

EK-RX012-PS-002

# RX01/RX02

## Pocket Service Guide

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|              | MASSBUS      |         |

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# 1 TROUBLESHOOTING

## 1.1 GENERAL

This chapter summarizes information on the disk drives, interface boards, and diagnostics for the RX01/RX02 subsystem. For additional information, refer to Table 1-1 for a list of appropriate documents.

### NOTE

**PDT floppy drives are not included in this document. Refer to the PDT Pocket Service Guide.**

Table 1-1 Reference Documentation

| Title                                    | Order Number |
|--|--------------|
| RX01/RX02 Pocket Service Guide           | EK-RX012-PS  |
| RX01/RX02 Reference Card                 | EK-RX102-RC  |
| RX01/08/11 Maintenance Manual            | EK-ORX01-MM  |
| RX02 Floppy Disk System Technical Manual | EK-ORX02-TM  |
| RX8/RX11 RX01 Floppy Disk System         | EK-ORX01-OP  |
| RX02 Floppy Disk System Users Guide      | EK-ORX02-UG  |
| RXV11 Users Guide                        | EK-RXV11-OP  |
| RX01/RX02 Customer Equipment Care        | EK-RX012-EC  |
| RX01 Floppy Disk IPB                     | EK-ORX01-IP  |
| RX02 Floppy Disk IPB                     | EK-ORX02-IP  |
| 70-13077 Drive IPB                       | EK-13077-IP  |
| H771 Power Supply IPB                    | EK-OH771-IP  |

The RX01/RX02 subsystem is made of seven field replaceable units (FRUs) plus the chassis and cables. The FRUs and their functions are listed in Table 1-2.

The RX01/RX02 may be in one of several types of subsystem configurations. Figure 1-1 diagrams the most popular configurations.

Parts commonly used in the RX01/RX02 are listed in the Spare Parts List in Appendix A.

## 1.2 TROUBLESHOOTING CHARTS

Table 1-3 lists the most common failures, their symptoms, and their remedies. Table 1-4 lists intermittent problems that can occur.

### NOTE

**When troubleshooting, always have the customer duplicate the problem if possible.**

**Always check all connections before servicing any board or other assemblies.**

**Table 1-2 RX01/RX02 Field Replaceable Units\***

| FRU                                     | Function  |
|---|---|
| Drive assembly                          | Does electromechanical handling of the diskette.  |
| Read/write board                        | Transfers data, decodes/encodes data, selects drive, controls head positioning.   |
| Controller board                        | Decodes commands from host and initiates functions.   |
| Interface board                         | Converts bus signal levels to RX compatible levels. Controls interrupts and transfers commands and data.                          |
| Power supply (includes regulator board) | Steps down ac line voltage. Converts ac to dc. Regulates dc. Outputs ac to drive; outputs dc to read/write and controller boards. |
| Regulator board                         | Regulates dc voltages. Outputs dc to read/write and controller boards.  |
| Plenum/fan assembly                     | Cools RX01/RX02 assembly.   |

\* See Appendix A for part numbers.



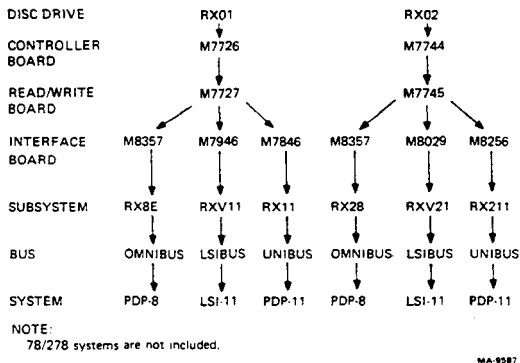


Figure 1-1 What System/Subsystem Is This?

Table 1-3 RX01/RX02 Troubleshooting Chart

| Symptom   | Possible Cause                   | Remedy  |
|---|----------------------------------|---|
| Door handle not latching properly                                 | Latch wire                       | Adjust handle latch wire (Paragraph 3.1).               |
|   | Handle release button            | Install headed-pin pivot (P/N 74-21076).                |
|   |                                  | Replace door handle.                                    |
| Both drives inoperative, fan not turning (no indication of power) | Power cord                       | Check power cord and ac input.                          |
|   | AC power fuse or circuit breaker | Replace ac power fuse (2.0 A) or reset circuit breaker. |

**NOTE**

To check if diskette (Figure 1-2) is turning, align index hole in diskette with hole in cover. Place in drive and close cover. Then, remove diskette. If holes are still aligned, diskette is not turning.

Table 1-3 RX01/RX02 Troubleshooting Chart (Cont)

| Symptom | Possible Cause | Remedy |
|---------|----------------|--------|
|---------|----------------|--------|

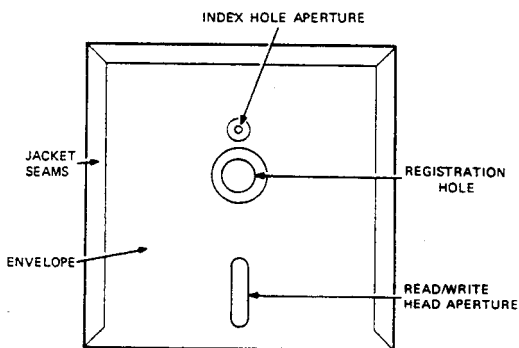


Figure 1-2 Diskette Media

|                                |                               |   |
|--------------------------------|-------------------------------|---|
| Diskette not turning           | Belt                          | Replace belt (Paragraph 2.8).   |
|                                | Drive power plug              | Check plug connection to drive (Figure (2-7)).                                    |
|                                | Power supply                  | Check voltages (Paragraph 1.2).   |
|                                | Drive motor                   | Replace drive (Paragraph 2.5).  |
| Both drives fail to initialize | Host                          | Make sure host is interacting with other I/O devices.                             |
|                                | Interface/<br>interface cable | Check connection and polarity of cable with host.<br><br>Replace interface cable. |
|                                | Power supply                  | Check voltages (Paragraph 1.2).   |

Table 1-3 RX01/RX02 Troubleshooting Chart (Cont)

| Symptom | Possible Cause            | Remedy  |
|---------|---------------------------|---|
|         | Configuration (RX02 only) | Set switches on controller board to correct position (Table 2-1). |
|         | Interface board           | Replace interface board.  |

**CAUTION**

Do not short out a board. When checking read/write or controller board, place insulating material on top of existing board and temporarily cable board in place. Remove board only when verified as faulty.

|                               |                       |                                |
|-------------------------------|-----------------------|--------------------------------|
|                               | Controller board      | Replace board (Paragraph 2.3). |
|                               | Read/write board      | Replace board (Paragraph 2.4). |
| One drive fails to initialize | Drive power connector | Check connector (Figure 2-7).  |

**NOTE**

In the RX02 unit, interchange all cables of drives 0 and 1 (Figure 2-5). If symptom appears on other drive, substitute boards to determine defective board (Paragraphs 2.3 and 2.4). If symptom remains on original drive, replace drive mechanism (Paragraph 2.5).

|  |                                |                                |
|--|--------------------------------|--------------------------------|
|  | Read/write board               | Replace board (Paragraph 2.4). |
|  | Read/write to controller cable | Replace cable.                 |
|  | Controller board               | Replace board (Paragraph 2.3). |
|  | Drive                          | Replace drive (Paragraph 2.5). |

Table 1-3 RX01/RX02 Troubleshooting Chart (Cont)

| Symptom  | Possible Cause                 | Remedy  |
|--|--------------------------------|---|
| <b>NOTE</b><br>Diagnostics should boot in drive 0 and 1 of unit A.<br>Host software may not. |                                |   |
| Program cannot be booted or run from either drive.   | Diskette                       | Replace diskette.                                     |
|  | Controller board               | Replace board (Paragraph 2.3).                        |
|  | Interface cable                | Replace cable.  |
|  | Read/write board               | Replace board (Paragraph 2.4).                        |
|  | Read/write to controller cable | Replace cable.  |
| Diagnostics boot in one drive only   | Read/write board               | Replace board (Paragraph 2.4).                        |
|  | Drive                          | Replace drive (Paragraph 2.5).                        |
| Diagnostics boot but will not run  | Diagnostic                     | Use correct diagnostics (Paragraphs 1.3 through 1.5). |
|  | Load error                     | Reload diagnostic using second drive.                 |
|  | Controller board               | Replace board (Paragraph 2.3).                        |
|  | Interface board                | Replace interface.                                    |
|  | Interface cable                | Replace cable.  |
| Diagnostics run with errors  | Subsystem                      | Look up errors in Tables 1-6 and 1-7.                 |
| Diagnostics run okay but intermittent errors persist   | Subsystem                      | Go to Table 1-4.                                      |

Table 1-4 Intermittent Problems

| Symptom                               | Possible Cause            | Remedy   |
|---------------------------------------|---------------------------|--|
| Errors with read/write data functions | Read/write head plug (P3) | Install resistor assembly (P/N 70-16263). The resistor assembly must always be installed when using M7726 and M7727 boards (Figure 1-3). |

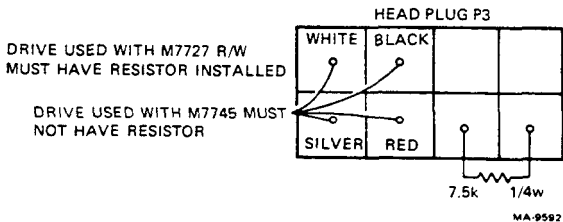


Figure 1-3 Head Plug (P3) to M7727

|   |                            |   |
|---|----------------------------|---|
|   | Metal read/write head      | If subsystem has one drive with a metal head and one with a ceramic head, replace drive with metal head.  |
| Seek errors                             | Stepper motor lead shaft   | Clean shaft with alcohol and regrease (Paragraph 2.11).   |
|   | Stepper motor burning etch | Stepper motor can cause burning or discoloration around transistors in rear corners of board. Replace drive and read/write board. (Paragraphs 2.4 and 2.5). |
| Diskettes do not recopy but appear okay | Faulty write current       | Replace read/write board (Paragraph 2.4).<br>Replace controller board (Paragraph 2.3).  |
| Any symptom                             | Interface cable            | Reinsert cable.   |

**Table 1-4 Intermittent Problems (Cont)**

| Symptom                           | Possible Cause  | Remedy  |
|-----------------------------------|---|---|
| Any symptom                       | Interface cable   | Replace cable.  |
|                                   | Controller to read/write cable                                    | Reinsert cable.   |
|                                   |   | Replace cable.  |
|                                   | Connectors P3 through P7 (Figures 2-4 and 2-5)                    | Reinsert connectors. No brass Female ends should push out of plastic plugs. |
| Hold-down screw shorting to board | Install nylon washers on any hold-down screw near the board etch. |   |

### 1.3 POWER SUPPLY VOLTAGES

Use Table 1-5 and Figure 1-4 for all dc voltage checks. There are no adjustments. If voltages are incorrect, replace the power board (Paragraph 2.7) or the power supply (Paragraph 2.6).

**Table 1-5 Voltages\***

| Pin   | Voltage   | Purpose   |
|---|-----------|---|
| <b>Connection P2 to J4/J3 (power board to controller board)</b> |           |   |
| 1   | +9.5 Vdc† | Initializes   |
| 2   |           | No connection   |
| 3   |           | Ground  |
| 4   | +5 Vdc    | Powers logic signal   |
| 5   |           | Ground  |
| 6   |           | No connection   |
| <b>Connection P1 and J2 (power board to read/write board)</b>   |           |   |
| 1   |           | No connection   |
| 2   | -5 Vdc    | Powers analog IC  |
| 3   |           | Ground  |
| 4   | +5 Vdc    | Powers logic signal   |
| 5   | 0.V       | +24 V return  |
| 6   | +24 Vdc   | Powers stepper motor, erase and write current, head-load solenoid |

\* Use with Figure 1-4.

† Some documents wrongly state 10 V.

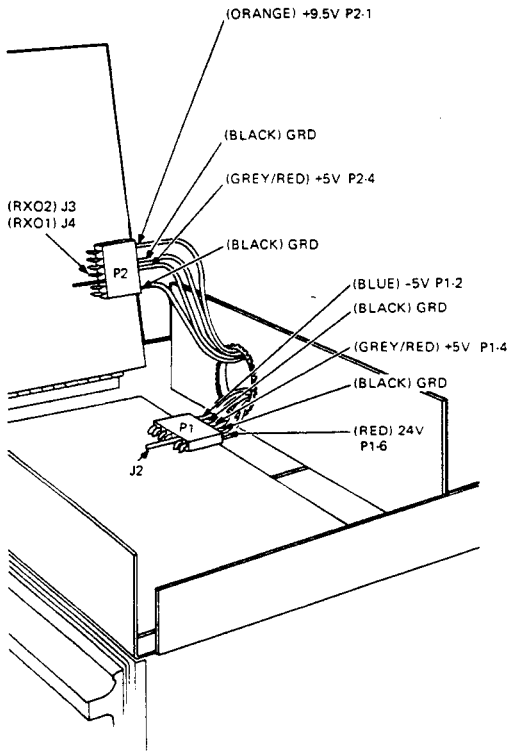


Figure 1-4 Power Supply Voltage Checks

#### 1.4 RX8/RX28 SUBSYSTEM

Use this information for diagnostics, installations, and troubleshooting. Table 1-1 lists documents with additional information. The RX8/RX28 subsystem has two diagnostics.

- AIRXA(x) functional test
- AIRXB(x) performance exerciser\*

Make sure the revision level of the diagnostic and diagnostic writeup are the same. Tables 1-6 and 1-7 are for use with diagnostic error printouts.

\*The symbol (x) represents the revision level.

Table 1-6 Diagnostic Error Code Definitions and Probable Causes

| Code  | Definition  | Causes   |
|-------|---|--|
| 0010  | Drive 0 failed to see home on initialize.                             | Drive<br>Controller<br>R/W electronics   |
| 0020  | Drive 1 failed to see home on initialize.                             | Drive<br>Controller<br>R/W electronics   |
| 0030* | Found home when stepping in 10 tracks for init.                       | Drive<br>Controller<br>R/W electronics   |
| 0040  | Tried to access a track greater than 76 (decimal).                    | Interface module<br>Controller   |
| 0050  | Home was found before desired track was reached.                      | R/W electronics<br>Drive<br>Controller   |
| 0060* | Self diagnostic error (Init).   | Controller<br>Cables<br>Interface module   |
| 0070  | Desired sector not found after looking at 52 headers (2 revolutions). | Diskette<br>R/W electronics<br>Drive<br>Controller<br>Interface module                 |
| 0100* | Write command on a write-protected drive.                             | R/W electronics<br>Controller  |
| 0110  | More than 40 $\mu$ s and no SEP clock seen.                           | Diskette<br>R/W electronics<br>Drive<br>Controller                                     |
| 0120  | A preamble not found.   | Diskette<br>R/W electronics<br>Drive<br>Controller<br>Power supply<br>Interface module |
| 0130  | Preamble found but no ID mark found in time.                          | Diskette<br>R/W electronics<br>Controller  |



**Table 1-6 Diagnostic Error Code Definitions and Probable Causes (Cont)**

| Code  | Definition   | Causes  |
|-------|--|---|
| 0140* | CRC error on a header but error not asserted.                        | Controller<br>Cables<br>Interface module                      |
| 0150  | Good header track address does not compare with desired track.       | R/W electronics<br>Drive<br>Controller                        |
| 0160  | Too many tries for an IDAM (identifies header).                      | R/W electronics<br>Drive<br>Controller                        |
| 0170  | Data AM not found in time.   | Diskette<br>R/W electronics<br>Controller                     |
| 0200  | CRC error on reading the sector from disk. No code appears in ERREG. | Diskette<br>R/W electronics<br>Controller                     |
| 0210* | Parity error on a word from I/F to controller.                       | Controller<br>Interface module<br>Cables                      |
| 0220† | R/W electronics failed maintenance mode test.                        | R/W electronics<br>Controller                                 |
| 0230† | Word count overflow.   | Interface module<br>Controller                                |
| 0240† | Density error.   | Diskette<br>Controller<br>Interface module<br>R/W electronics |
| 0250† | Wrong key word for set media density command.                        | Interface module<br>Controller                                |

\* RX01 only

† RX02 only

**Table 1-7 Diagnostic Printout Troubleshooting Chart**

| <b>Symptom</b>                       | <b>Possible Cause</b>     | <b>Remedy</b>                         |
|--------------------------------------|---------------------------|---------------------------------------|
| Done bit timeout                     | Configuration (RX02 only) | Set switches (Table 2-1).             |
|                                      | Interface board           | Replace board.                        |
| TR bit timeout                       | Controller board          | Replace board (Paragraph 2.3).        |
|                                      | Interface board           | Replace board.                        |
| Set density error                    | Diskette                  | Replace diskette.                     |
|                                      | Controller board          | Replace board (Paragraph 2.3).        |
|                                      | Read/write board          | Replace board (Paragraph 2.4).        |
| Data error but no CRC error          | Controller board          | Replace board (Paragraph 2.3).        |
|                                      | Interface board           | Replace board.                        |
| Fill buffer error                    | NPR jumper                | Cut jumper on PDP-11 backplane RX211. |
| Empty buffer error                   | Interface board           | Replace board.                        |
|                                      | Controller board          | Replace board (Paragraph 2.3).        |
| Unexpected interrupt to location XXX | Interface board           | Set switches correctly.               |
|                                      |                           | Replace board.                        |

**1.4.1 Bootstrap**

When a front panel is available, use toggle-in routines (Table 1-8) to boot the floppy.

**1.4.2 Registers**

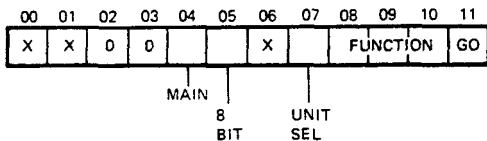
The RX8/RX28 registers are broken down in Figure 1-5.

Table 1-8 RX8/RX28 Bootstraps

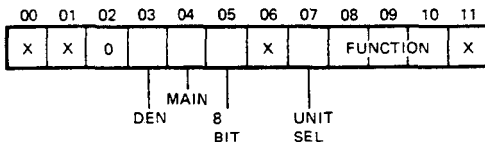
| RX8        |             | RX28       |             |
|------------|-------------|------------|-------------|
| Location   | Instruction | Location   | Instruction |
| 24         | 7126        | 20         | 1061        |
| 25         | 1060        | 21         | 1046        |
| 26         | 67x1        | 22         | 0060        |
| 27         | 7201        | 23         | 3061        |
| 30         | 4053        | 24         | 7327        |
| 31         | 4053        | 25         | 1061        |
| 32         | 7104        | 26         | 67x1        |
| 33 (START) | 67x5        | 27         | 7301        |
| 34         | 5054        | 30         | 4053        |
| 35         | 67x4        | 31         | 4053        |
| 36         | 7450        | 32         | 7004        |
| 37         | 7610        | 33 (START) | 67x5        |
| 40         | 5046        | 34         | 5054        |
| 41         | 1060        | 35         | 67x4        |
| 42         | 7041        | 36         | 7450        |
| 43         | 1061        | 37         | 5020        |
| 44         | 3060        | 40         | 1061        |
| 45         | 5024        | 41         | 67x1        |
| 46         | 67x1        | 42         | 1061        |
| 47         | 4053        | 43         | 0046        |
| 50         | 3002        | 44         | 1032        |
| 51         | 2050        | 45         | 3060        |
| 52         | 5047        | 46         | 0360        |
| 53         | 0000        | 47         | 4053        |
| 54         | 67x3        | 50         | 3002        |
| 55         | 5033        | 51         | 2050        |
| 56         | 67x2        | 52         | 5047        |
| 57         | 5453        | 53         | 0000        |
| 60         | 7024        | 54         | 67x3        |
| 61         | 6030        | 55         | 5033        |
|            |             | 56         | 67x2        |
|            |             | 57         | 5453        |
|            |             | 60         | 0420        |
|            |             | 61         | 0020        |

## COMMAND AND STATUS REGISTER

RXCS, PDP-8, RX01 67X1



RX2CS, PDP-8, RX02 67 X 1

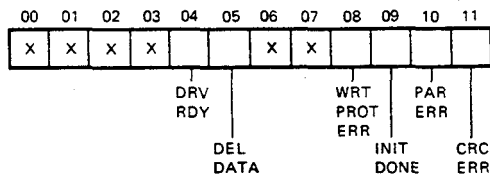


## FUNCTION CODES

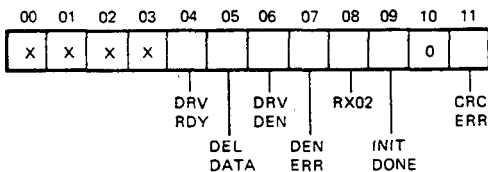
|                  |                              |
|------------------|------------------------------|
| 000 FILL BUFFER  | 100 NOT USED (RX01)          |
| 001 EMPTY BUFFER | SET DENSITY (RX02)           |
| 010 WRITE SECTOR | 101 READ RXES                |
| 011 READ SECTOR  | 110 WRITE WITH DEL DATA MARK |
|                  | 111 READ ERROR REG           |

## ERROR AND STATUS REGISTER (StatusA)

RXES, PDP-8, RX01 67X2



RX2ES, PDP-8, RX02 67 X 2



MA-9597

Figure 1-5 RX8/RX28 Registers (Sheet 1 of 2)

## TRACK ADDRESS REGISTER

RXTA, RX2TA, PDP-8, RX01/02 67X2

|    |    |    |    |    |               |    |    |    |    |    |    |                  |
|----|----|----|----|----|---------------|----|----|----|----|----|----|------------------|
| 00 | 01 | 02 | 03 | 04 | 05            | 06 | 07 | 08 | 09 | 10 | 11 |                  |
| X  | X  | X  | X  | 0  | TRACK ADDRESS |    |    |    |    |    | 0  | 114 <sub>8</sub> |

## DATA BUFFER REGISTER

RXDB, PDP-8, RX01/RX02 67X2

|                            |    |    |    |           |    |    |    |    |    |    |    |
|----------------------------|----|----|----|-----------|----|----|----|----|----|----|----|
| 00                         | 01 | 02 | 03 | 04        | 05 | 06 | 07 | 08 | 09 | 10 | 11 |
| DATA - 12 BIT<br>MODE ONLY |    |    |    | DATA BYTE |    |    |    |    |    |    |    |

## SECTOR ADDRESS REGISTER

RXSA, RX2SA, PDP-8, RX01/02 67X2

|    |    |    |    |    |    |    |                |    |    |    |    |                 |
|----|----|----|----|----|----|----|----------------|----|----|----|----|-----------------|
| 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07             | 08 | 09 | 10 | 11 |                 |
| X  | X  | X  | X  | 0  | 0  | 0  | SECTOR ADDRESS |    |    |    | 1  | 32 <sub>8</sub> |

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Figure 1-5 RX8/RX28 Registers (Sheet 2 of 2)

**1.4.3 Interface (M8357)**

Use the M8357 board (Figure 1-6) for both RX01s and RX02s when they are connected to PDP-8 systems. Device code switch settings are the same whether the interface is on an RX8 or RX28 subsystem.

**NOTE**

**RX01/RX02 interfacing to 78/278 series computers is part of the CPU.**

**1.5 RX11/RXV11 SUBSYSTEM**

Use this information for diagnostics, installations, and troubleshooting. Table 1-1 lists documents with additional information. The RX11/RXV11 subsystem has two diagnostics.

ZRXA(x) system reliability test  
ZRXB(x) interface diagnostic\*

Make sure the revision level of the diagnostic and diagnostic writeup are the same. Use Tables 1-6 and 1-7 with error printouts.

\*The symbol (x) represents the revision level.

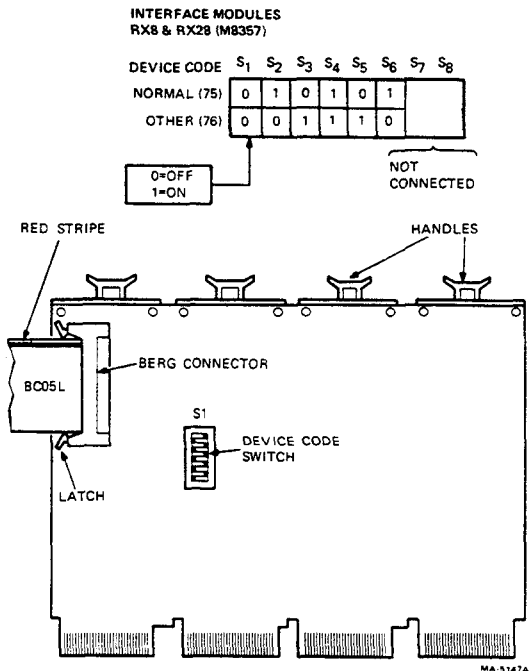


Figure 1-6 M8357 Interface (RX8/RX28)

### 1.5.1 Bootstrap

When a front panel is available, use a toggle-in routine (Table 1-9) to boot the floppy.

### 1.5.2 Registers

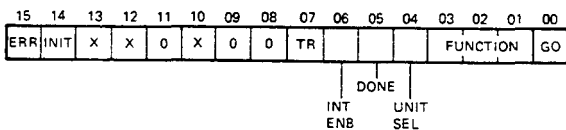
The RX11/RXV11 registers are broken down in Figure 1-7.

Table 1-9 RX11/RXV11 Bootstrap

| Location | Instruction | Location | Instruction |
|----------|-------------|----------|-------------|
| 1000     | 005000      | 1022     | 100405      |
| 1002     | 012701      | 1024     | 105711      |
| 1004     | 177170      | 1026     | 100004      |
| 1006     | 105711      | 1030     | 116120      |
| 1010     | 001776      | 1032     | 000002      |
| 1012     | 012711      | 1034     | 000770      |
| 1014     | 000003      | 1036     | 000000      |
| 1016     | 005711      | 1040     | 005000      |
| 1020     | 001776      | 1042     | 000110      |

## COMMAND AND STATUS REGISTER

RXCS, PDP-11/LSI-11, RX01 177170

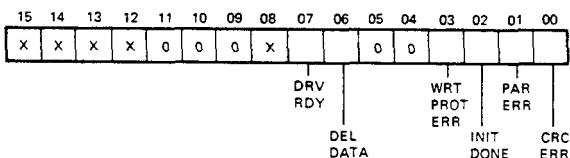


## FUNCTION CODES

|                  |                              |
|------------------|------------------------------|
| 000 FILL BUFFER  | 100 NOT USED (RX01)          |
| 001 EMPTY BUFFER | SET DENSITY (RX02)           |
| 010 WRITE SECTOR | 101 READ RXES                |
| 011 READ SECTOR  | 110 WRITE WITH DEL DATA MARK |
|                  | 111 READ ERROR REG           |

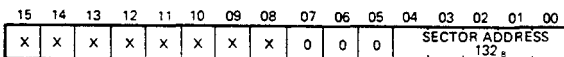
## ERROR AND STATUS REGISTER (Status A)

RXES, PDP-11/LSI-11, RX01 177172



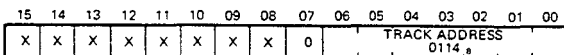
## SECTOR ADDRESS REGISTER

RXSA, PDP-11/LSI-11, RX01/02 177172



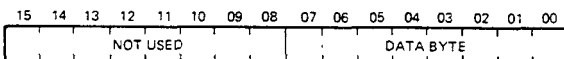
## TRACK ADDRESS REGISTER

RXTA, PDP-11/LSI-11, RX01/02 177172



## DATA BUFFER REGISTER

RXDB, PDP-11/LSI-11 177172



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Figure 1-7 RX11/RXV11 Registers

### 1.5.3 Interfaces (M7846 and M7946)

The M7846 (RX11) and M7946 (RXV11) boards work with RX01s and RX02s set for single-density use. Figures 1-8 and 1-9 give normal bus and vector addresses.

### 1.6 RX211/RXV21 SUBSYSTEM

Use this information for diagnostics, installations, and troubleshooting. Table 1-1 lists documents with additional information. The RX211/RXV21 subsystem has four diagnostics.

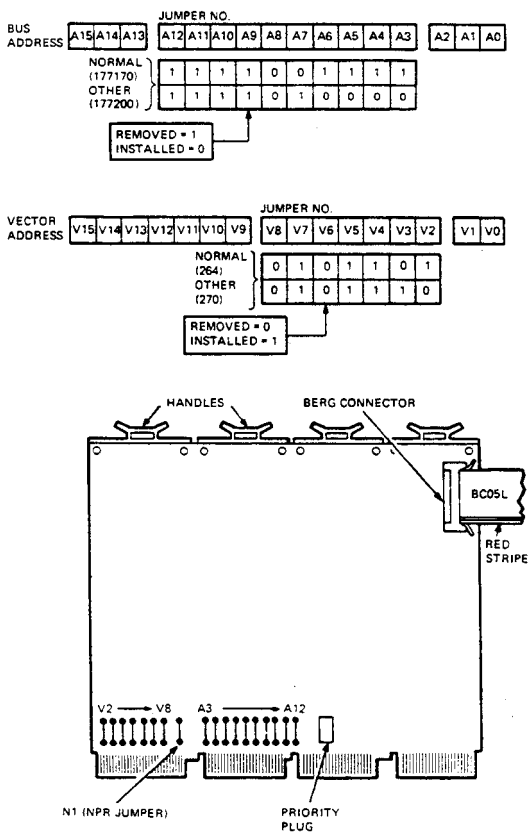


Figure 1-8 M7846 Interface (RX11)



ZRXD(x) RX02 performance exerciser  
 ZRXF(x) RX02 function/logic  
 ZRXC(x) RX02 utility driver (Brutus)  
 ZRXE(x) RX02 formatter program\*

Field Service requires ZRXD and ZRXF only. ZRXC is primarily an engineering tool. ZRXE sets media density only and does not write headers. Make sure the revision level of the diagnostic and diagnostic writeup are the same. Use Tables 1-6 and 1-7 with error printouts.

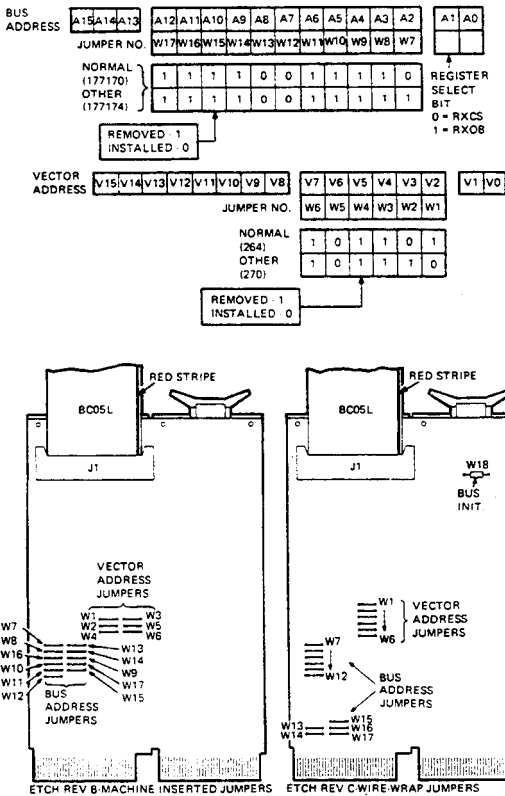


Figure 1-9 M7946 Interface (RXV11)

\*The symbol (x) represents the revision level.

**1.6.1 Bootstrap**

When a front panel is available use a toggle-in routine (Table 1-10) to boot the floppy.

**1.6.2 Registers**

The RX211/RXV21 registers are broken down in Figure 1-10.

**1.6.3 Interfaces (M8256 and M8029)**

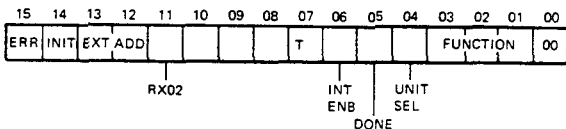
Use the M8256 (RX211) and M8029 (RXV21) boards with RX02s only. Figures 1-11 and 1-12 show normal bus and vector addresses.

**Table 1-10 RX211/RXV21 Bootstrap**

| Location | Instruction | Location | Instruction |
|----------|-------------|----------|-------------|
| 2000     | 012701      | 2060     | 000304      |
| 2002     | 177170      | 2062     | 030011      |
| 2004     | 012700      | 2064     | 001776      |
| 2066     | 100240      | 2056     | 100422      |
| 2010     | 005002      | 2070     | 012711      |
| 2012     | 012705      | 2072     | 000403      |
| 2014     | 000200      | 2074     | 030011      |
| 2016     | 012704      | 2076     | 001776      |
| 2020     | 000401      | 2100     | 100415      |
| 2022     | 012703      | 2102     | 010513      |
| 2024     | 177172      | 2104     | 030011      |
| 2026     | 030011      | 2106     | 001776      |
| 2030     | 001776      | 2110     | 100411      |
| 2032     | 100440      | 2112     | 010213      |
| 2034     | 012711      | 2114     | 060502      |
| 2036     | 000407      | 2116     | 060502      |
| 2040     | 030011      | 2120     | 122424      |
| 2042     | 001776      | 1211     | 120427      |
| 2044     | 100433      | 2124     | 000007      |
| 2046     | 110413      | 2126     | 003737      |
| 2050     | 000304      | 2130     | 005000      |
| 2052     | 030011      | 2132     | 005007      |
| 2054     | 001776      | 2134     | 000000      |
| 2056     | 110413      |          |             |

## COMMAND AND STATUS REGISTER

RX2CS, PDP-11/LSI-11, RX02 177170

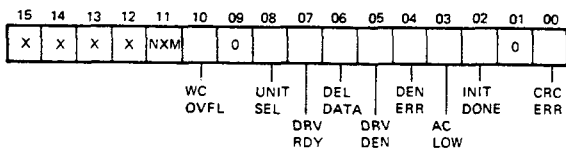


## FUNCTION CODES

|                     |                              |
|---------------------|------------------------------|
| 000 FILL BUFFER     | 101 READ RXES                |
| 001 EMPTY BUFFER    | 110 WRITE WITH DEL DATA MARK |
| 010 WRITE SECTOR    | 111 READ ERROR REG           |
| 011 READ SECTOR     |                              |
| 100 NOT USED (RX01) |                              |
| SET DENSITY (RX02)  |                              |

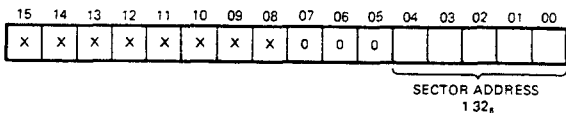
## ERROR AND STATUS REGISTER (STATUS A)

RX2ES, PDP-11/LSI-11, RX02 177172



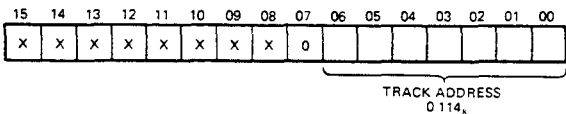
## SECTOR ADDRESS REGISTER

RX2SA, PDP-11/LSI-11 RX01/02 177172



## TRACK ADDRESS REGISTER

RX2TA, PDP-11/LSI-11 RX01/02 177172

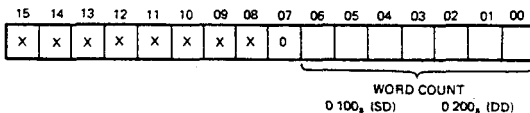


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Figure 1-10 RX211/RXV21 Registers (Sheet 1 of 2)

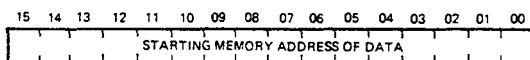
## WORD COUNT REGISTER

RX2WC, PDP-11/LSI-11, RX02 ONLY 177172



## BUS ADDRESS REGISTER

RX2BA, PDP-11/LSI-11, RX02 ONLY 177172



## ERROR CODES

| ERR REG           |  |  |  | PDP 11, LSI 11    |            |          |            | RX02 ONLY |  |  |            |        |
|-------------------|--|--|--|-------------------|------------|----------|------------|-----------|--|--|------------|--------|
| TRACK ADDR SEL DV |  |  |  | DV<br>SEL         | DEN<br>DV1 | HD<br>LD | DEN<br>DVO |           |  |  | DEN<br>CMD | WORD 4 |
| TARGET SECTOR     |  |  |  | TARGET TRACK      |            |          |            |           |  |  |            |        |
| CURRENT TRACK DV1 |  |  |  | CURRENT TRACK DV0 |            |          |            |           |  |  |            |        |
| WORD COUNT REG    |  |  |  | ERROR CODE        |            |          |            |           |  |  |            | WORD 1 |
| 15                |  |  |  | 8 7               |            |          |            | 4         |  |  |            | 0      |

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Figure 1-10 RX211/RXV21 Registers (Sheet 2 of 2)

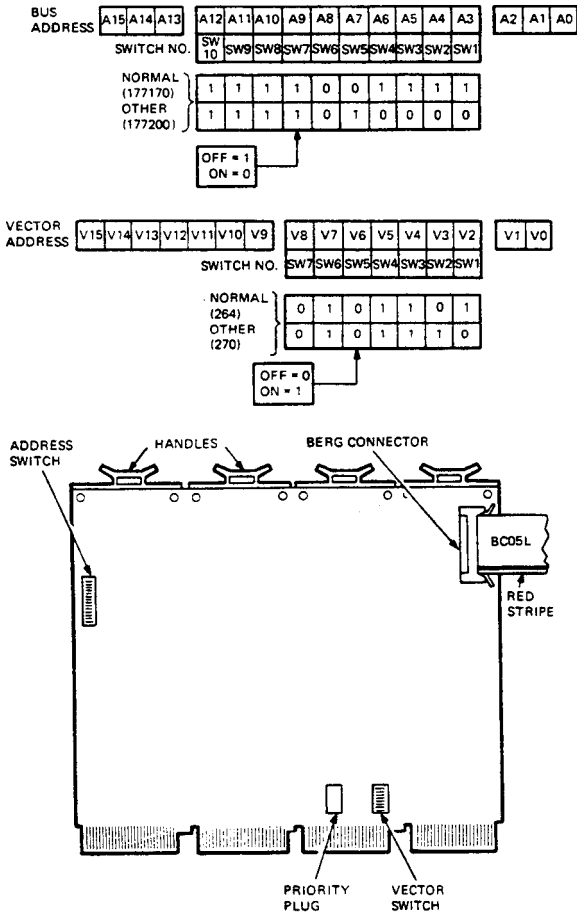
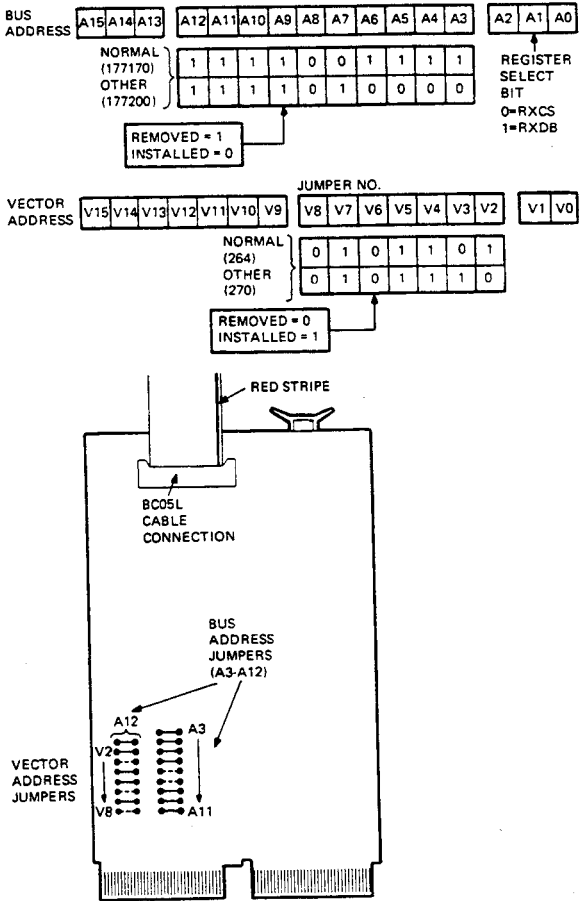


Figure 1-11 M8256 Interface (RX211)



MA 5132A

Figure 1-12 M8029 Interface (RXV21)

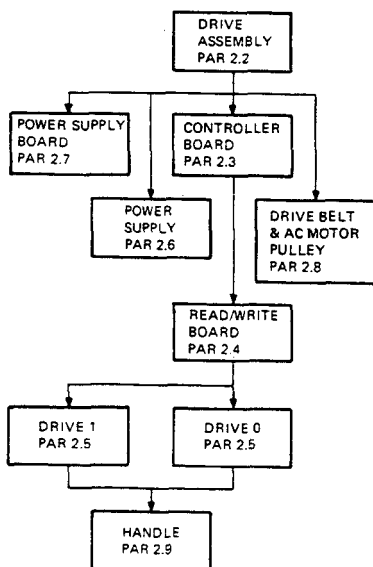
# 2 MECHANICAL SERVICING

## 2.1 GENERAL

This chapter describes the removal, replacement, and cleaning of RX01/RX02 assemblies, boards, and field replaceable components. Figure 2-1 shows the order in which units must be removed and provides convenient references to the appropriate paragraphs.

### WARNING

**Before attempting to remove or replace any assemblies, disconnect all power plugs and interface cables.**



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Figure 2-1 Subassembly Removal and Replacement

## 2.2 RX01/RX02 DISK DRIVE ASSEMBLY

Use the following procedures to remove the entire disk drive assembly from a system. Paragraph 2.2.1 applies to an RX01/RX02 mounted in a rack, and Paragraph 2.2.2 applies to an RX01/RX02 mounted in a case.

### NOTE

**Some RX01s and RX02s are mounted in other type cabinets. Refer to the appropriate system documentation in these cases.**

#### 2.2.1 Rack-Mount

Perform the following procedure to remove and install a rack-mounted RX01/RX02.

### WARNING

**Disconnect the power cable from the prime power source and the interface cable from the host before attempting to remove the RX01/RX02.**

**The disk drive assembly weighs approximately 65 pounds. Lifting the unit requires two people to avoid personal injury or equipment damage.**

1. Disconnect power to the system.
2. Slide unit so that it is extended in the rack.
3. Disconnect the ac power cord from the host system.
4. Disconnect the interface cable from the interface board.
5. Remove any cable clamps holding the interface cable.
6. Carefully remove the RX01/RX02 from the rack by pressing in on the stop tabs. In some versions, eight screws on the side rails must be removed first.
7. Install the RX01/RX02 assembly by reversing steps 1 through 6.



### 2.2.2 Case-Mount

Perform the following procedure to remove and install a case-mounted RX01/RX02. Refer to Figure 2-2.

#### WARNING

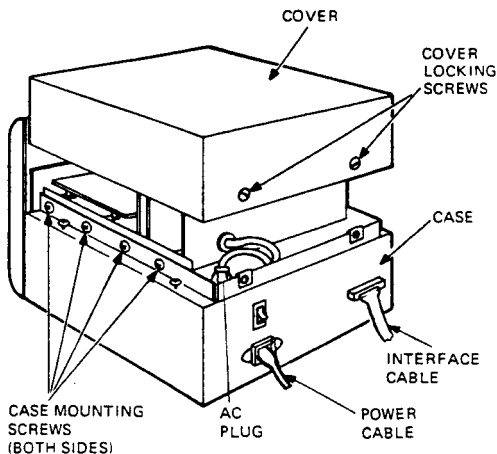
Disconnect the power cable from the prime power source and the interface cable from the host before attempting to remove the RX01/RX02.

The disk drive assembly weighs approximately 65 pounds. Lifting the unit requires two people to avoid personal injury or equipment damage.

1. Disconnect the power and interface cables from the rear of the RX01/RX02 (Figure 2-2).
2. Remove mounting screws if present.
3. Slide the unit from the mini-desk.

#### NOTE

When replacing the unit in the mini-desk, brace the desk against the wall to prevent it from rolling.



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Figure 2-2 Removing and Replacing RX01/RX02 (Case-Mount)

4. Turn the two cover-locking screws on the back of the unit 1/4-turn counterclockwise (Figure 2-2).
5. Slide the top cover backwards and lift it straight up.
6. Remove the four case-mounting screws on each side of the case (Figure 2-2).
7. Remove the ac plug from the receptacle in the rear of the case.
8. Remove the three screws securing the controller to the chassis. Note the position of any nylon washer. Swing the board upright. Remove connector J1 of the interface cable from the controller board (Figure 2-3). Swing the board down.
9. Slide the chassis forward and remove it from the case.
10. Install the RX01/RX02 assembly by reversing steps 1 through 9.

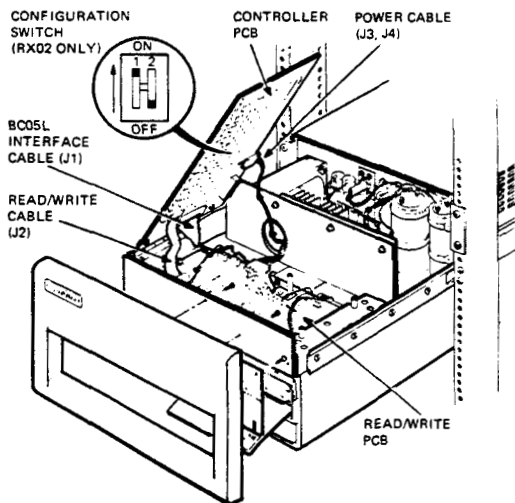


Figure 2-3 Controller Board Connections

### 2.3 CONTROLLER BOARD

Perform the following procedure to remove and install the controller board. Refer to Figure 2-3.

1. Perform steps 1 through 5 in Paragraph 2.2.1 (rack-mount) or steps 1 through 6 in Paragraph 2.2.2 (case-mount).
2. Remove the three screws securing the controller to the chassis. Note the position of any nylon washer. Swing the board upright.
3. Remove J1, J2, and either J4 (RX01) or J3 (RX02) from the controller board.
4. Remove the three nuts (not the screws) securing the controller board to the hinge assembly. Remove the board.
5. If the controller is an RX02, make the proper switch settings on the new controller board (Figure 2-3). Refer to Table 2-1.

#### NOTE

**When replacing the controller board, transfer the nuts and washers to the new board to act as spacers between the hinge and board.**

6. Install the controller board and the RX01/RX02 assembly by reversing steps 1 through 5.

**Table 2-1 Switch Configuration for M7744**

| System Designation      | RX01<br>S1-1 | DMA<br>S1-2 | Function   |
|-------------------------|--------------|-------------|--|
| RX211,<br>RXV21         | Off          | On          | RX02 operates as RX02 (PDP-11, LSI-11), DMA.                   |
| RX8E,<br>RX11,<br>RXV11 | On           | Off         | RX02 operates as RX01 (PDP-8, PDP-11, LSI-11), programmed I/O. |
| RX28                    | Off          | Off         | RX02 operates as RX02 (PDP-8), programmed I/O.                 |

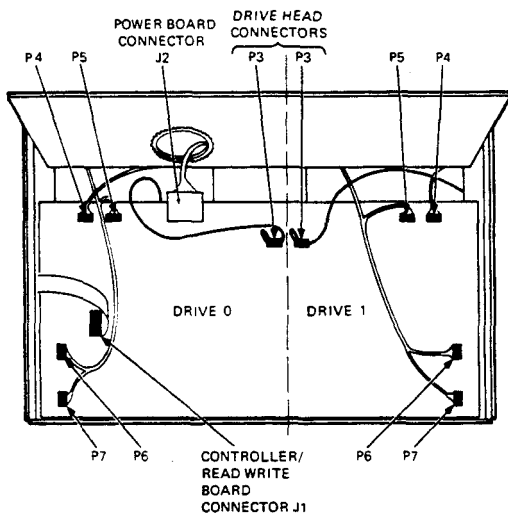
## 2.4 READ/WRITE BOARD

Perform the following procedure to remove and install the read/write board. Refer to Figures 2-4 and 2-5.

### NOTE

When replacing a read/write board, check the etch for burn or discoloration. This may be most visible around the four transistors in both rear corners of the board. Replace the drive as well as the board if this occurs.

1. Perform steps 1 and 2 in Paragraph 2.3.
2. Remove all connectors for both drives (Figure 2-4 or 2-5).
3. Remove the eight screws and washers securing the read/write board to the chassis. (Note the position of the nylon washer if applicable.)



#### COLOR CODE

- P7 - BLUE, GREEN, BLACK, GRAY (HOME PHOTOSENSOR)  
 P6 - BLACK, WHITE, BLUE, GRAY (INDEX PHOTOSENSOR)  
 P5 - GRAY, BLUE (HEAD LOAD SOLENOID)  
 P4 - YELLOW, RED, GRAY, BROWN, BLACK (STEPPER MOTOR)

MA 4155B

Figure 2-4 RX01 Read/Write Board Connections

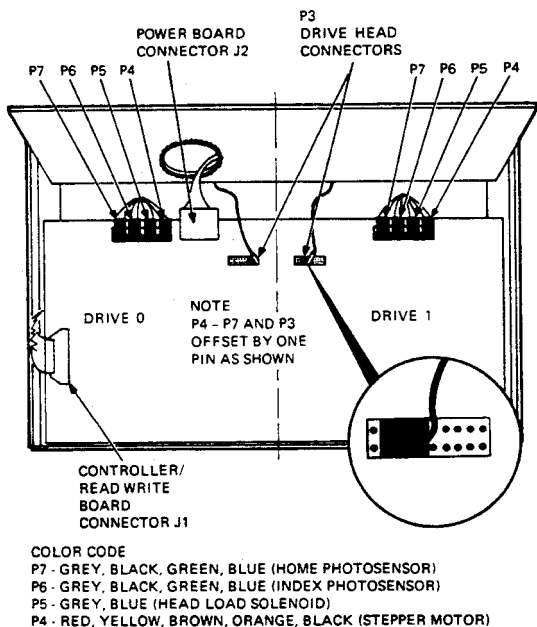


Figure 2-5 RX02 Read/Write Board Connections

**CAUTION**

When you reinstall the board, make sure the screw and the nylon washer that insulates the screw from the circuitry are in the correct location.

4. Install the read/write board and the RX01/RX02 assembly by reversing steps 1 through 3. Connect the power supply and drive connectors as shown in Figure 2-4 (RX01) or Figure 2-5 (RX02).

**NOTE**

Connector P3 can be reversed, but the positioning of the connector on the board is important.

## 2.5 DRIVE

Perform the following procedure to remove and install the drive.

1. Perform steps 1 and 2 in Paragraph 2.3.
2. Unplug all drive connectors from the read/write board of the drive in question.
3. Remove the head cable from the head cable clamp.

### NOTE

**The following two steps apply only to the case-mounted RX01/RX02.**

4. Swing the controller board down. Secure it with one of the screws removed in step 1.
5. Set the RX01/RX02 on its side.
6. If necessary, remove the screws securing the plenum/fan assembly to the rear of the RX01/RX02 (Figure 2-6).

### NOTE

**Some early rack-mounted RX01s do not have a plenum/fan assembly. Retrofit any units found this way.**

7. Disconnect the drive power connector from the rear of the drive (Figure 2-7).

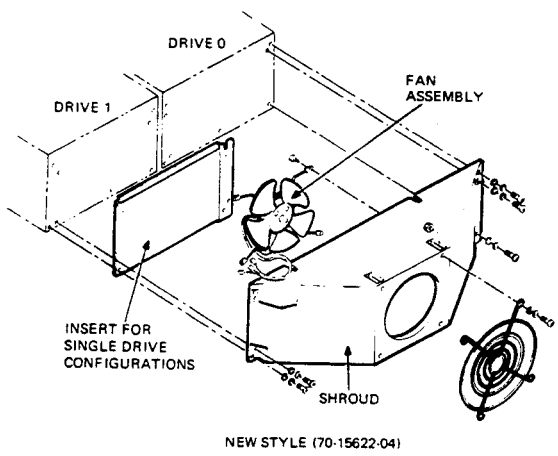
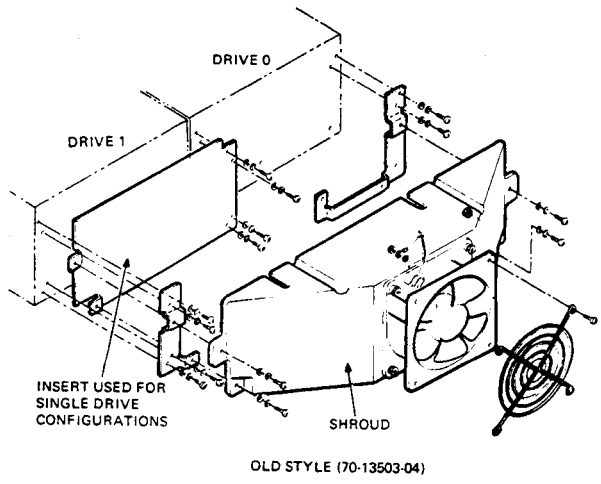
### CAUTION

**Close the drive door before attempting to remove the drive unit. Support the drive assembly during the next step. It can fall out of the chassis at this point.**

8. Remove the screw holding the controller board. Remove the six drive screws securing the drive assembly to the chassis (three on each side) (Figure 2-7). Remove the drive unit.
9. Install the drive and RX01/RX02 assembly by reversing steps 1 through 8.

### NOTE

**If using the M7727 read/write board, install the resistor assembly in head plug P3 (Figure 1-3).**



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Figure 2-6 Plenum/Fan Assembly

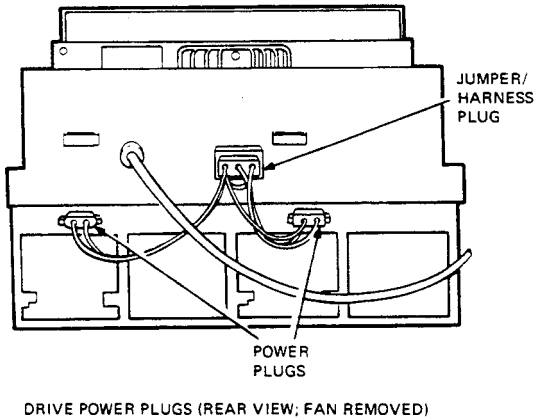
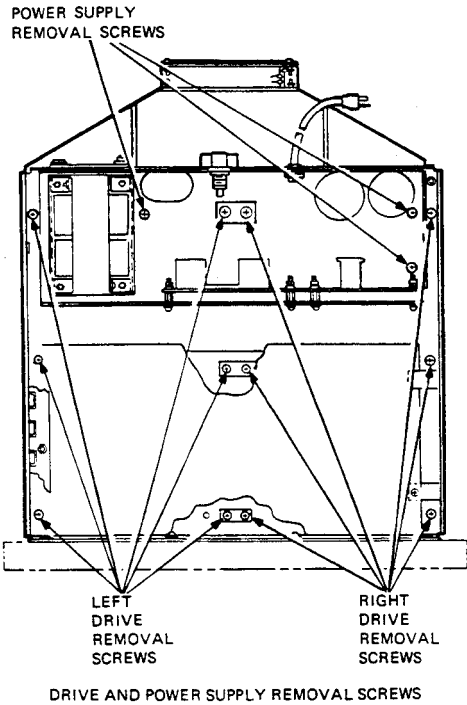


Figure 2-7 Drive and Power Supply Removal



## 2.6 POWER SUPPLY

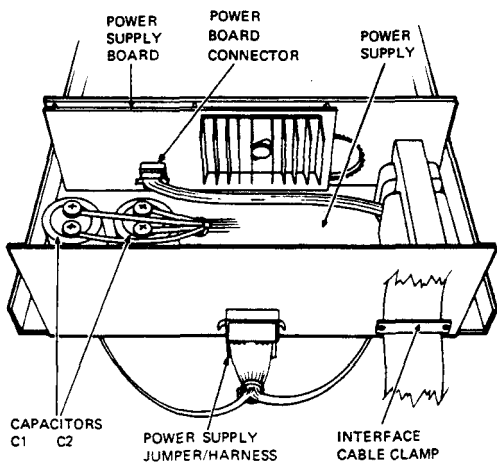
Perform the following procedure to remove and install the power supply. Refer to Figure 2-8 and 2-9.

1. Perform steps 1 and 2 in Paragraph 2.3.

### WARNING

Before attempting to remove the power supply, disconnect power from the drive. Then short out the two terminals on capacitors C1 and C2 (Figure 2-9).

2. Remove the jumper/harness plug from the rear of the power supply (Figure 2-8).
3. Remove the power board connectors from J2 on the read/write board and J3/J4 on the controller board (Figures 2-3 and 2-4).
4. Remove the interface cable clamp if applicable (Figure 2-8).
5. Remove the three power supply screws and washers securing the power supply to the RX01/RX02 chassis (Figure 2-7).
6. Lift the power supply free from the chassis.
7. Install the power supply and the RX01/RX02 assembly by reversing steps 1 through 6.



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Figure 2-8 Power Supply Components

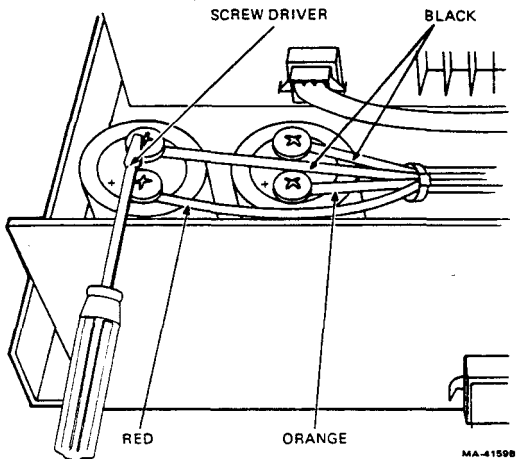


Figure 2-9 Capacitor C1 and C2 Connections

## 2.7 POWER BOARD ASSEMBLY (REGULATORS)

Perform the following procedure to remove and install the power board assembly. Refer to Figures 2-8 and 2-9.

1. Perform steps 1 and 2 in Paragraph 2.3.

### WARNING

**Before attempting to remove the power supply, disconnect power from the drive. Then short out the two terminals on capacitors C1 and C2 (Figure 2-9).**

2. Disconnect the connector from the center of the power supply board (Figure 2-8).
3. Remove the power board connectors from J2 on the read/write board and J3/J4 on the the controller board (Figures 2-3 and 2-4).
4. Note the polarity of the leads on capacitors C1 and C2, and then remove the leads (Figure 2-8).
5. Remove the six screws securing the board to the power supply and remove the board. When installing, be careful not to tighten the screws too much.

**CAUTION**

Observe the correct polarity when connecting the wires to C1 and C2 (Figure 2-9).

6. Install the power board assembly and the RX01/RX02 assembly by reversing steps 1 through 5.

**2.8 DRIVE BELT AND AC MOTOR PULLEY**

Perform the following procedure to remove and install the drive belt and ac motor pulley.

1. Perform steps 1 and 2 in Paragraph 2.2.1 (rack-mount) or steps 1 through 10 in Paragraph 2.2.2 (case-mount).
2. Set the RX01/RX02 on its side (case-mount only). Remove the screws securing the bottom cover of the appropriate drive assembly. Remove the cover.
3. While turning the spindle pulley, remove the belt by rolling it off the spindle pulley (Figure 2-10).

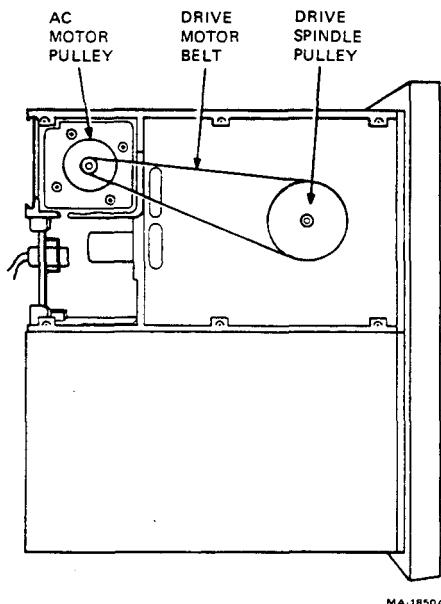


Figure 2-10 Drive Belt and AC Motor Pulley

**NOTE**

**If the belt has fallen off, replace the ac motor pulley. If the belt is simply worn, go to step 6.**

**Replace the defective belt and pulley with the proper parts. See Appendix A for the correct part numbers.**

4. Using a 1/16-inch Allen wrench, loosen the 6-32 set screw securing the pulley to the motor. Remove the pulley.
5. Place the new flanged pulley on the shaft.
6. Clean the face of the pulleys with alcohol.
7. Adjust pulley position and belt tension according to Paragraph 3.2.
8. Install the RX01/RX02 assembly by reversing steps 1 through 3.

**2.9 DOOR HANDLE**

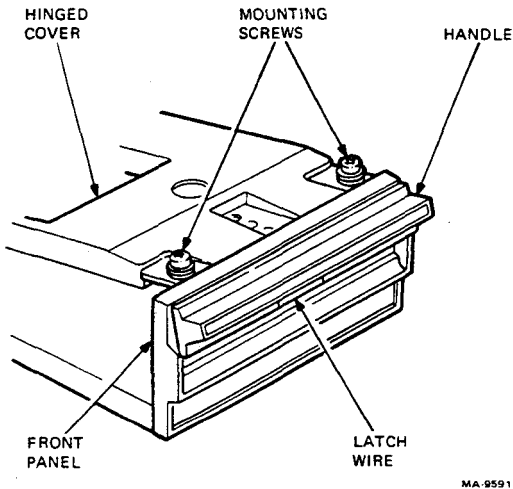
Perform the following procedures to remove and install the door handle.

**2.9.1 Door Handle Removal**

1. Remove the drive assembly according to Paragraph 2.5.
2. Remove the two mounting screws securing the handle to the hinged cover (Figure 2-11). Hold the cover securely to prevent it from suddenly springing up.
3. Remove the handle by pulling it through the opening in the front panel.

**2.9.2 Door Handle Installation**

1. Insert the handle through the front panel and install the mounting screws, (Figure 2-11). Do not tighten the screws completely.
2. Adjust the handle so that the handle brackets do not rub on the front panel. Latch the handle.
3. Tighten the mounting screws.
4. Check the head gap clearance according to Paragraph 3.3. Do the adjustment if necessary.
5. Check again for freedom of movement. Install the drive according to Paragraph 2.5. Begin with step 9.



MA-9591

Figure 2-11 Door Handle Assembly

## 2.10 READ/WRITE HEAD

Perform the following procedure to clean the read/write head.

### NOTE

**Clean the read/write head only when error symptoms occur.**

1. To reach the read/write head, remove the drive (Paragraph 2.5) or the read/write board (Paragraph 2.4).
2. Lift the pressure pad assembly (Figure 2-12). Clean the head with magnetic head-cleaner.
3. Install the unit by reversing step 1.

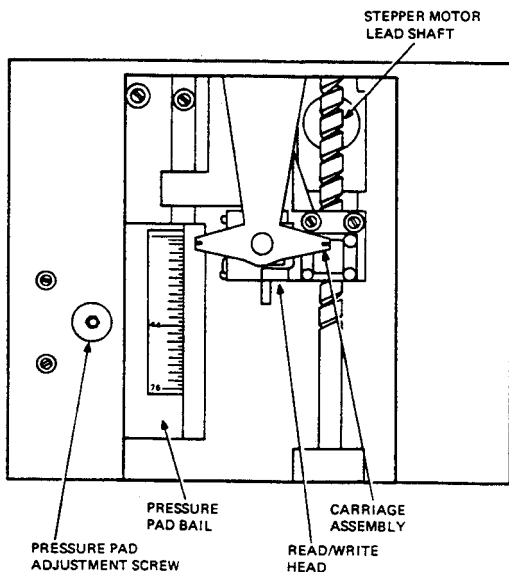
## 2.11 STEPPER MOTOR LEAD SHAFT

Perform the following procedure to clean the head shaft.

### NOTE

**Clean the head shaft only when error symptoms occur.**

1. Remove the drive according to Paragraph 2.5.



MA-0683A

Figure 2-12 Head Carriage Components  
(Top View)

2. Clean the shaft (Figure 2-12) with alcohol while moving the carriage assembly in and out by hand-turning the shaft.
3. Add a little grease to the shaft. Use only molybium grease (lithium base, grade #2).
4. Install the drive according to Paragraph 2.5. Begin with step 9.

# 3 ALIGNMENT AND ADJUSTMENT

## 3.1 HANDLE LATCH WIRE

Adjust the handle latch wire (Figure 2-11) so that it firmly holds the handle latch. The wire must not rub against the latch when the handle is pushed past the latched position. To adjust the handle latch wire properly, perform the following steps.

1. Pull the latch wire out by placing a screwdriver between the wire and the front panel. Pry one side at a time until the wire firmly holds the handle latch.
2. Pull the latch wire in by tapping the wire loop on one side at a time. Do this until it does not rub the handle latch when the handle is pushed past the latched position.

## 3.2 DRIVE BELT AND AC MOTOR PULLEY

Perform the following procedure to adjust the drive belt and ac motor pulley.

1. Remove the drive belt and ac motor pulley according to Paragraph 2.8.
2. Using a straight edge, make sure the motor pulley aligns with the spindle pulley (Figure 3-1).

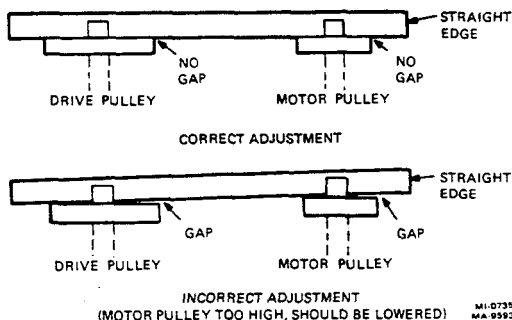


Figure 3-1 Motor Pulley Alignment

**CAUTION**

**Misadjustment of the drive pulley causes the belt to fly off the pulley.**

3. Tighten the set screw on the flat of the motor shaft.
4. Use the spacer gauge to check for correct spacing between the pulleys. This is critical for proper belt tension. When the motor and spindle pulleys hold the spacer gauge in place, the spacing is correct (Figure 3-2).

**NOTE**

**Each type of drive has a different spacer gauge. Use the correct gauge (Appendix A).**

5. If the spacing is wrong, loosen the four motor-mounting screws (Figure 3-2). Adjust the position of the motor for correct spacing and tighten the four screws.

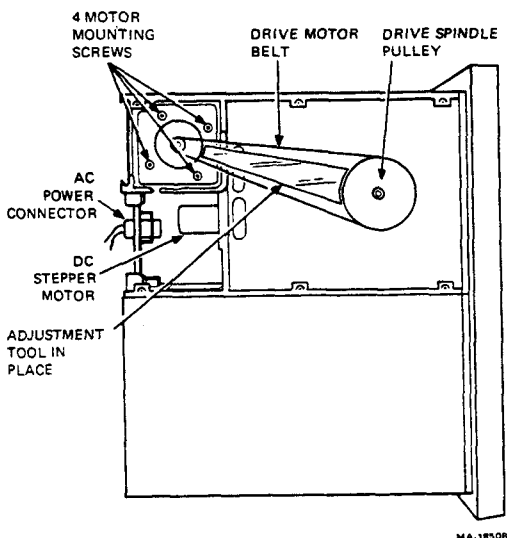


Figure 3-2 Underside View of Drive



6. Install the belt by rolling it onto the large spindle pulley.

### CAUTION

Do not stretch the belt onto the pulley. It is nylon, not rubber. Stretching breaks nylon fibers and damages the belt.

7. Return to Paragraph 2.8.

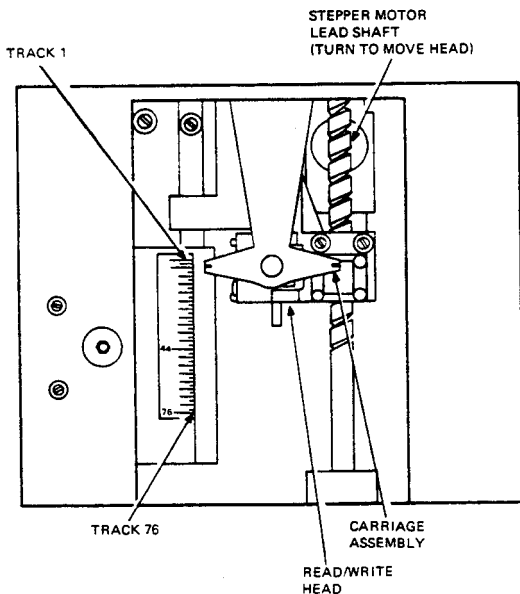
### 3.3 HEAD GAP

Perform the following procedure to adjust the head gap.

1. Remove the read/write board according to Paragraph 2.4.

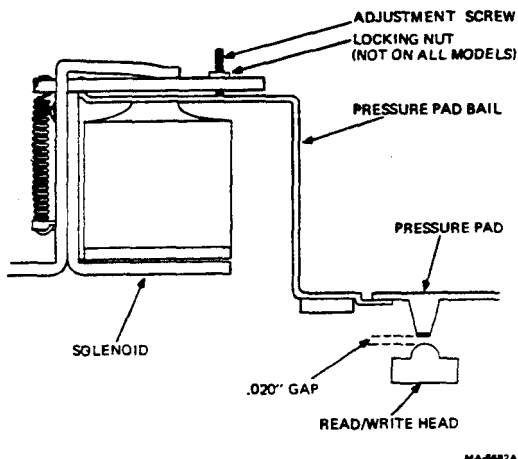
### NOTE

Make sure the carriage assembly is riding on the top surface of the pressure pad bail (Figures 3-3 and 3-4).



MA-6838

Figure 3-3 Head Gap Adjustment



MA-9882A

Figure 3-4 RX01 Pressure Pad Mechanism  
(Front View)

2. With the drive door closed, move the read/write head and carriage assembly as far away from the spindle as possible (track 1) (Figure 3-3).

#### NOTE

Move the head and carriage assembly by turning the stepper motor shaft.

3. With the drive door still closed, lift the pressure pad and place the plastic shim between the read/write head and felt pressure pad.

#### NOTE

The size of the plastic shim (P/N 93-06123-01) used for step 3 is important. Cut the yellow (0.020 in) shim to a 1 inch  $\times$  1 inch square.

4. Refer to Figures 3-4 and 3-5. Set the RX01/RX02 on its side. If the shim stays in place, the head gap is too small. Unscrew the pressure pad adjustment screw until the shim falls out of place but drags slightly. If the shim does not drag, the head gap is too wide. Tighten the screw so that the shim drags as it falls out. On some models the gap is tightened by the locknut.

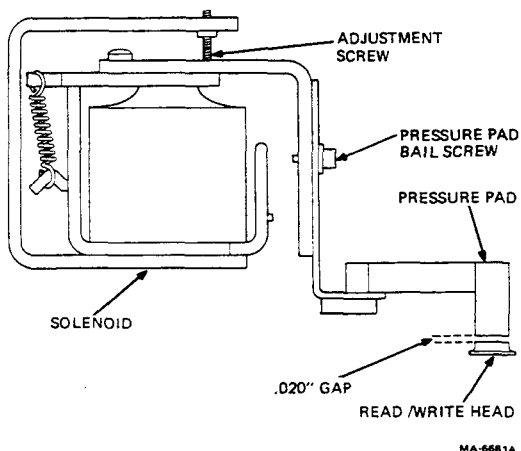


Figure 3-5 RX02 Pressure Pad Mechanism  
(Front View)

5. Once the gap has been adjusted, open and close the door several times.
6. Close the door and recheck the gap. If it has changed, readjust the gap starting at step 2.
7. Move the carriage assembly as close to the spindle as possible (track 76) and check the gap. Then, move the assembly to a midpoint, and check the gap. If the gap is correct at both points, skip step 8.
8. Refer to Figure 3-5. If there is a pressure pad bail screw, loosen it. Move the bail so it is parallel to the carriage and the gap is the same at all tracks. Tighten the screw and perform step 6 again.

#### NOTE

If there is no pressure pad bail screw, adjustment is not possible. Replace the drive (Paragraph 2.5).

9. Replace the read/write board according to Paragraph 2.4.

## APPENDIX A SPARE PARTS LIST

| Part                                | Description            | DEC P/N     |
|-------------------------------------|------------------------|-------------|
| <b>All Drives</b>                   |                        |             |
| Power supply                        | 110 V 60 Hz            | H771-A      |
|                                     | 110 V 50 Hz            | H771-C      |
|                                     | 230 V 50 Hz            | H771-D      |
| Power harness                       | Power supply to drive  |             |
|                                     | 90-120 V 50/60 Hz      | 70-10696-02 |
|                                     | 100-132 V 50 Hz        | 70-10696-01 |
|                                     | 180-240 V 50 Hz        | 70-10696-04 |
|                                     | 200-264 V 50/60 Hz     | 70-10696-03 |
| Fuse                                | 2A slo blow            | 90-07216    |
| Power board assembly                | Regulator              | 70-10718-00 |
| Plenum/fan assembly<br>(Figure 2-6) | 115 V, dual, new style | 70-15622-04 |
|                                     | 230 V, dual, new style | 70-15622-05 |
|                                     | 115 V, dual, old style | 70-13503-04 |
|                                     | 230 V, dual, old style | 70-13503-05 |
| Fan<br>(Figure 2-6)                 | 115 V, new style       | 12-15113-00 |
|                                     | 230 V, new style       | 12-15742-00 |
|                                     | 115 V, old style       | 12-13185-00 |
|                                     | 230 V, old style       | 12-10930-01 |
| Drive                               | 60 Hz                  | 70-13077-00 |
|                                     | 50 Hz                  | 70-13077-01 |
| Flanged ac motor pulley             | 60 Hz                  | 74-21078-00 |
|                                     | 50 Hz                  | 74-21078-01 |
| Interface cable                     | Controller to host     | BC05L-8     |
|                                     |                        | BC05L-15    |

| Part                                   | Description  | DEC P/N                    |
|--|--|----------------------------|
| <b>All Drives</b>                      |  |                            |
| Interface/board                        | Case-mounted units only                            | BC08R-02<br>54-14168       |
| Sems screw                             | Hold-down for controller<br>(Lockwasher attached)  | 90-09984-02                |
| <b>RX01 Drives Only</b>                |  |                            |
| Controller board                       |  | M7726                      |
| Read/write board                       |  | M7727                      |
| Resistor assembly                      | Must be installed in P3 connector when using M7727 | 70-16263-00                |
| DIP cable                              | M7726 to M7727                                     | 70-08612-0F                |
| Door handle assembly                   |  | 70-14297-00                |
| <b>RX02 Drives Only</b>                |  |                            |
| Controller board                       |  | M7744                      |
| Read/write board                       |  | M7745                      |
| Ribbon cable                           | M7744 to M7745                                     | 70-15580-00                |
| Door handle assembly                   |  | 70-13454-00                |
| <b>70 Class Drives Only (70-13077)</b> |  |                            |
| Drive belt                             | 60 Hz<br>50 Hz                                     | 12-14005-00<br>12-14005-01 |
| Spacer gauge                           | 60 Hz<br>50 Hz                                     | 93-06353-02<br>93-06353-03 |

| <b>Part</b>                               | <b>Description</b> | <b>DEC P/N</b> |
|---|--------------------|----------------|
| <b>Calcomp™ Drives Only (RX01-CA/CC)*</b> |                    |                |
| Drive belt                                | 60 Hz              | 12-13454-00    |
|   | 50 Hz              | 12-13454-00    |
| Spacer gauge                              | 60 Hz              | 93-06353-00    |
|   | 50 Hz              | 93-06353-01    |

™ Calcomp is a trade name of California Computer Products, Inc.

- These drives should be used when locally available to replace identical units. They cannot be ordered. Only 70 class drives can be ordered.

**READER'S COMMENTS**  
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This Pocket Service Guide is intended for *Field Service Technicians*. Your comments and suggestions will help us in our continuous effort to improve its quality and usefulness.

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