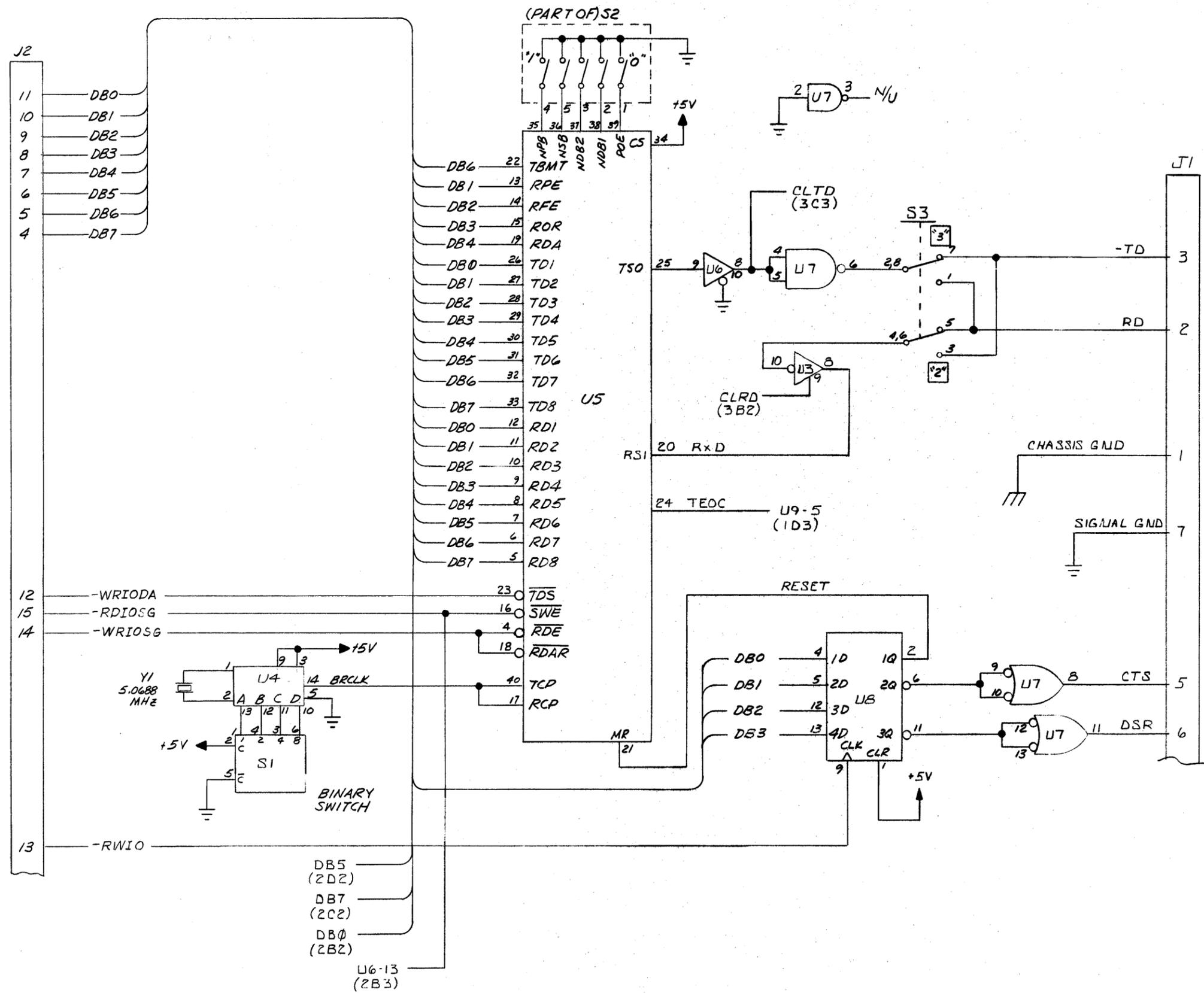
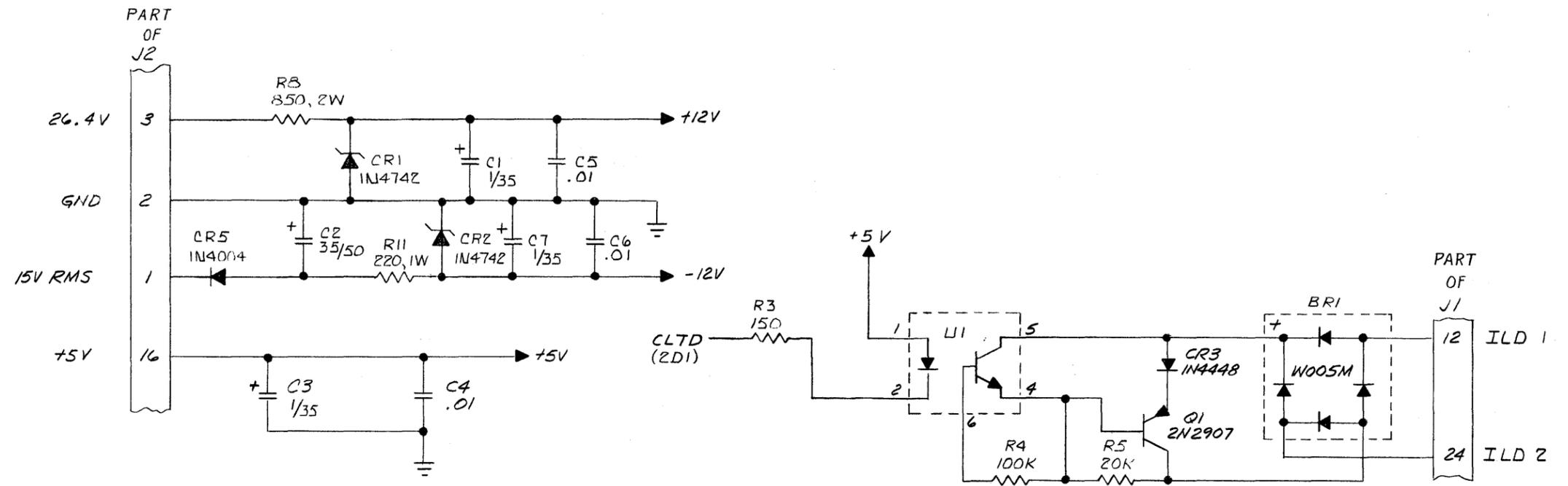
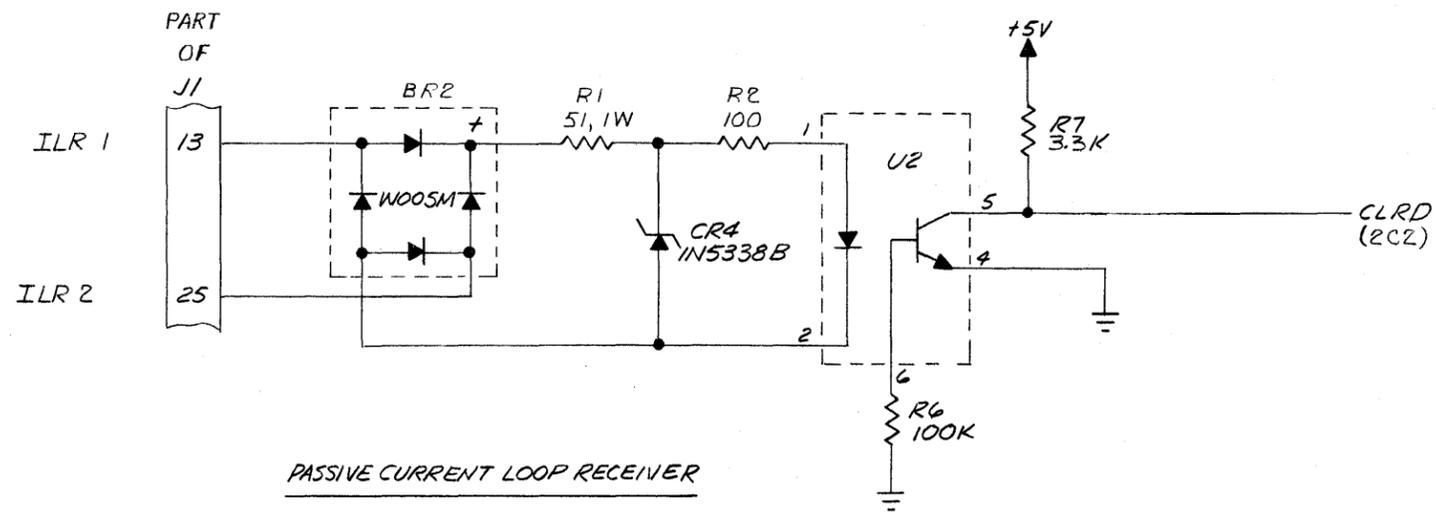


Figure 10-5. Schematic for P/N 135653 PCB (cont'd).



PASSIVE CURRENT LOOP DRIVER



PASSIVE CURRENT LOOP RECEIVER

Figure 10-5. Schematic for P/N 135653 PCB (cont'd).

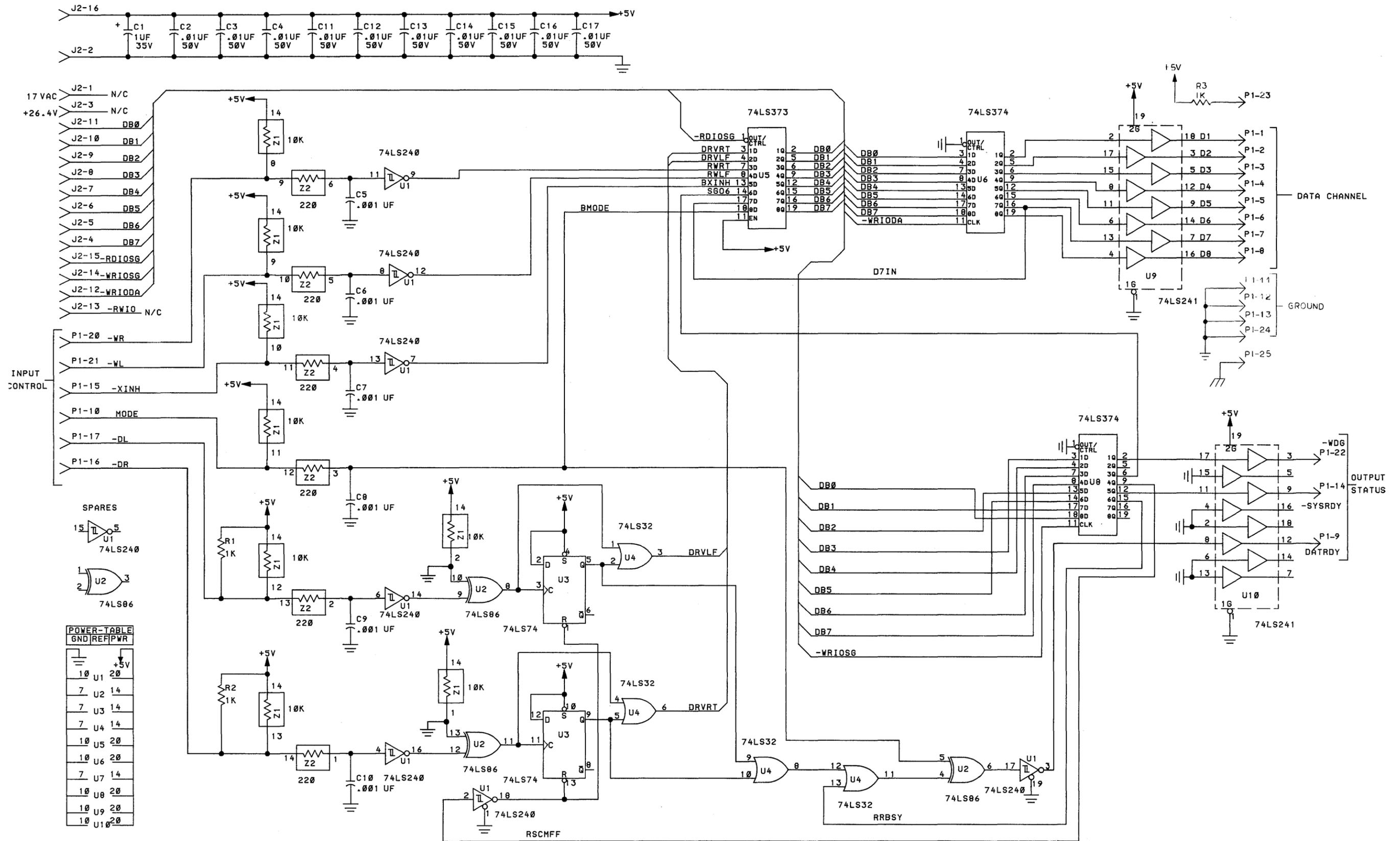


Figure 10-6. Schematic for P/N 135658 PCB.