CHAPTER 2
INSTALLATION

2.1 SITE PREPARATION AND PLANNING

This chapter describes power, space, environmental, cabling, and safety requirements that must be considered before installation of the RL01/RL02 disk subsystem.

2.1.1 Environmental Considerations

The RL01/RL02 disk subsystem is designed to operate in a business or light industry environment. Although cleanliness is an important consideration in the installation of any computer system, it is particularly crucial for proper operation of a disk drive. The RL01K/RL02K disk cartridge is not sealed while being loaded and is therefore vulnerable to dust or smoke particles suspended in the air, as well as to fingerprints, hair, lint, etc. These minute obstructions can cause head crashes, resulting in severe damage to the read/write heads and disk surfaces.

2.1.1.1 Cleanliness – The RL01/RL02 disk drives can operate in an ambient with less than five million particles per cubic foot of air which are 0.5 micron or larger in diameter. The drive contains a filter system which, under these conditions, maintains the particle count within the cartridge below 100 particles per cubic foot.

2.1.1.2 Space Requirements – Provision should be made for service clearances of 1 m (39 in) at the front and rear of the rack or cabinet in which the drive is mounted and 1 m (39 in) at either side.

Storage space for the RL01K/RL02K cartridges should also be made available. Each cartridge has a diameter of approximately 38 cm (15 in) and a height of approximately 6 cm (2.5 in).

CAUTION

RL01K/RL02K disk cartridges must never be stacked on top of each other. A designated shelf area or specially designed disk cartridge storage unit is recommended (see the DIGITAL Supplies and Accessories Catalog).

2.1.1.3 Floor Loading – The weight of the RL01/RL02 disk drive alone is 34 kg (75 lb), which will not place undue stress on most floors. However, the added weight of the rack or cabinet as well as the number of drives to be installed should be considered in relation to the weight of existing computer systems. Possible future expansion should also be a consideration.

2.1.1.4 Heat Dissipation – The heat dissipation of each RL01/RL02 disk drive is 546 Btu/hour maximum. The approximate cooling requirements for the entire system can be calculated by multiplying this figure by the number of drives, adding the result to the total heat dissipation of the other system components, and then adjusting the total figure to compensate for personnel, cooling system efficiency, etc. It is advisable to allow a safety margin of at least 25 percent above the maximum estimated requirements.

2.1.1.5 Acoustics – Most computer sites require at least some degree of acoustical treatment. However, the RL01/RL02 disk subsystem should not contribute unduly to the overall system noise level. Ensure that acoustical materials used do not produce or harbor dust.

2.1.1.6 Temperature – The RL01/RL02 disk subsystem operates over a temperature range of 10° C (50° F) to 40° C (104° F). The maximum temperature gradient is 16.6° C (30° F) per hour. The nonoperating temperature range is from −40° C (−40° F) to 66° C (151° F).

2.1.1.7 Relative Humidity – Humidity control is important for proper operation of any computer system since static electricity may cause memory errors or even permanent damage to logic components. The RL01/RL02 disk subsystem is designed to operate within a relative humidity range of 10 to 90 percent with a maximum wet bulb temperature of 28° C (82° F) and a minimum dew point of 2° C (36° F). The nonoperating relative humidity range is from 10 to 95 percent, with a maximum wet bulb temperature of 46° C (115° F).

2.1.1.8 Altitude – Computer systems operating at high altitudes may have heat dissipation problems. Altitude also affects the flying height of read/write heads in disk drives. The maximum altitude specified for operating the RL01/RL02 disk subsystem is 2440 m (8000 ft). Also, the maximum allowable operating temperature is reduced by a factor of 1.8° C per 1000m (1° F per 1000 ft) above sea level. Thus, the maximum allowable operating temperature at 2440 m (8000 ft) would be reduced to 36° C (96° F).

2.1.1.9 Power and Safety Precautions – The RL01/RL02 disk subsystem presents no unusual fire or safety hazards to an existing computer system. AC power wiring should be checked carefully, however, to ensure that its capacity is adequate for the added load as well as for any possible expansion. The RL01/RL02 disk drive is UL listed and CSA certified.

2.1.1.10 Radiated Emissions – Any source of electromagnetic interference (EMI) that is near the computer system may affect the operation of the processor and its related peripheral equipment. Common EMI sources that are known causes of failures include:

- Thunderstorms,
- Broadcast stations,
- Radar,
- Mobile communications,
- High-voltage power lines,
- Power tools,
- Arc welders,
- Vehicle ignition systems,
- Static electricity.

The effect of radiated EMI emissions on a computer system is unpredictable. Thus, grounding plays an important role in protecting the circuits used in disk drive subsystems.

To help reduce the effects of known high-intensity EMI emissions, perform the following actions:

- Ground window screens and other large metal surfaces,
- Ensure that the overall computer system is grounded properly (refer to Paragraph 2.1.5, Grounding Requirements),
- Provide proper storage (metal cabinets with doors) for disk cartridges.

2.1.1.11 Attitude/Mechanical Shock – Performance of the RL01/RL02 disk subsystem will not be affected by an attitude where maximum pitch and roll do not exceed 15 degrees.

The subsystem is designed to operate while a half-sine shock pulse of 10 gravity peak and 10 ± 3 ms duration is applied once in either direction of three orthogonal axes (three pulses total).

2.1.2 Options

The RL01/RL02 disk drive can be shipped with various controllers (for UNIBUS, OMMIBUS and LSI-11 Bus computer systems), and can be configured for 115 Vac or 230 Vac operation.

Table 2-1 shows saleable RL01/RL02 subsystem options. Table 2-2 shows RL01/RL02 cabinet components.

Table 2-1 Saleable RL01/RL02 Subsystem Options

Option Number	Description
RL01A	RL01 unit, BC20J I/O cable, chassis slide and mounting hardware
RL02A	RL02 unit, BC20J I/O cable, chassis slide and mounting hardware
RL01-AK	RL01-A (drive), RL01K-DC (cartridge)
RL02-AK	RL02-A (drive), RL02K-DC (cartridge)
RL01K-DC	RL01 data cartridge
RL02-DC	RL02 data cartridge
RL11-AK	RL01-AK, RL11 controller, BC06R, terminator
RL211-AK	RL02-AK, RL11 controller, BC06R, terminator
RLV11-AK	RL01-AK, RLV11 controller, BC06R, terminator
RLV12-AK	RL02-AK, RLV11 controller, BC06R, terminator
RL8A-AK	RL01-AK, RL8A controller, BC80J, terminator
RL28A-AK	RL02-AK, RL8A controller, BC80J, terminator
RLV21-AK	RL01-AK, RLV12 controller, BC80M, terminator
RLV22-AK	RL02-AK, RLV12 controller, BC80M, terminator

NOTE

BC20J cables come in lengths of 20, 40 or 60 feet. If 10 foot cables are desired, then the cable designation becomes 70-12122-10. Total length of cables from this controller to the last drive must not exceed 30 M (100 ft.).

Table 2-2 Saleable Cabinet Options: (Includes Skins, Doors, Covers, Trim, and Power Controllers)

Type	Volts	Dwg.	Remarks
H950	110 220	H960-BC H960-BD	Includes five 26.67 cm (10.5 in) high panels
H967	110 220	H967-BA H967-BB	26.67 cm (10.5 in) cover panels (H950-QA) must be ordered if required
H9500	110	H9603-ED	SWLB with H9514-B top covers
	220 110	H9603-EE H9601-ED	DWLB with H9514-A top covers
	220 110	H9601-EE H9602-EA	SWHB complete hiboy cabinet
	220 110	H9602-EB H9600-EA	DWHB complete hiboy cabinet
H9500	220	H9600-EB H9602-B-O	SWHB option arrangement dwg. Order as required
		H9600-A-O	DWHB option arrangement dwg. Order as required
		H9603-B-O	SWLB option arrangement dwg. Order as required
H9500		H9601-A-O	DWHB option arrangement dwg. Order as required

2.1.3 AC Power Requirements

The RL01 or RL02 drive can operate within one of four voltage ranges that are manually selected by means of two terminal blocks located at the rear of the device (Figure 2-1). These voltage ranges are:

	110	**220**
NOM	105–128	210–256
LO	90–110	180–220

The drive will operate when the line frequency is between 47.5 and 63 Hz.

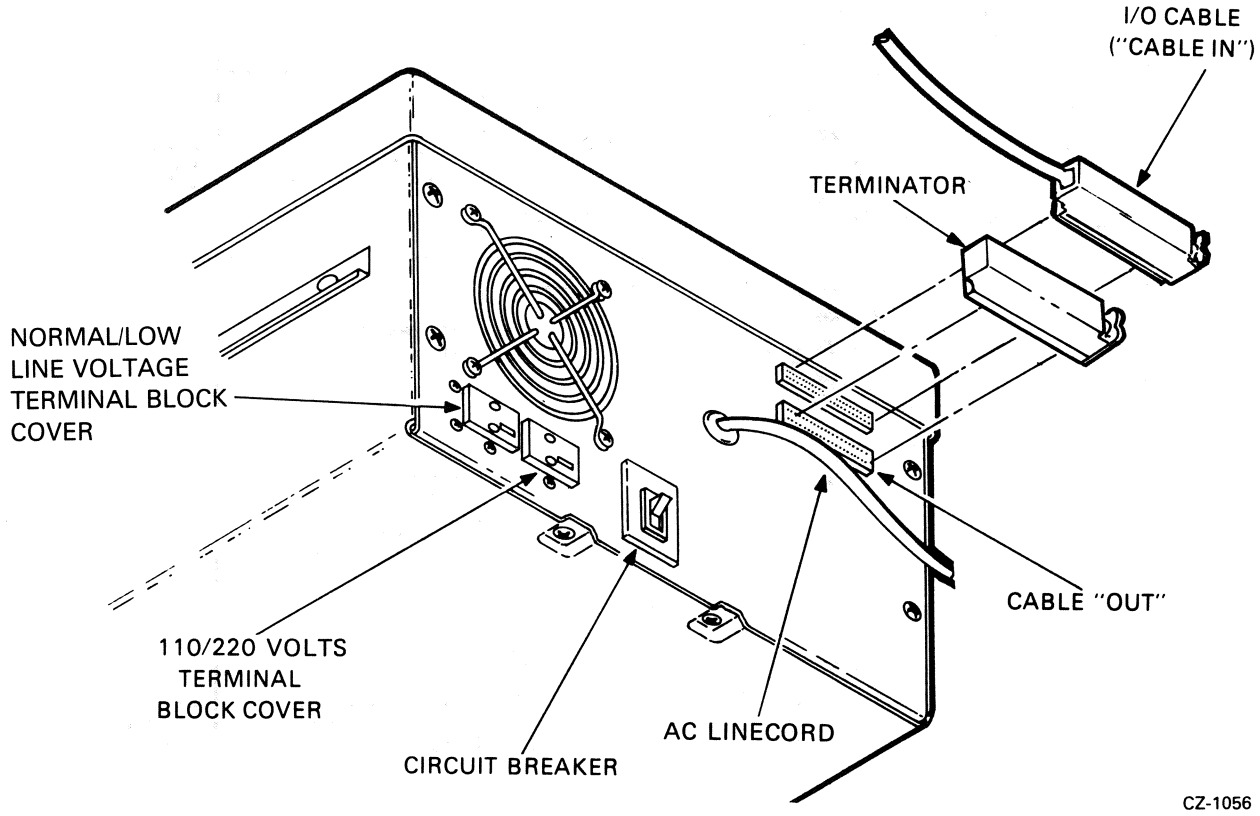


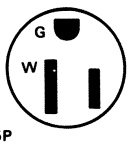
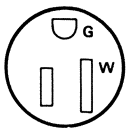
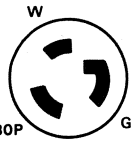
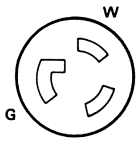
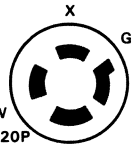
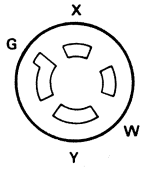
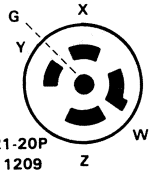
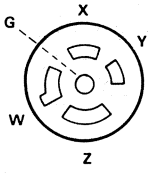
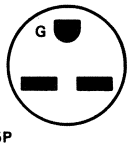
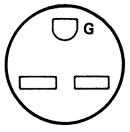
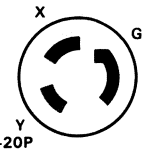
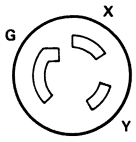
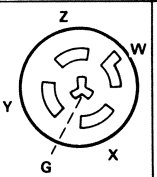
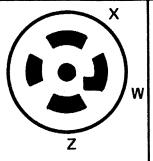
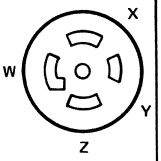
Figure 2-1 RL01/RL02 Disk Drive – Rear View

2.1.3.1 Standard Applications – The drive can be shipped from the factory as a free-standing unit or mounted in various racks and cabinets (refer to Paragraph 2.1.2, Options).

If shipped as a free-standing unit, the 2.74 m (9 ft) ac power cord is terminated with a NEMA type 5-15P plug (DIGITAL Part No. 90-08938). This plug requires a NEMA type 5-15P receptacle (Figure 2-2).

2.1.3.2 Optional Applications – Operation in the high voltage range (180–256 Vac) will require reconfiguring the terminal block at the rear of the drive and changing the line cord plug (Figure 2-1).

In 50 Hz applications, the line cord plug must be changed (Figure 2-2).

SOURCE	PLUG	RECEPTACLE	USED ON	
120V 15A 1-PHASE	 HUBBEL #5266-C NEMA # 5-15P DEC # 90-08938	 #5262 5-15R 12-05351	ALL 120 V TABLE-TOP COMPUTERS. STANDARD 120V LOW-CURRENT DISTRIBUTION. 120V TU10 UNITS. MOST 120V TERMINAL DEVICES.	POWER CONTROLLER 861-F
120/208V 30A 3-PHASE Y	 HUBBEL #2611 NEMA # L5-30P DEC # 12-11193	 #2610 L5-30R 12-11194	ALL 120V STANDARD CABINET MOUNTED EOPT	POWER CONTROLLER 861-C
120/208-240V 20A 2-PHASE or 120/208V 20A 3-PHASE Y	 HUBBEL #2411 NEMA # L14-20P DEC # 12-11045	 #2410 L14-20R 12-11046	120V PDP-11/45 PROCESSOR CABINET ONLY.	POWER CONTROLLER 861-A
120/208V 20A 3-PHASE Y	 HUBBEL #2511 NEMA # L21-20P DEC # 12-11209	 #2510 L21-20R 12-11210	60 Hz RM 10 DRUM 60 Hz RP02/RP03/ RP04, RP05, RP06	
240V 15A 1-PHASE	 NEMA # 6-15P DEC # 90-08853	 6-15R 12-11204	ALL 240V TABLE-TOP COMPUTERS. STANDARD LOW-CURRENT 240V DISTRIBUTION. MOST 240V TERMINAL DEVICES. 240V TU10.	
240V 20A 1-PHASE	 HUBBEL #2321 NEMA # L6-20P DEC # 12-11192	 #2320 L6-20R 12-11191	ALL 240V STANDARD CABINET MOUNTED EQUIPMENT.	POWER CONTROLLER 861-B
240/416V 20A 3-PHASE Y	 NEMA # -- NOT NEMA DEC # 12-09010	 NOT NEMA 12-11259	50 Hz RM10 DRUM 50 Hz RP02/RP03/ RP04	
120V 30A 1-PHASE	 HUBBEL #2811 NEMA L21-30P DEC 12-12314	 #2810 L21-30R 12-12315	PDP11/70 PROCESSOR PDP 11/70 MEM. VAX-11/780 PROCESSOR	POWER CONTROLLER 861-D

CP-1968

Figure 2-2 Approved Electrical Plugs and Receptacles

2.1.4 Installation Constraints

The route from the receiving area to the installation site that the equipment will travel should be studied in advance to ensure problem-free delivery. Among the considerations are:

- Height and location of loading doors,
- Size, capacity, and availability of elevators,
- Number and size of aisles and doors en route,
- Bends or obstructions in hallways.

2.1.5 Grounding Requirements

Each cabinet of a DIGITAL computer system is equipped with ground lug terminals that should be connected to a low-impedance earth ground by No. 4 AWG (5 mm/0.20 in) copper wire or stranded No. 4 AWG welding cable. A Burndy QA4C-B solderless lug (or equivalent) is recommended for terminating the cable. DIGITAL supplies a standard grounding conductor with each I/O and memory cabinet.

A steel building beam is an adequate ground in many instances. However, some disk-oriented systems may require additional connections to earth ground, in addition to the ground leads carried through various signal buses and ground connectors contained within the power cables. The green grounding wire in the power cable must also be returned to ground, usually through the conduit of the electrical distribution system. Note that the green wire is a not a current-carrying conductor, nor a neutral conductor.

Whenever possible, the system power panel must be either mounted in contact with bare building steel by bonded joints (Figure 2-3) or connected to the steel by a short length of cable.

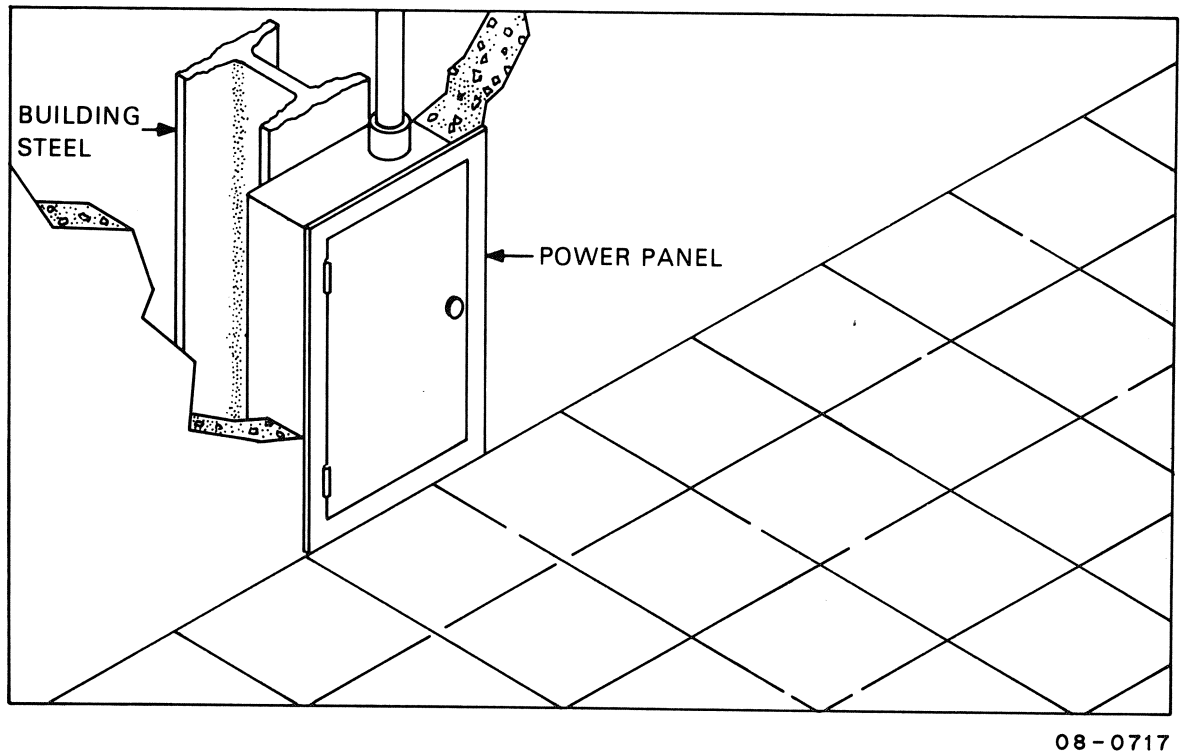


Figure 2-3 Power Panel Grounded Building Frame

Where neither scheme is possible, a metal area (comprising the power panel, the conduit, and a metal plate) of at least 1 m^2 (10 ft^2) that is in contact with masonry must be connected to the green ground wire (Figure 2-4). The connecting wire must not exceed 1.5 m (5 ft) in length and should be at least a No. 12 AWG (2mm).

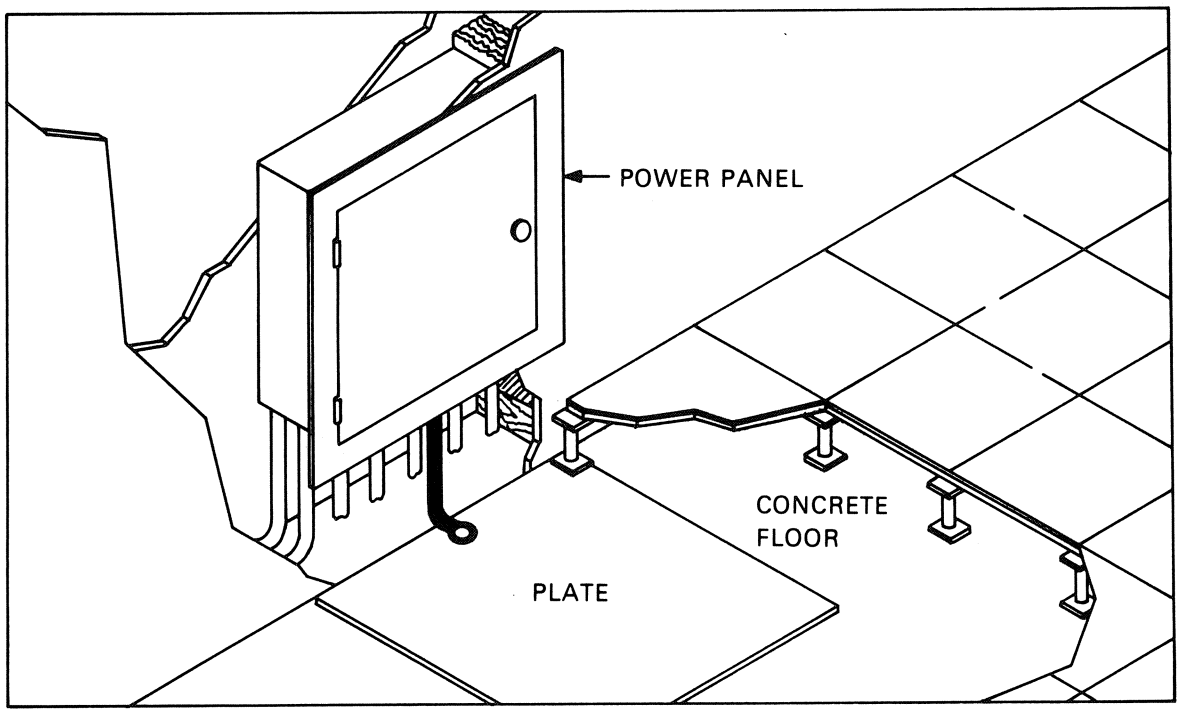


Figure 2-4 Power Panel Grounded To Metal Plate

When two cabinets are bolted together, DIGITAL bonds them electrically with a No. 4 AWG conductor (5 mm/0.20 in) or by several copper mesh straps connected between the cabinet frames.

After the grounding system is installed, it is advisable to take a voltage reading between the cabinet frame and the nearest grounded object. NBFU No. 70 (published by the National Bureau of Underwriters) provides further details regarding preferred grounding procedures.

2.2 AC CABLING

Computer equipment requires a power source with a minimum number of voltage and frequency disturbances. Line voltage disturbances greater than 1/4 cycle (measured at the receptacle during system operation) are undesirable.

DIGITAL power wiring conforms to Underwriters Laboratories, Inc., Handbook UL No. 478, National Electrical Code standards, and the type II requirements of the National Fire Protection Association (NFPA 70). This means that in the United States the wire used as equipment ground is green, or green with a yellow stripe; it carries no load current (except in emergency), but does carry leakage current. No equipment is permitted to leave DIGITAL that does not have a grounding connection to its frame.

The grounded conductor is light grey or white. It must not be used to ground equipment. Its purpose is to conduct current.

Lines 1, 2, and 3 in a typical 60 Hz power system (Figure 2-5) are represented by black, red, and blue wires, respectively, and phase rotation is in that order.

CAUTION

Where no grounded wire can be guaranteed, it must not be assumed. There are some 115 V/60 Hz systems within the United States where neither side of the line is grounded (115 V 3-phase delta).

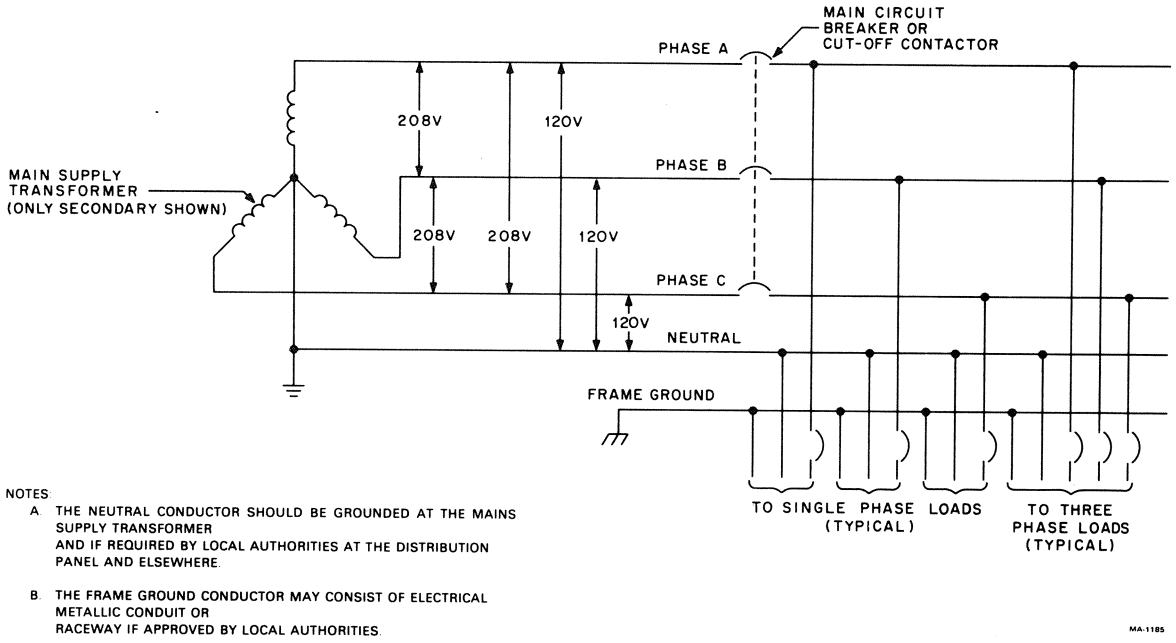


Figure 2-5 Typical 60 Hz Power System

Figure 2-6 shows a typical 50 Hz power system.

Two types of power systems can be used to provide power to the NEMA type L14-20R receptacle. The type shown in Figure 2-7 is referred to as split-phase (or 2-phase 180° displaced) 120/240 Vac. It comprises a center-tapped transformer with 120 Vac between the center tap and either of the two legs. 240 Vac exists between the two outside legs.

The second type (Figure 2-8) is referred to as 3-phase Y (120° displaced) 120/280 Vac. The 120 Vac exists between neutral and any of the three other legs (X, Y, or Z), and 208 Vac exists between any two of the outer legs (i.e., between X and Y, X and Z, or Y and Z). Although Figure 2-8 shows the X and Y connections as the two phases used for the receptacle, any two of the three phases shown can be used.

The ground terminal on the L14-ZOR receptacle will normally have a green screw, the neutral terminal will be white or silver, and the "hot" terminal will be brass covered.

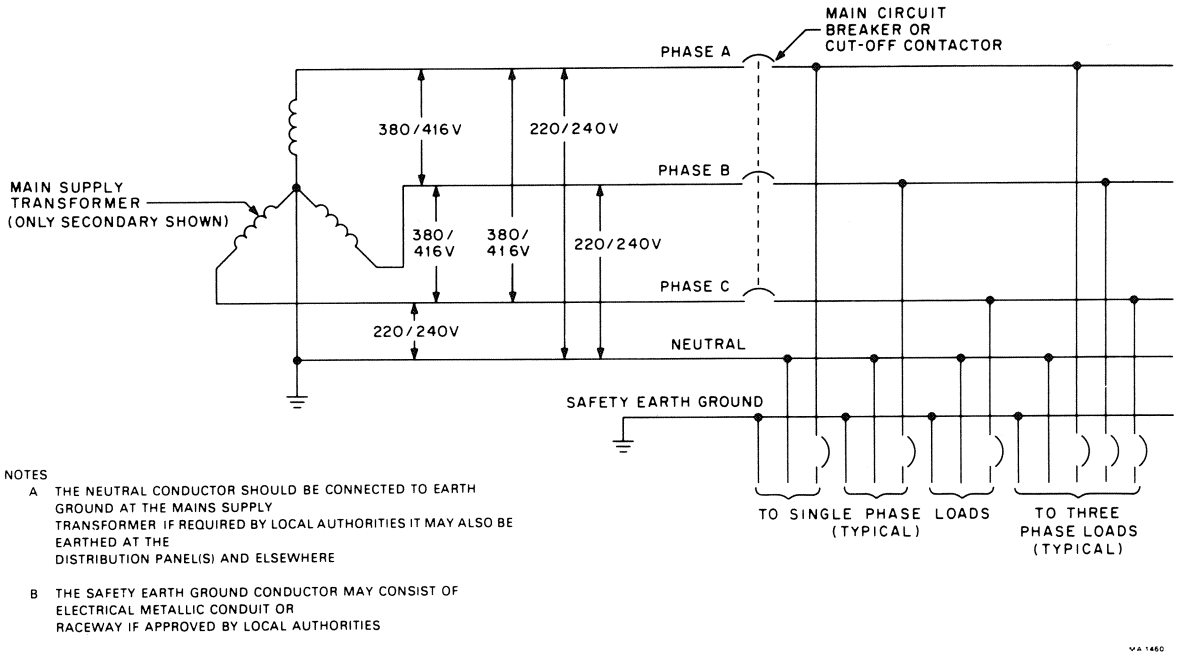


Figure 2-6 Typical 50 Hz Power System

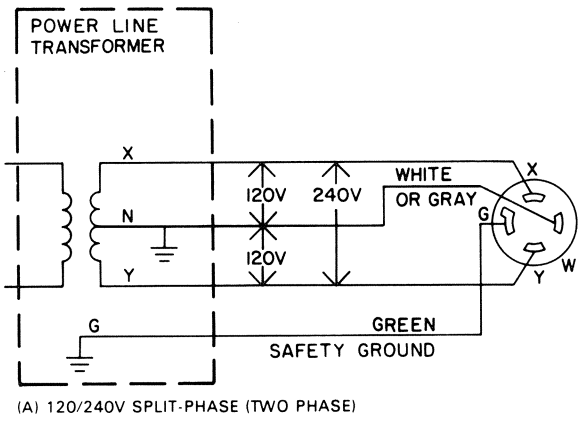


Figure 2-7 Split Phase (2-phase) Power System

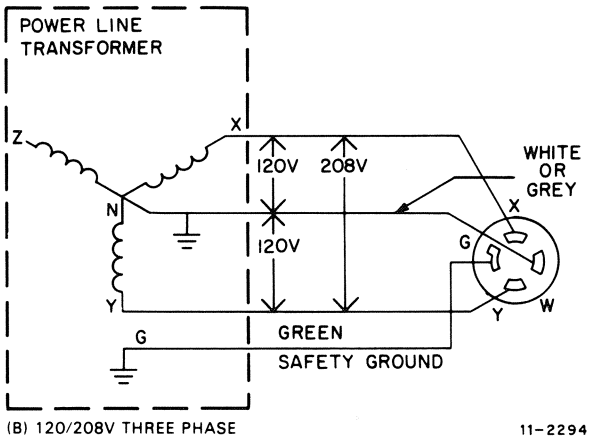


Figure 2-8 Three Phase Y Power System

2.3 INSTALLATION - GENERAL

The controller should be installed first, followed by the drive(s). Next, the diagnostics should be run to demonstrate that the subsystem is functioning properly or to diagnose any problems. Paragraph 2.4 explains the installation of the RL11 controller, Paragraph 2.5 deals with the RLV11, Paragraph 2.6 describes RLV12 installation and Paragraph 2.7 describes RL8A installation.

Paragraph 2.8 contains instructions to install the unit and Paragraph 2.9 explains acceptance testing and contains separate paragraphs for each of the three controllers. Paragraph 2.10 describes the use of the M9312 bootstrap module that may be used on RL11-based systems.

2.4 RL11 CONTROLLER INSTALLATION

The RL11 controller (M7762) is a single hex-height module that is installed in a hex-height Small Peripheral Controller (SPC) slot. Connector J1 connects the controller to the drive bus (Figure 2-9).

Of the 21 jumpers on the RL11 controller, five are used for factory test purposes. The remaining 16 are for address selection:

W1-W6	VECTOR ADDRESS (160)
W7-W16	BASE ADDRESS (774400)

NOTE

A logical one is represented by the presence of a jumper wire.

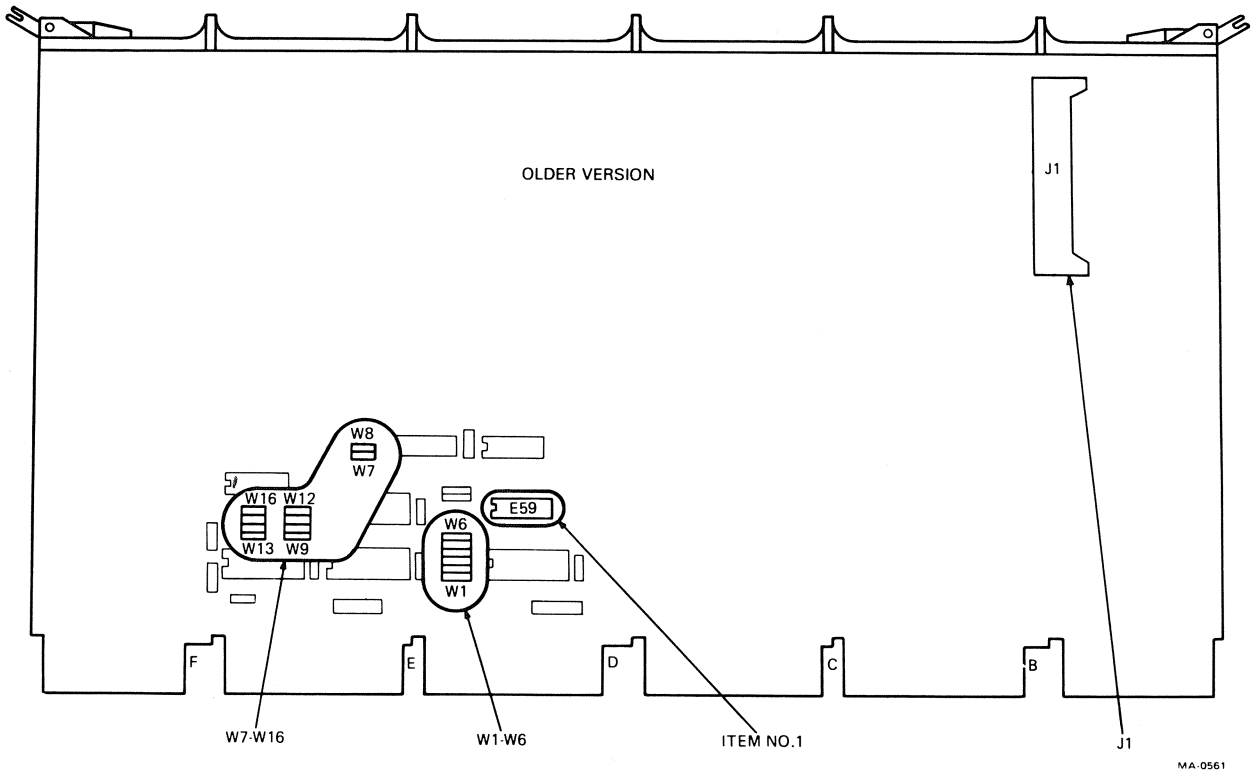


Figure 2-9 RL11 Component Layout (Sheet 1 of 2)

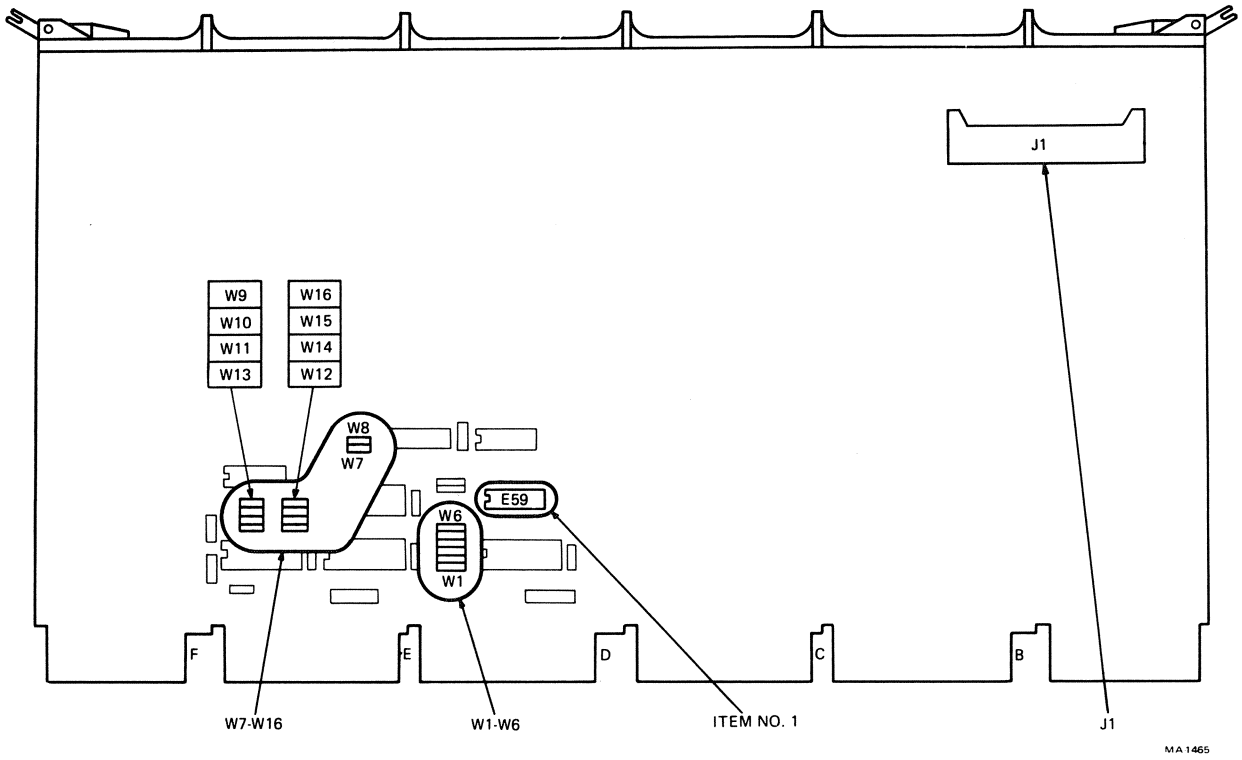


Figure 2-9 RL11 Component Layout (Sheet 2 of 2)

The UNIBUS priority plug sets the priority for bus requests. For the RL11 subsystem, bus requests are at priority level 5 (BR5/BG5). (See Figures 2-10 and 2-11.)

To install the controller:

1. Remove the M7762 module from its shipping container and examine it for any physical damage.

2. If a priority level other than 5 is required, obtain an appropriate priority jumper assembly or set up the priority jumper assembly (Item 1, Figure 2-9) using Figure 2-11 as a guide. The vector and base address jumpers W1-W16 are for 160 and 774400, respectively. If the subsystem configuration requires other than standard addresses, set the jumpers up as shown in Figure 2-10. Physical location of these jumpers is shown on Figure 2-9.

3. Install the ribbon cable (BC06R-XX) with the red indicator stripe to the right and the smooth side facing the viewer when viewing the component side of the controller as shown in Figure 2-12. Dress the cable as necessary.

4. Insert the controller into its appropriate slot in the SPC backplane as shown in Figure 2-12 after ensuring that the slot does not contain a grant continuity module in row D. Do not chafe the ribbon cable. Route the cable up and out to the rear of the cabinet, allowing for cable strain relief.

NOTE
Adjustments on the RL11 are preset at the factory and are not to be changed in the field.

VECTOR ADDRESS SCHEME

	0			0			0				1			6			0	
2^{17}	2^{16}	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0
X	X	X	X	X	X	X	X	X	X	W_1	W_3	W_4	W_5	W_6	W_2	X	X

FOR VECTOR ADDRESS 160 - W_3, W_4, W_5 JUMPERS IN
W_1, W_2, W_6 JUMPERS OUT

BASE ADDRESS SCHEME

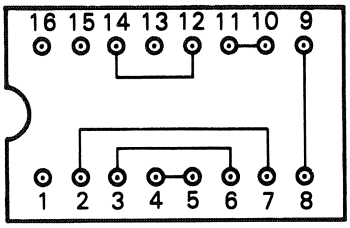
	7			7			4			4			0			0		
2^{18}	2^{17}	2^{16}	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
1	1	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0
X	X	X	X	X	X	W_{12}	W_{16}	W_{15}	W_{14}	W_7	W_8	W_9	W_{11}	W_{10}	W_{13}	X	X	X

FOR BASE ADDRESS 774400 – W_{12}, W_{16}, W_7 JUMPERS IN
W_1, W_9, W_{10}, W_{11}, W_{13}, W_{14}, W_{15}, JUMPERS OUT

NOTE:
X'S DENOTE DON'T CARE (NOT SELECTABLE)
1'S DENOTE JUMPER IN
0'S DENOTE JUMPER OUT

CZ-2004

Figure 2-10 RL11 Base and Vector Address Jumper Configuration

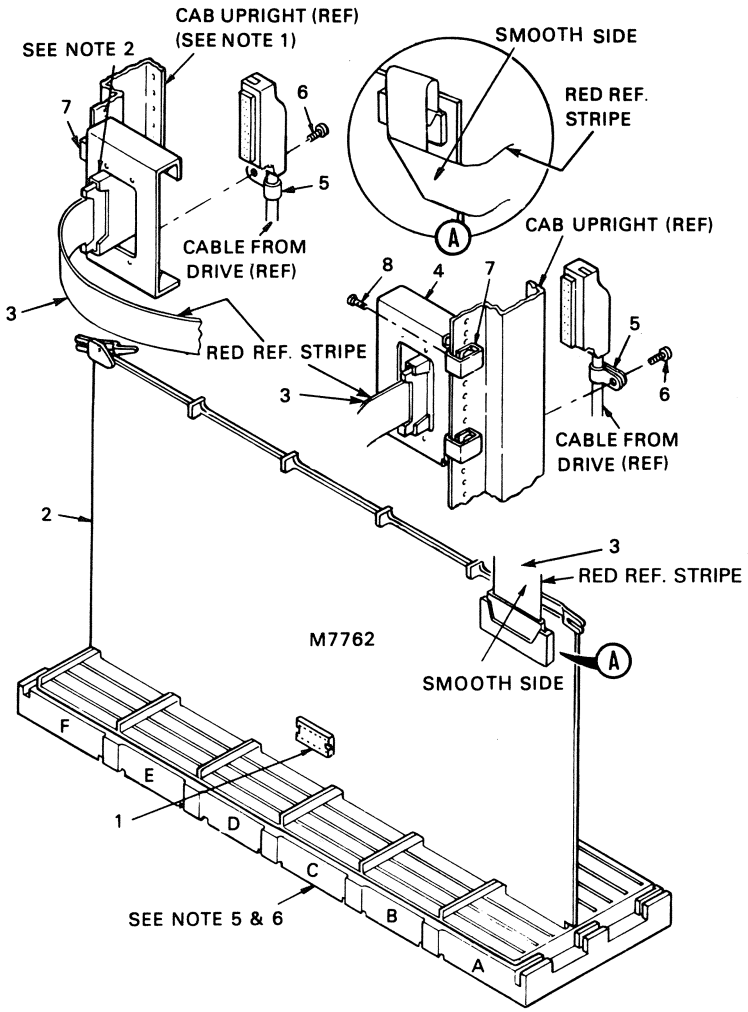


PRIORITY JUMPER PLUG FOR
BUS REQUEST LEVEL FIVE (5)

PLUG PIN NUMBER	SIGNAL NAME	UNIBUS PIN
1		
2	BG IN	
3	BG OUT	
4	UB BG 4	DT2
5	UB BG 4 IN	DS2
6	UB BG 5	DR2
7	UB BG 5 IN	DP2
8	UB BG 6	DN2
9	UB BG 6 IN	DM2
10	UB BG 7	DL2
11	UB BG 7 IN	DK2
12	BR	
13	UB BR 4	DD2
14	UB BR 5	DE2
15	UB BR 6	DF2
16	UB BR 7	DH2

MA-0560

Figure 2-11 RL11 Priority Jumper Assembly Connections



NOTES:

1. WHEN INSTALLED IN BA11K OR BA11L EXPANSION BOX, BC06R CABLE (ITEM #3) SHOULD BE FOLDED 90° AND ROUTED UP OUT OF THE BOX AS SHOWN.
2. WHEN ALTERNATE MOUNTING POSITION IS USED CONNECTOR IN TRANSITION BRACKET MUST BE INVERTED SO THAT I/O CABLE FROM DRIVE WILL HANG IN A DOWNWARD POSITION AS SHOWN.
3. ITEM #3 THRU ITEM #8 ARE NOT ASSEMBLED AT THIS POINT BUT ARE SHIPPED WITH UNIT FOR ASSEMBLY AT INSTALLATION TIME.
4. PRIORITY JUMPER ASSY (ITEM #1) TO BE PLUGGED INTO M7762 AT FINAL ASSY.
5. THE RL11 MODULE (M7762) WILL OCCUPY ONE HEX SPC SLOT.
6. JUMPER WIRE FROM CA1 TO CB1 ON THE SPC BACKPLANE MUST BE REMOVED AT INSTALLATION.

DESCRIPTION	DWG PART NO.	ITEM NO.
2 SCREW, PHL TRS HD. #10-32 X .50 LG	9006073-03	8
2 NUT, SPRING #10-32	9007786-00	7
1 SCREW, TAP-TLTE, #8 X .38 LG	9006418-01	6
1 CLAMP, CABLE	9007083-00	5
1 TRANSITION BRACKET ASSY	C-AD-7012415-0-0	4
1 CABLE ASSY	D-UA-BC06R-06	3
1 RL11 CONTROLLER	D-UA-M7762-0-0	2
1 PRIORITY JUMPER ASSY	5408778	1

CZ-2005

Figure 2-12 RL11 Controller Installation

NOTE
See Appendix A for configuration rules and SPC slot selection considerations.

5. Remove the jumper between CA1 and CB1 (NPR Grant) on the backplane if the jumper exists.

6. Install the transition bracket at the rear of the cabinet shown in Figure 2-12. Assemble and install transition connector.

7. Connect the other end of the ribbon cable (BC06R-XX) with the red indicator stripe on the top. Use Figure 2-12 as a guide.

8. Apply system power and, using a suitable measuring device (i.e., digital voltmeter or equivalent), verify that the voltages are within the ranges specified below.

Voltage	Range	Test Point	
Ground		AC2	
+5 Vdc	+4.75 to +5.25 Vdc	AA2	Backplane
+15 Vdc	+14.25 to +15.75 Vdc	CU1	Location
−15 Vdc	−15.75 to −14.25 Vdc	CB2	

Measure all voltages between the ground test point and the appropriate voltage test point. If any adjustments to the power supply are necessary, refer to the appropriate power supply manual.

2.5 RLV11 CONTROLLER INSTALLATION

An RLV11 controller is comprised of a bus interface module (M8014) and the drive bus module (M8013). Each module has switches, jumpers, trimpots, and connectors that are explained in the following paragraphs.

2.5.1 Bus Interface Module

The bus interface module (M8014) contains the logic circuits that perform the following major functions:

- LSI-11 bus interface functions,
- Programmable registers,
- Silo data storage and control circuits.

An illustration of the component side of M8014 is shown in Figure 2-13. The location of the bus address switches, the vector address switches, and the connector finger assignments are shown in this figure.

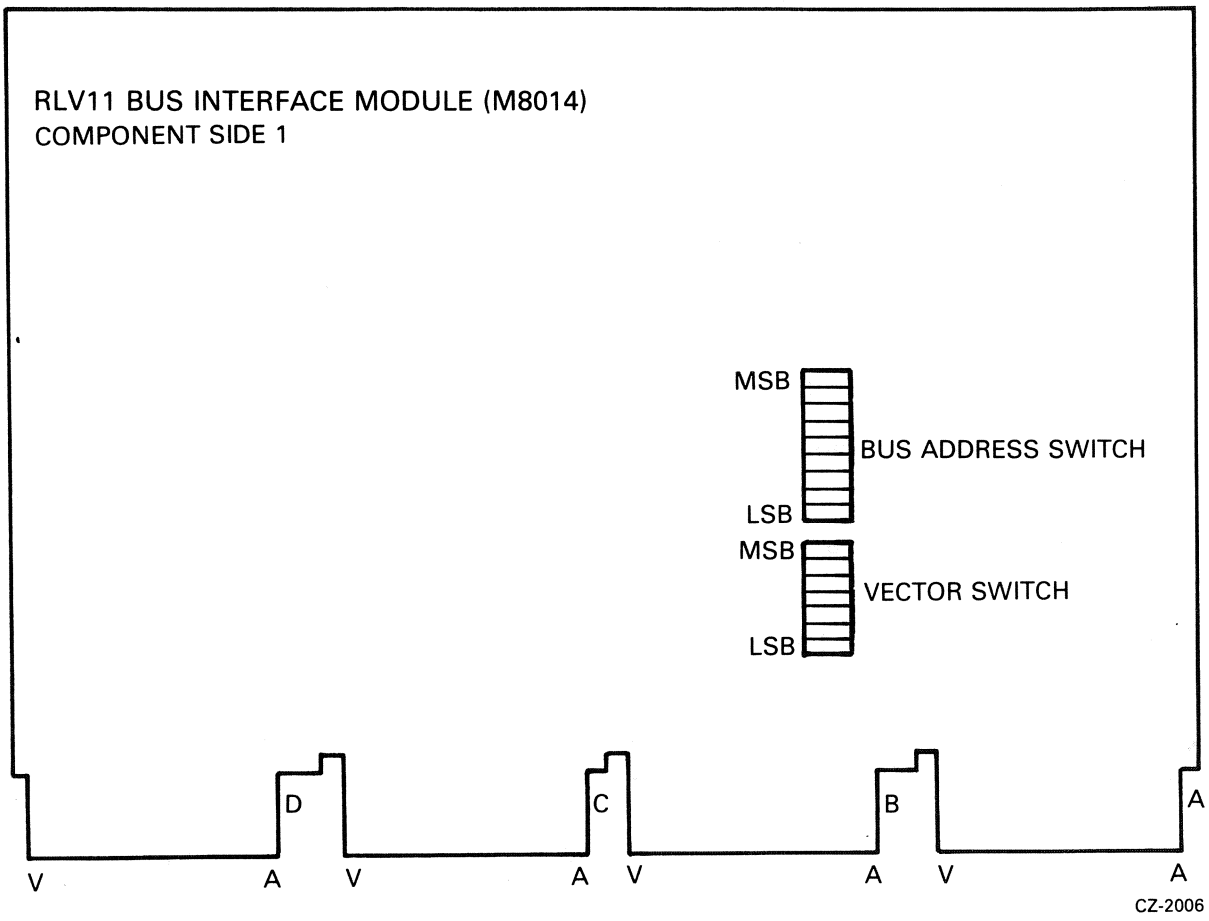


Figure 2-13 RLV11 Bus Interface Module (M8014) (Component Side)

The bus address switch is used to set up the device base address. It is normally factory preset to 7440. This means the device CS register has an address of 174400 and the MP register has an address of 174406. The switches have the ON and OFF positions labeled. The ON position is the logical 1 or true state (Figure 2-14).

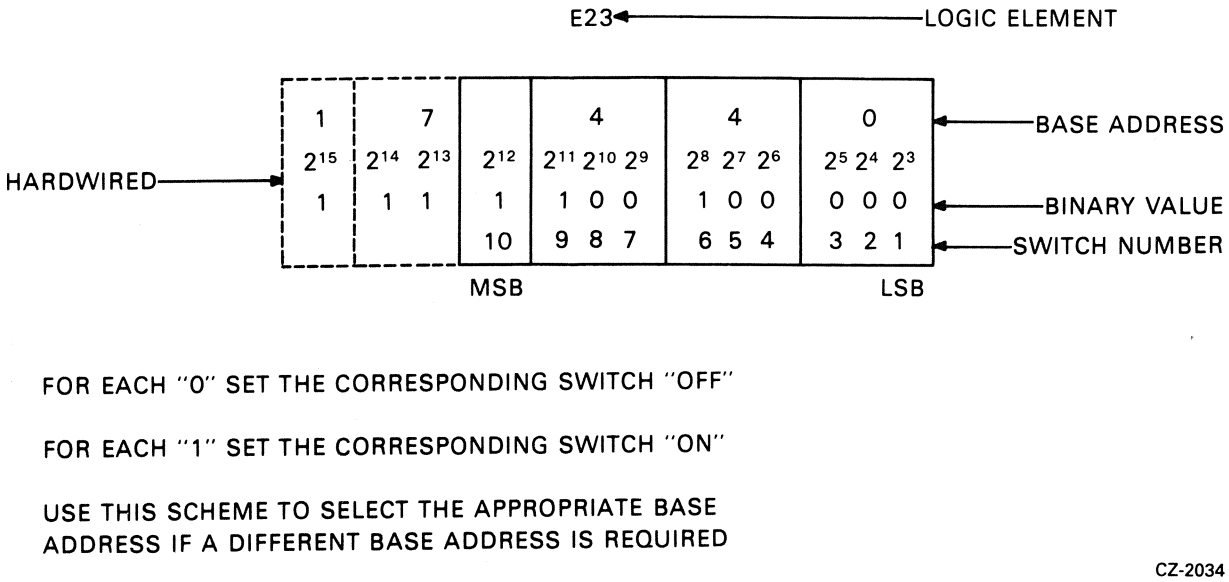


Figure 2-14 RLV11 Base Address Switch Settings

The vector address switch is used to select the address of the vector for this device when it interrupts. It is factory preset for an address of 160 (Figure 2-15).

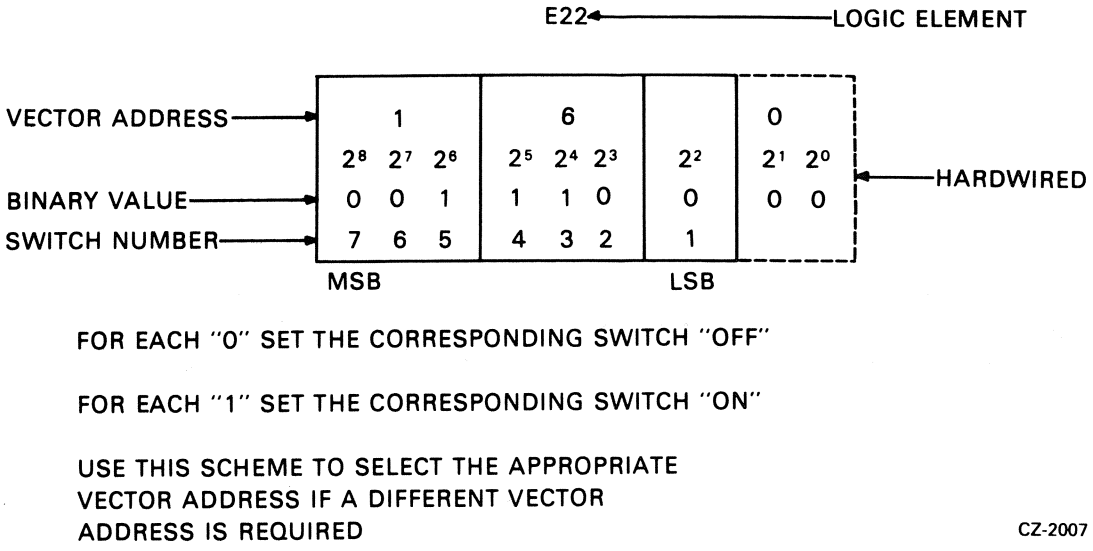


Figure 2-15 RLV11 Vector Address Switch Settings

2.5.2 Drive Module

The drive module (M8013) contains the circuitry that performs the following major functions:

- Data formatting and error-detecting circuits,
- Control microsequencer and timing circuits,
- Drive bus interface.

An illustration of the component side of M8013 is shown in Figure 2-16.

NOTE
Adjustments to the RLV11 are preset at the factory and are not to be adjusted in the field.

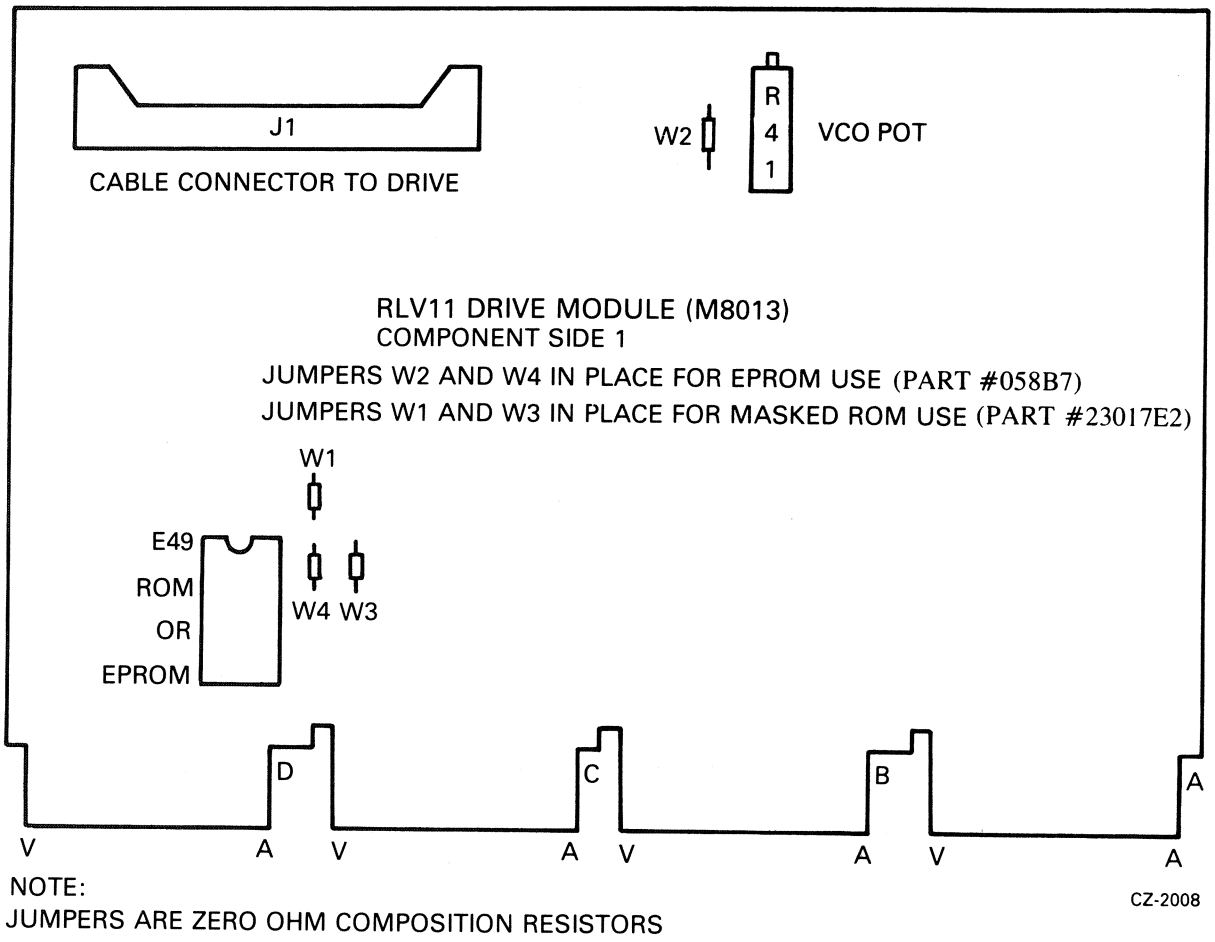


Figure 2-16 RLV11 Drive Module (M8013)

2.5.3 Module Slot Location

Modules M8013 and M8014 must be inserted into the H9273 backplane (Figure 2-17) such that the M8013 module is in the slot closest to the processor. Outside of this one restriction, the two modules can be inserted in any two unused slots. The controller priority level is based solely on its electrical distance from the microprocessor module in slot 1.

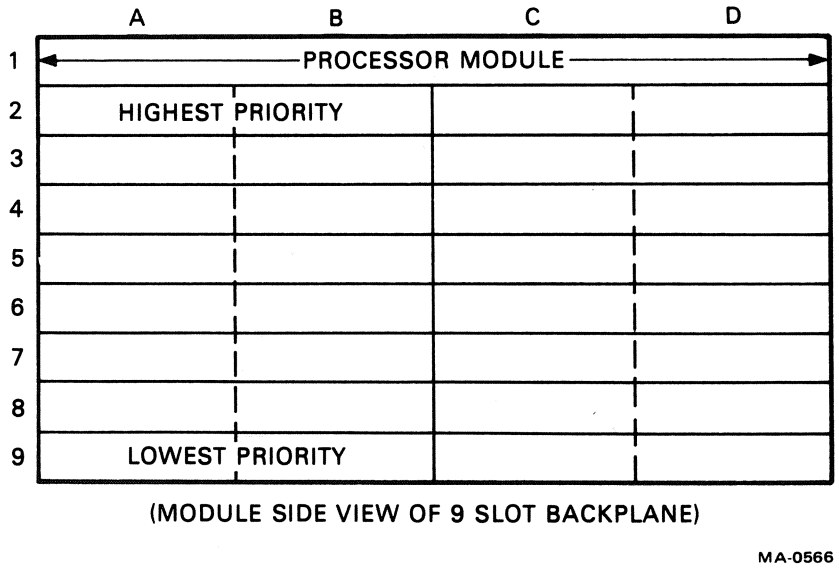


Figure 2-17 H9273 Backplane Grant Priority Structure

2.5.4 Module Installation

1. Using the normal configuration rules, select two adjacent slots in the backplane for the two controller modules.

2. Insert the ribbon cable (BC06R-XX) into J1 on the M8013 with the red stripe edge toward the top (Row A) of the module.

3. Insert the M8013 module into the selected slot that is closest to the processor.

4. Examine the M8014 to insure that the base address switches and the vector address switches are set correctly. Check jumpers W1 thru W4 for correctness. See Figures 2-14, 2-15, and 2-16.

5. Insert the M8014 module next to the M8013.

6. Install the transition bracket at the rear of the cabinet as shown in Figure 2-12. Assemble and install the transition connector.

7. Connect the other end of the ribbon cable with the red stripe up.

8. Apply system power and, using a suitable measuring device (i.e., digital voltmeter or equivalent), verify that the voltages are within the ranges specified below.

Voltage	Range	Test Point
Ground	AC2	
+5 Vdc	+4.75 Vdc to +5.25 Vdc	AA2
+12 Vdc	+11.5 Vdc to +12.5 Vdc	AD2
−5 Vdc	−5.25 Vdc to −4.75 Vdc	AL1 (M8013 only)

NOTE

The -5 Vdc is generated on the M8013 module. It is not adjustable but must be within specifications for proper operation. Module replacement is the only corrective procedure.

Measure all voltages between the ground test point and the appropriate voltage test point. If any adjustments to the power supply are necessary, refer to the appropriate power supply manual.

2.6 RLV12 CONTROLLER INSTALLATION

2.6.1 Introduction

The following paragraphs provide the user or installer with information to correctly configure and install the RLV12 in a 16-, 18-, or 22-bit LSI-11 bus. The user can change the device address, interrupt vector, and memory parity error abort feature.

2.6.2 Device Address Selection

Software control of the RLV12 is by means of four or five device registers – CSR, BAR, DAR, MPR, and BAE. Four registers are used for 16- or 18-bit addressing; five registers are used for 22-bit addressing. The bus address extension (BAE) register is added for upper address bit selection for 22-bit addressing. The usual device starting address is as follows.

Addressing Mode	Starting Address
16-bit	174400
18-bit	774400
22-bit	17774400

The first register, the CSR, is assigned the starting address and the other registers are assigned the next sequential addresses as shown in Table 2-3.

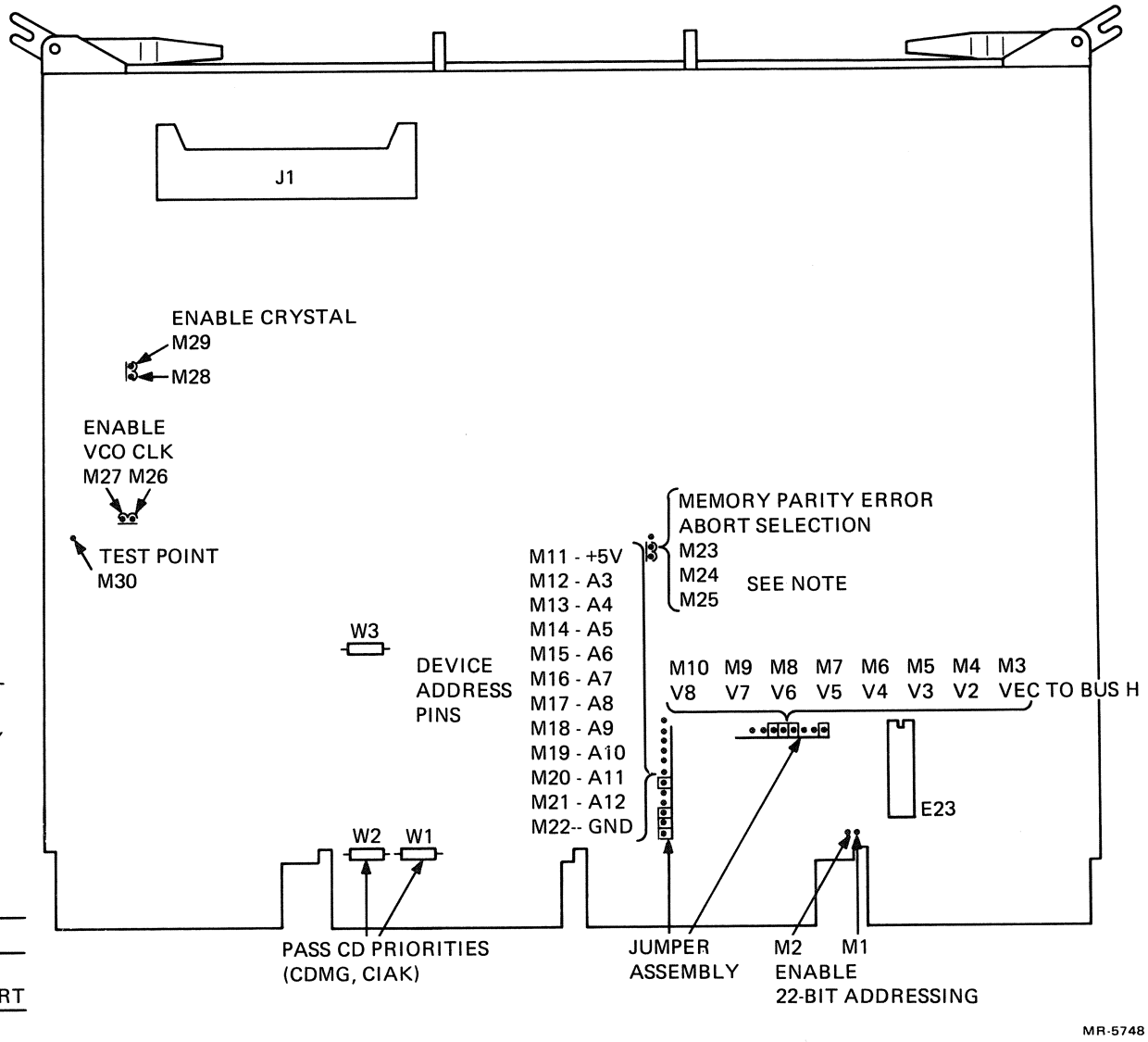
Table 2-3 Address Selection

	16-bit Addressing	**18-bit Addressing**	**22-bit Addressing**
Device Address			
Starting Address Range:	160000–177770	760000–777770	17760000–17777760
Starting Address:	174400	774400	17774400
No. of Registers:	4	4	8 (5 are used; 3 are not)
Registers Used:	CSR (174400) BAR (174402) DAR (174404) MPR (174406)	CSR (774400) BAR (774402) DAR (774404) MPR (774406)	CSR (17774400) BAR (17774402) DAR (17774404) MPR (17774406) BAE (17774410)
Jumpers Used:	Tie M22 ("**1**") to: M17, M20, and M21	Tie M22 ("**1**") to: M17, M20, and M21	Tie M22 ("**1**") to: M17, M20, and M21; Tie M11 ("**X**") to: M12
Interrupt Vector			
Vector Range:	0–774	0–774	0–774
Standard Vector:	160	160	160
Jumpers Used:	Tie M3 ("**1**") to: M6, M7, and M8	Tie M3 ("**1**") to: M6, M7, and M8	Tie M3 ("**1**") to: M6, M7, and M8

The device starting address is selected by jumpers for bits 3 through 12. These jumpers are shown in Figure 2-18. A jumper from the selected bit to ground (M22) decodes a **1**; no jumper decodes a **0**; and a jumper to +5 V (M11) decodes an **X (don't care)** condition. Figure 2-19 shows the RLV12 device starting address format.

NOTE

For 22-bit addressing, bit A3 is not decoded in the starting address.



NOTE:
THE MEMORY PARITY ERROR ABORT FEATURE IS AVAILABLE FOR USE WITH MEMORIES THAT HAVE PARITY ERROR CHECKING.
THIS FEATURE DOES NOT HAVE TO BE DISABLED FOR MEMORIES THAT DO NOT HAVE PARITY ERROR CHECKING. THE PINS ARE CONNECTED AS FOLLOWS:

CONNECTION	FUNCTION
M23 - M24	NO PARITY
M24 - M25	PARITY ERROR ABORT

Figure 2-18 RLV12 Jumper Locations

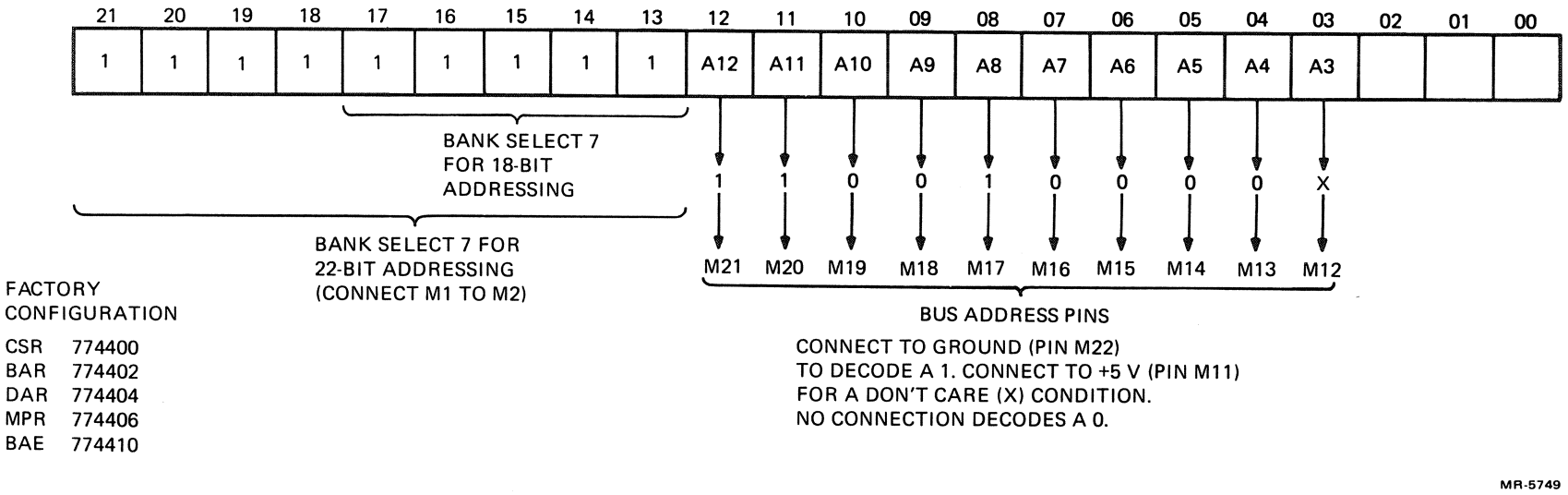


Figure 2-19 RLV12 Device Address Format

2.6.3 Bus Selection

The RLV12 module can be used on 16-, 18-, or 22-bit LSI-11 buses. When sent from the factory, the module operates on 16- or 18-bit buses. To enable the module to operate on a 22-bit extended LSI-11 bus, install jumper M1 to M2, shown in Figure 2-18. When installed, the jumper enables bank select 7 (BBS7) to be determined by the upper address bits (13–21). When the jumper is removed, the RLV12 has an 18-bit mode bank select 7 and can replace an existing RLV11 or RLV21 as the disk controller for RL01 and RL02 disk drives.

2.6.4 Interrupt Vector

The interrupt vector has a range of 0 to 774. The interrupt vector is preset at the factory to 160. The user may select another vector by changing the jumpers for bits V2–V8, as shown in Figure 2-20. A connection to VEC TO BUS H (M3, shown in Figure 2-18) generates a **1** for that bit; no connection generates a **0**.

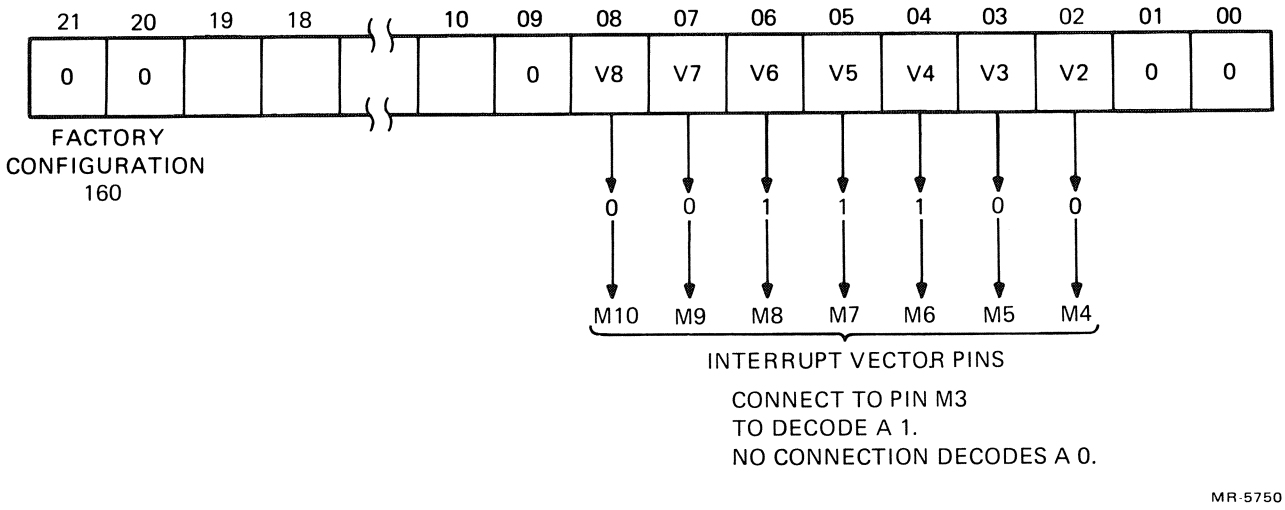


Figure 2-20 RLV12 Format Interrupt Vector

2.6.5 Interrupt Request Level

The RLV12 interrupts at priority level 4 determined by the interrupt chip E23, a DC003.

2.6.6 Memory Parity Error Abort Feature

When reading the system's optional memory with parity error detection, a parity error will set OPI and NXM of the CSR. This is a unique error condition that aborts the current command to the RLV12. This error abort feature is possible only with memories that have parity data bits.

The RLV12 is sent from the factory with the memory parity error abort feature enabled. To disable parity error abort, remove the jumper between pins M24 and M25 and install a jumper between pins M23 and M24 (see Figure 2-18). This feature does not have to be disabled for non-parity memories, as parity errors are not generated. Parity error abort uses data bits 16 and 17.

2.6.7 Other Jumpers

The module has two jumpers, W1 and W2, that enable priority signals to pass on the CD side of the module. The module has these jumpers installed and they should be left in when this controller is installed on the normal LSI-11 bus. If the RLV12 is installed in a C-D interconnect backplane with another module already in place, then these jumpers are removed. If the other module does not use the C-D interconnect scheme, then the status of jumpers W1 and W2 is not important.

Jumper	Signal
W1	CIAKI to CIAKO
W2	CDMGI to CDMGO

One jumper, W3, enables the word count register to automatically increment during a DMA operation. This jumper is used for factory testing and should be left in.

Two jumpers on the module disable the crystal oscillator and the voltage-controlled oscillator during factory testing. These jumpers should be left in.

Jumper	Oscillator
M26-M27	VCO
M28-M29	Crystal

2.6.8 Installation

The RLV12 can be installed in any quad LSI-11 bus slot. The controller's priority level is based on its electrical distance from the processor module. Use the following procedure to install the module.

1. Examine the module to make sure that the base address jumpers and vector address jumpers are set correctly. (See Paragraphs 2.6.2 and 2.6.4.)

2. Check jumpers M1 and M2 for enabling the correct bank select 7 (BBS7) for the 18- or 22-bit LSI-11 bus.

3. If desired, disable the memory parity error abort feature. This feature can only be used with system memories that have parity options, but this feature does not have to be disabled for non-parity memories. (See Paragraph 2.6.6.)

4. Insert the BC80M controller cable into J1 on the M8061.

5. Insert the M8061 in the selected slot in the LSI-11 bus.

6. Connect the other end of the BC80M cable to the drive.

7. Continue with the disk installation. (Refer to Paragraph 2.8.)

2.6.9 Acceptance Testing

The RLV12 controller is tested by running the RLV12 diskless diagnostic test and, if a drive is attached, by running the diagnostics that exercise the RL01 and RL02 disk drive. The diskless diagnostic should be run first. The RLV12 diagnostics are available on different media. Contact your local DIGITAL sales office for the types of media available and their part numbers.

Run the XXDP+ diagnostics in the following order.

1. CVRLB RLV12 Diskless Diagnostic (16-, 18-, or 22-bit mode)

NOTE

When the RLV12 is configured for 16- or 18-bit addressing, the RLV11 diskless diagnostic (CVRLA) is compatible with the RLV12 diskless diagnostic and checks the same logic.

2. CZRLG Controller Test Part 1
3. CZRLH Controller Test Part 2
4. CXRLI Drive Test Part 1
5. CZRLJ Drive Test Part 2
6. CZRLN Drive Test Part 3
7. CZRLK Performance Exerciser
8. CZRLL Compatibility Test
9. CZRLM Bad Sector File Utility

NOTE

The Bad Sector File Utility is not a diagnostic test. It is used by Field Service personnel to examine the bad sector file on the disk and to write entries into that file.

2.7 RL8A CONTROLLER INSTALLATION

2.7.1 Introduction

The RL8A OMNIBUS controller module (M8433) contains the following logic functions:

- Interface logic,
- Programmable registers,
- Silo data storage and control,
- Data formatting and error detection,
- Control microsequencer and timing logic,
- Drive bus interface logic.

NOTE

Adjustments on the RL8A are preset at the factory and are not to be changed in the field.

2.7.2 Module Slot Location

The module can be inserted into any unused OMNIBUS hex-height slot between the CPU and the first memory element. The controller is connected to the first drive via a BC80J-20 interface cable. Connections between drives are made using a BC20J-XX (70-12122-10) cable.

2.7.3 Module Installation

1. Remove the M8433 module (see Figure 2-21) and interface cable (BC80J-20) from the shipping container and inspect them for physical damage.

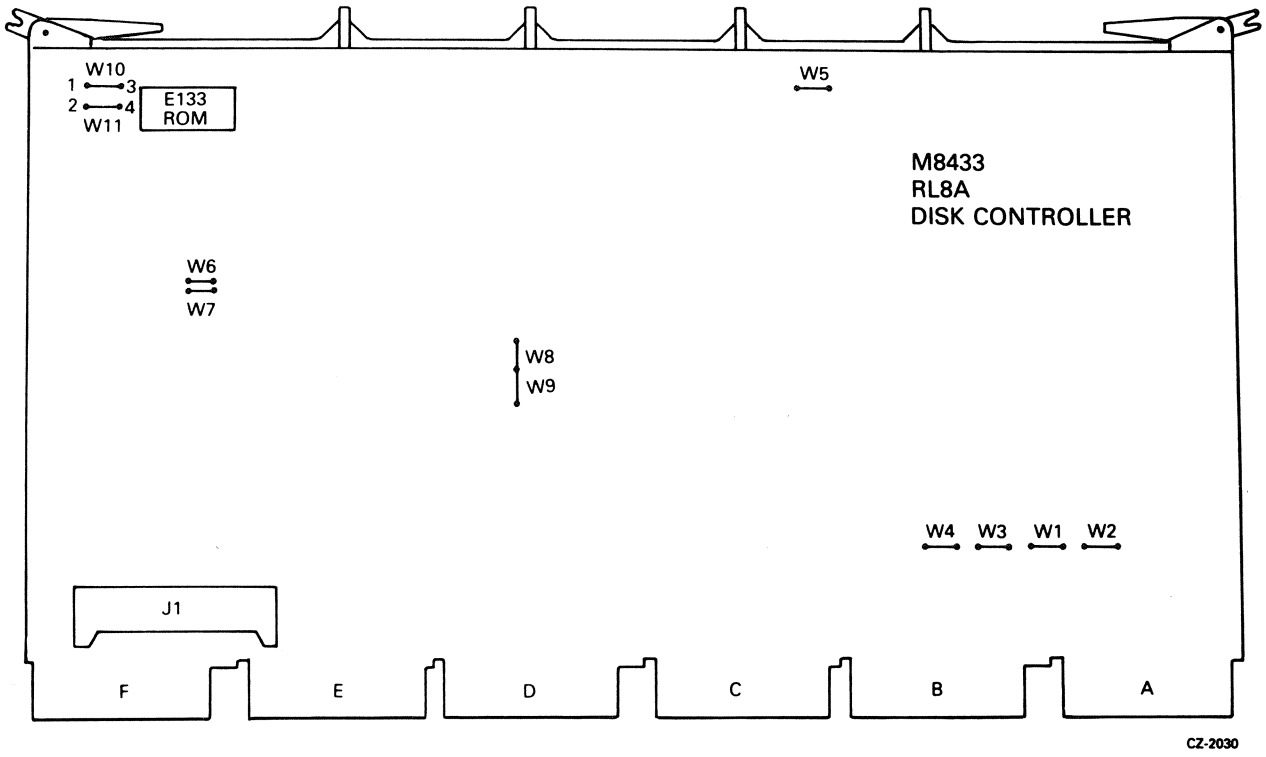


Figure 2-21 RL8A Jumpers

2. Verify the proper jumper configuration for device codes and priority (Figure 2-21).

Device Code	W1	W2
60,61	IN	OUT
62,63	IN	IN

Break Priority	W3	W4	W5
0	IN	OUT	IN
1	OUT	IN	OUT

NOTE

The RL8A is shipped from the factory with a priority of 0.

Device Type	W8	W9
RL01	OUT	IN
RL02	IN	OUT

ROM Type (E133)	W10	W11	W6	W7
012E2	OUT	IN	IN	OUT
8708 or 2708	IN	OUT	OUT	IN

3. Position the BC80J-20 interface-to-drive cable in the PDP-8 chassis and connect the Berg connector to the M8344 module.

4. Install the M8344 module into selected slot in the OMNIBUS backplane.

5. Route the cable out to where the first drive will be installed.

2.8 RL01/RL02 DISK DRIVE INSTALLATION

2.8.1 Unpacking and Inspection

1. When delivered, each drive and its associated cabinetry is enclosed by a heavy cardboard carton. If the drive is shipped with a system and mounted in a cabinet, then the carton is attached to a shipping skid (Figure 2-22). Remove the plastic straps that secure the shipping carton to the skid.

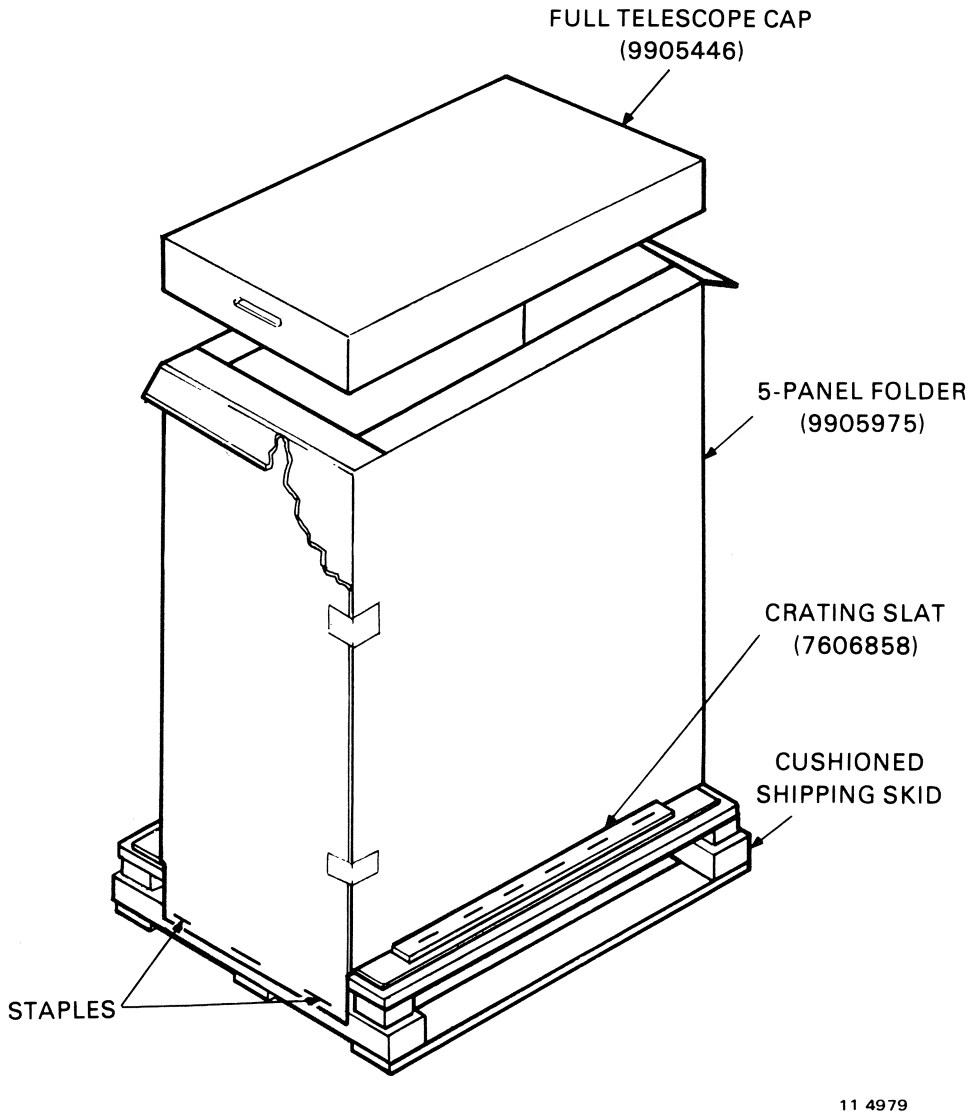


Figure 2-22 H950 Shipping Package

2. Remove the lid from the top of the carton.

3. Remove the staples that fasten the wooden crating slats and carton flanges to the skid.

4. Remove the shipping carton.

5. Inspect the cabinet and drive for signs of damage. Retain all packing material and receipts in the event that any claims for shipping damage must be filed. All claims should be filed promptly with the transportation company.

2.8.2 RL01/RL02 Disk Drive Unit Mounting

NOTE

If the RL01/RL02 is to be mounted in an H950 cabinet, the shipping brackets must be retained and refitted after installation. This is the only way to prevent the drive from sliding while repositioning or moving the H950 cabinet.

The drive may be shipped in a rack or cabinet as an integral part of a system or may be shipped in a separate container for addition to an existing system.

If the drive is to be installed in an existing rack or cabinet, install the chassis slides first as described in Steps 1 through 6 below (Figure 2-23). The procedure for installing the drive itself begins with Step 7.

1. Install cabinet stabilizers before mounting the drive.

2. Remove the slides from the carton. (Retain the hardware for reassembly.)

3. Install slides into the rack or cabinet using enclosed hardware. Be sure the slides are at the correct height to permit installation of pop panels (dress panels) upon completion of installation. Also verify that the slides do not bind on any hardware used to mount the slide.

4. Extend slides to lock position.

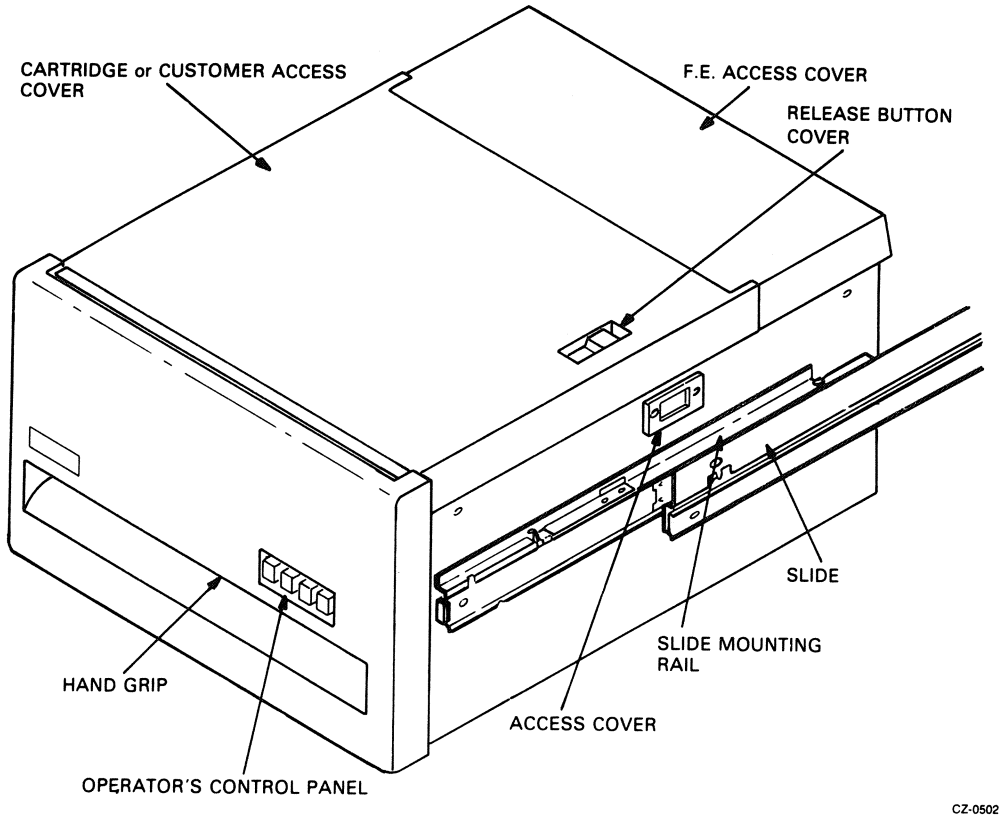


Figure 2-23a RL01/RL02 Cabinet Installation

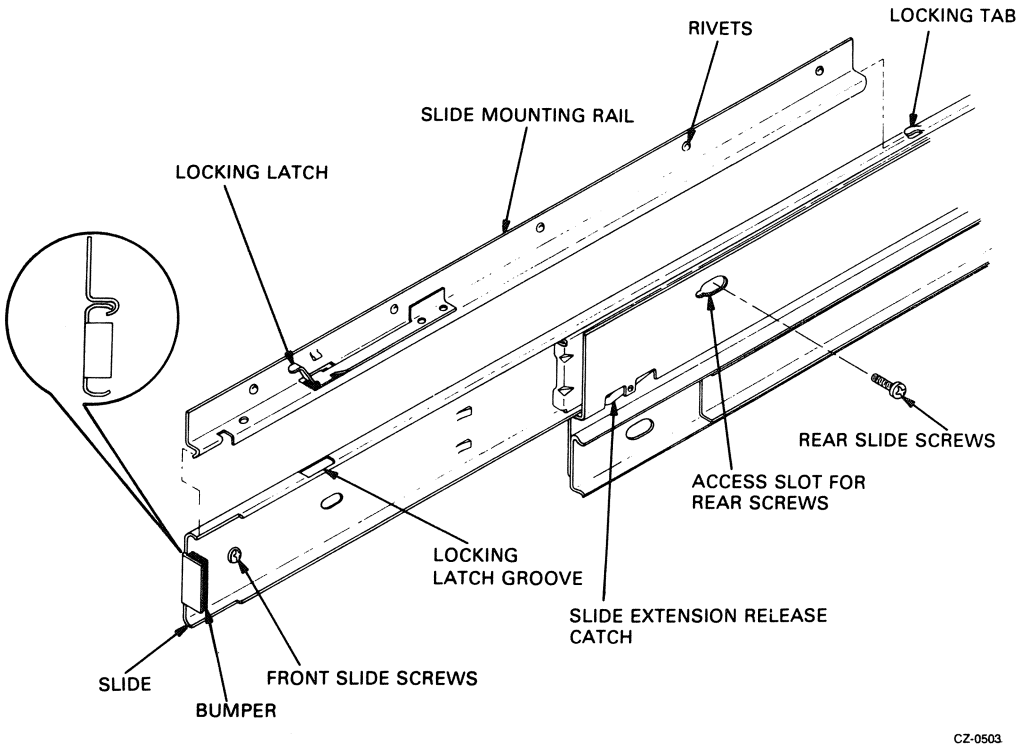


Figure 2-23b RL01/RL02 Cabinet Installation

5. Place drive onto chassis slides and reinstall mounting hardware.

   a. Figure 2-23 shows the relationship between the drive, slide mounting rails, and slides. Note first the position of the slide mounting rails. These rails are currently riveted to the sides of the drive.

   b. The cabinet slides fit under the edge of the mounting rails. The forward edge of the mounting rails are curved to grip the curled edge of the slides (see Figure 2-23a, 2-23b, and detailed view A).

   c. At the rear of each slide is a locking tab that grips the top rear edge of the rail (Figure 2-23b).

   d. The drive should be carefully placed on top of the slides hooking the front and rear of each slide as previously described.

   e. When properly placed, the locking latch (Figure 2-23b) on each mounting rail drops into a groove on each slide. This holds the drive securely so that the screws may be inserted to bolt the front of each slide to the drive (Figure 2-23b).

   f. After bolting the front of each slide, adjust the length of the slide (using the slide extension release catch) so that the rear slide screw may be inserted (Figure 2-23b).

6. Ensure that the disk drive moves easily on the slides, that there is no binding in the cabinet, and that the proper height has been maintained for dress panels.

7. Open the drive access cover by loosening the four captive fasteners holding the module access cover. When the screws are sufficiently loosened to raise the cover, the drive access cover may then be lifted off the drive. The module access cover may be rested on the rear lip of the drive (Figure 2-24).

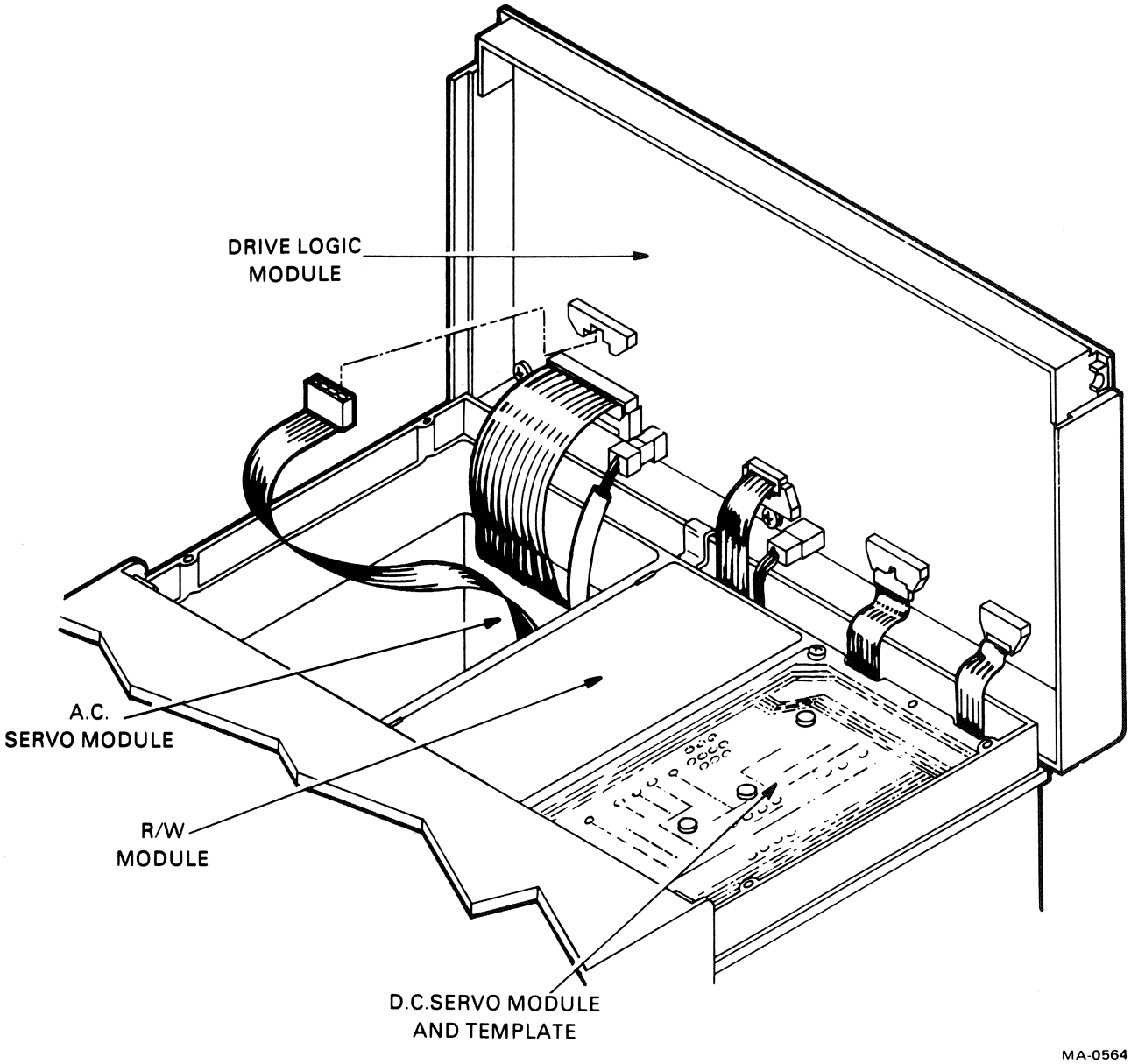


Figure 2-24 RL01/RL02 Disk Drive – Exposed Drive Logic Module

8. Loosen the head restraining bracket screw located on the positioner. Turn the bracket 90 degrees and retighten the screw (Figure 2-25).

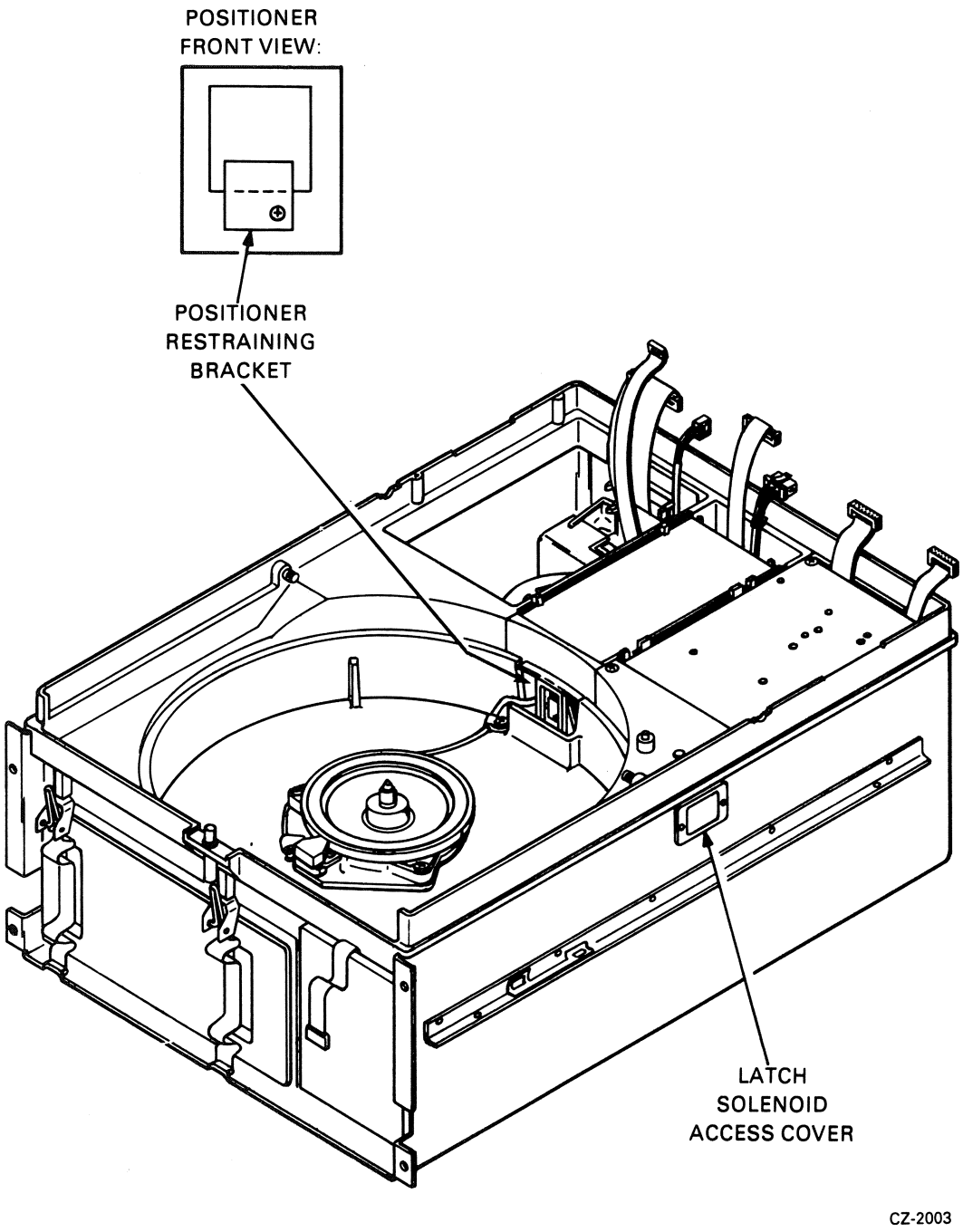


Figure 2-25 RL01/RL02 – Covers Removed

9. On newer drives there are two shipping screws on the bottom of the unit that secure the spindle/blower motor. Remove the screws.

10. If the drive is being installed in a dual-drive cabinet that has an interlock system to prevent more than one drive being extended at a time, ensure that the interlock is connected.

11. Inspect the terminal block covers at the rear of the drive. Ensure that they are configured properly for the input power available (Figure 2-26).

CAUTION
Connection to the wrong power source will result in serious damage to the disk drive.

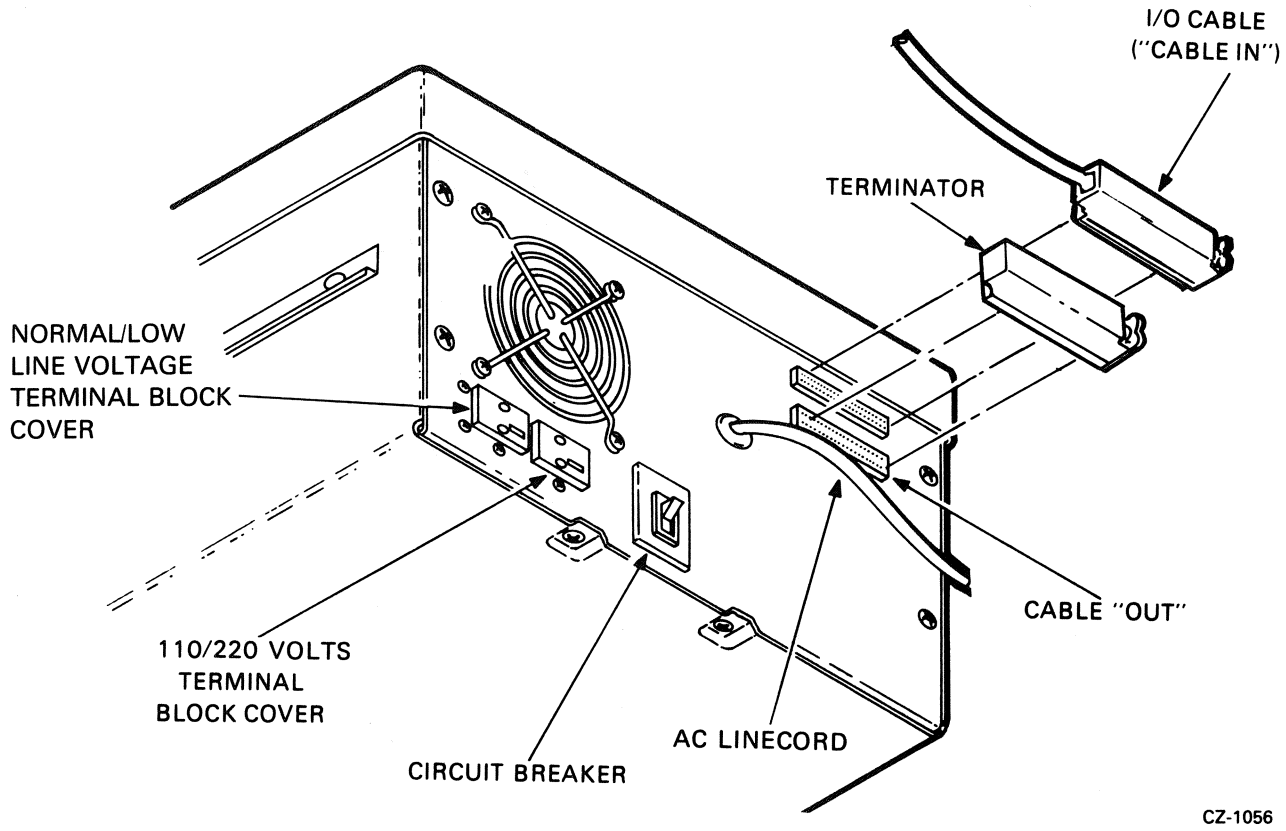


Figure 2-26 RL01/RL02 Disk Drive – Rear View

NOTE
On newer-drives, a shielded cable is used. Its part number is BC21Z-XX.

12. If there is only one disk drive in the system, or if this is the last drive of the daisy chain, install a terminator assembly (DIGITAL part no. 70-12293) in the "cable out" location at the rear of the drive (Figure 2-26).

13. If this is an RL11- or an RLV11-based system, route the I/O cable BC20J-XX (DIGITAL part no. 70-12122-10) between the first drive and the transition connector. If this is an RL8A-based system, route the BC80J-20 cable from the RL8A to the first drive. If this is an RLV12-based system, route the BC80M-6 between the RLV12 and the first drive.

14. If this is a multidrive installation, connect an I/O cable from "cable in" of this drive to the "cable out" connector of the previous drive. Repeat for each drive.

NOTE
The total length of cable from controller to the last drive must not exceed 30 m (100 ft).

15. Install the proper unit-select plug at the front of the drive (Figure 2-27).

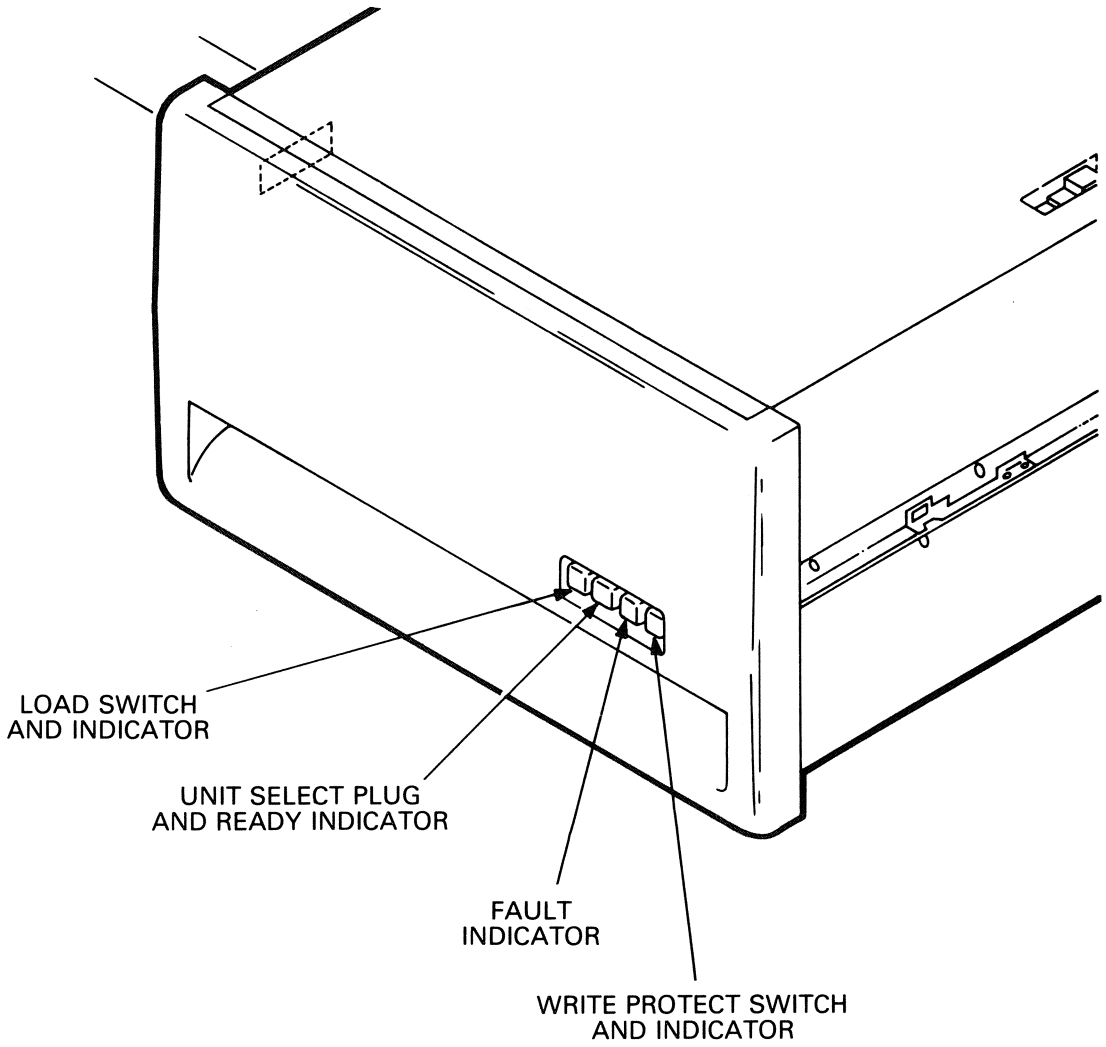


Figure 2-27 RL01/RL02 Disk Drive – Front View

2.8.3 Drive Prestartup Inspection

With the drive power off, follow these steps.

NOTE
If a problem occurs, consult the RL01/RL02 Technical Manual.

1. Ensure that the positioner restraining bracket is secured out of position to prevent interference with the positioner (Figure 2-25).

2. Ensure that the positioner is home.

3. Ensure that the read/write head gimbals are not bent or dirty. (If they are dirty, clean with a solution of 91 percent alcohol and 9 percent water and a lint-free wiper.

4. Ensure that the spindle rotates freely and its top surfaces are not dirty. (Clean as described above.)

5. Ensure that the brush assembly is home (not exposed).

NOTE

An engineering change has eliminated the need for brushes on the drive. On newer RL01 and RL02 drives, the brush assembly has been replaced with a unit containing only the cartridge-in-place and top cover interlock. The Drive Logic Module also contains some logic changes to accommodate the brush cycle removal.

6. Ensure that the logic modules and connectors are seated firmly.

7. Turn CB1 ON.

8. Ensure that the spindle rotates slowly counterclockwise for approximately 15 seconds and stops. At this time, the LOAD light will come on.

NOTE

On the newer drives (without brushes), the spindle will NOT rotate until both the top cover and the cartridge-in-place interlocks are depressed.

9. Ensure that the FAULT light is not on.

10. Ensure that the cooling fan at the rear of the drive is operating.

11. On the newer drives, release the top cover and cartridge-in-place interlocks, noting that the spindle stops rotating.

12. Using a suitable measuring device (i.e., digital voltmeter or equivalent), ensure the following drive voltages are within the specified tolerances.

Voltage	Range	Test Point
+15 UNREG	(+15.0 to +18.0 Vdc)	+V UNREG
−15 UNREG	(−15.0 to −18.0 Vdc)	−V UNREG
+5 REG	(+4.48 to +5.1 Vdc)	TP8
+8 REG	(+7.7 to +8.3 Vdc)	TP4
−8 REG	(−7.7 to −8.3 Vdc)	TP5

See Figure 2-24 for dc servo module location. Test points are located on the mask covering the dc servo module.

13. Verify that the WRITE PROTect switch cycles in and out and the indicator lights up when the switch is pressed.

14. Verify that the LOAD switch cycles in and out and the indicator light goes out when the switch is pressed. Return switch to the "out" position.

15. Turn off CB1.

16. Reinstall the top cover and secure with the captive screws.

17. Ensure that the drive access cover cannot be opened.

18. Turn CB1 on and ensure the drive access cover will open.

2.8.4 Drive Startup Operation Check

1. With the drive power ON, install a scratch cartridge as described in Paragraph 3.3.

2. Close the cover, press the LOAD switch and note the following.

   - The LOAD light will go out.

   - When the cartridge reaches nominal speed (after approximately 30 seconds), a brush cycle commences on those drives that have brushes. When the brushes have returned home, the read/write heads will load and approach cylinder 0. When the heads have locked onto cylinder 0, the READY light will illuminate. The total time for this process is approximately 45 seconds.

3. Press the LOAD switch again. The READY light should go off and the read/write heads should retract to their home position. The spindle should slow down and then come to a complete stop after about 30 seconds. The LOAD light should illuminate when the spindle has stopped.

4. If the drive startup operation check detailed above is successfully completed (i.e., the READY indicator illuminates), run the subsystem confidence tests described in Paragraph 2.9. If there is a problem, consult the *RL01/RL02 Technical Manual.*

2.9 CONFIDENCE TESTING

Confidence testing consists of running the diagnostic programs. Each diagnostic has a listing that contains operating instructions. Each listing explains system hardware requirements, software environment, which features are tested and how they are tested, program options and how to select them, how to interpret printouts, error handling, device information tables, dialogue with the Diagnostic Supervisor, and complete operating instructions. The listings are available as hard copy printouts or on microfiche.

The binary form of the diagnostic programs are available on various media. It is always advisable to keep a copy of the RL01/RL02 diagnostics on a media other than the RL01K or RL02K cartridge so that the diagnostics can be loaded through another device if the RL subsystem is down.

The old MAINDEC naming system is replaced with a new naming system. Manual and microfiche designations are also converted. In addition, part numbers are assigned that conform to DIGITAL's standard twelve character part numbering system.

When ordering diagnostic media, listings, manuals, or microfiche, check the current catalog or index for the latest revision level. The applicable catalogs and indexes are listed in Table 2-4. Unless otherwise specified when ordering, the latest revision will be shipped.

Table 2-4 Diagnostic Catalogs and Indexes

Name	Part Number
PDP-11 Diagnostic Software Components Catalogue*	AV-B021E-TC
PDP-8 Software Components Catalogue*	AV-0872B-TA
PDP-11 Maindec Index (microfiche)	AH-9026P-MC
PDP-8 Maindec Index (microfiche)	AH-6572G-MA

* Both of these catalogs are available on microfiche (EP-08/11)

2.9.1 RL11-Based Diagnostics

The diagnostic package used for an RL11/RL01 subsystem before the release of the RL02 consisted of the six free-standing programs listed in Table 2-5. There were two revisions, Revision A and Revision B. These programs handled only RL01 drives (not RL02 units).

Table 2-5 RL11-Based Diagnostics

Part Number	Description
CZRLAA0	Controller Test Part 1
CZRLBA0	Controller Test Part 2
CZRLCA0	Drive Test Part 1
CZRLDA0	Drive Test Part 2
CZRLEA0	Performance Exerciser
CZRLFA0	Drive Compatibility Test

These diagnostics can be run free-standing under the Diagnostic Supervisor, manually under XXDP, chainable under XXDP (except CZRLFA0 which requires manual intervention), or under manufacturing checkout environments such as SLIDE or ACT-11.

A new diagnostic package is available to test either an RL01 or an RL02 unit. The kit numbers are listed in Table 2-6 and the contents of the tests are shown in Table 2-7.

Table 2-6 RL11 Diagnostic Kit Numbers

Part Number	Description
ZJ283-RB	Documentation and paper tape
ZJ283-RZ	Documentation only
ZJ283-PB	Paper tape only
ZJ283-FR	Microfiche only

Table 2-7 RL11 Diagnostic Components

Part Number	Name	Item
AC-F111A-MC	CZRLGA0 Controller Test #1	Documentation
AH-F110A-MC		Fiche
AK-F108A-MC		Paper tape #1
AK-F109A-MC		Paper tape #2
AF-F111A-M0		DECO
AC-F115A-MC	CZRLHA0 Controller Test #2	Documentation
AH-F114A-MC		Fiche
AK-F112A-MC		Paper tape #1
AK-F113A-MC		Paper tape #2
AF-F115A-M0		DECO
AC-F119A-MC	CZRLIA0 Drive Test #1	Documentation
AH-F118A-MC		Fiche
AK-F116A-MC		Paper tape #1
AK-F117A-MC		Paper tape #2
AF-F119A-M0		DECO
AC-F123A-MC	CZRLJA0 Drive Test #2	Documentation
AH-F122A-MC		Fiche
AK-F120A-MC		Paper tape #1
AK-F121A-MC		Paper tape #2
AF-F123A-M0		DECO
AC-F127A-MC	CZRLKA0 Performance Exerciser	Documentation
AH-F126A-MC		Fiche
AK-F124A-MC		Paper tape #1
AK-F125A-MC		Paper tape #2
AF-F127A-M0		DECO

Table 2-7 RL11 Diagnostic Components (Cont)

Part Number	Name	Item
AC-F131A-MC	CZRLLA0 Drive Compatibility Test	Documentation
AH-F130A-MC		Fiche
AK-F128A-MC		Paper tape #1
AK-F129A-MC		Paper tape #2
AF-F131A-M0		DECO
AC-F135A-MC	CZRLMA0 Bad Sector File Utility	Documentation
AH-F134A-MC		Fiche
AK-F132A-MC		Paper tape #1
AK-F133A-MC		Paper tape #2
AF-F135A-M0		DECO

There is a new program added to the package named CZRLMA0. It is used to read the Bad Sector File and can be used to write entries into the field writable portion of the Bad Sector File. This program is not a diagnostic and should not be used as one. It assumes that the system is functioning properly.

In addition to the free-standing diagnostics, there is a DECX11 module for use with the DECX11 System Exerciser. Revision A (RLAA) will operate an RL01 drive only. Revision B or later (RLAB) will operate either an RL01 or an RL02.

There is also an RL subsystem driver for the Maintenance Program Generator (MPG).

The binary form of the diagnostics are included as part of XXDP. This makes them available on media for the RK05, RK06, RK07, RL01, RX01, DECtape, magnetic tape, and DECassette.

The use of XXDP, DECX11, and MPG is explained in the manuals listed in Table 2-8.

Table 2-8 User Documents

Part Number Hard Copy	Part Number Microfiche	Name
AC-9093I-MC	EP-DZQXA-J-D	CZQXAI0 XXDP User Guide
AC-8240Z-MC	AH-8242Z-MC	CXQBAZ0 DECX11 User Document
AC-816JC-MC	EP-DTUMA-C-D	CTUMAC0 M.P.G. User Manual

2.9.2 RLV11-/RLV12-Based Diagnostics

With one exception, the RLV11/RLV12 controller-based subsystem is tested with the same set of diagnostics as the RL11 controller subsystem. The RLV11 and RLV12 each has an internal maintenance feature that is not tested by the RL11 diagnostics. Therefore, for the RLV11 subsystem, there is an additional diagnostic program called the CVRLAA0 Diskless Test. RLV12 subsystems use the CVRLBA Diskless Test. {At some point in time, this test (CVRLBA) will replace CVRLAA.}

The diagnostic kit includes the same items as the RL11 diagnostic kit plus the CVRLAA0 test. The RLV11/RLV12 kit designations are shown in Table 2-9.

Table 2-9 RLV11/RLV12 Diagnostic Kit Designations

Designation	Contents
ZJ285-RB	Documentation and paper tape
ZJ285-RZ	Documentation only
ZJ285-PB	Paper tape only
ZJ285-FR	Microfiche only

The DECX11 module is the same one used for the RL11.

2.9.3 RL8A-Based Diagnostics

There are six free-standing diagnostic programs for the RL8/RL01 system. There is also a DECX8 module for use with the DECX8 System Exerciser. These diagnostics are available in a kit (see Table 2-10) or as individual components (see Table 2-11) and are for use with the RL01 only.

Table 2-10 RL8/RL01 Diagnostic Kits

Part Number	Contents
ZB233-RB	Documentation and paper tape
ZB233-RZ	Documentation only
ZB233-PB	Paper tape only
ZB233-FR	Microfiche only

Table 2-11 RL8/RL01 Diagnostic Components

Part Number	Designation
AC-C656A-MA	AJRLAA0, RL8A Diskless Control Test (Document)
AH-C657A-MA	AJRLAA0, RL8A Diskless Control Test (Fiche)
AK-C658A-MA	AJRLAA0, RL8A Diskless Control Test (Paper tape)
AL-C659A-NA	AJRLAA0, RL8A Diskless Control Test (DECtape)
AC-C660A-MA	AJRLBA0, RL8A/RL01 Drive Test 1 (Document)
AH-C661A-MA	AJRLBA0, RL8A/RL01 Drive Test 1 (Fiche)
AK-C662A-MA	AJRLBA0, RL8A/RL01 Drive Test 1 (Paper tape)
AL-C663A-NA	AJRLBA0, RL8A/RL01 Drive Test 1 (DECtape)
AC-C664A-MA	AJRLCA0, RL8A/RL01 Drive Test 2 (Document)
AH-C665A-MA	AJRLCA0, RL8A/RL01 Drive Test 2 (Fiche)
AK-C666A-MA	AJRLCA0, RL8A/RL01 Drive Test 2 (Paper tape)
AL-C667A-NA	AJRLCA0, RL8A/RL01 Drive Test 2 (DECtape)
AC-C668A-MA	AJRLDA0, RL8A/RL01 Compat. Verify (Document)
AH-C669A-MA	AJRLDA0, RL8A/RL01 Compat. Verify (Fiche)
AK-C670A-MA	AJRLDA0, RL8A/RL01 Compat. Verify (Paper tape)
AL-C671A-NA	AJRLDA0, RL8A/RL01 Compat. Verify (DECtape)
AC-C672A-MA	AJRLEA0, RL8A/RL01 Perf. Exer. (Document)
AH-C673A-MA	AJRLEA0, RL8A/RL01 Perf. Exer. (Fiche)
AK-C674A-MA	AJRLEA0, RL8A/RL01 Perf. Exer. (Paper tape)
AL-C675A-NA	AJRLEA0, RL8A/RL01 Perf. Exer. (DECtape)
AC-C676A-MA	AXRLAA0, RL8A DECX8 Module (Document)
AH-C677A-MA	AXRLAA0, RL8A DECX8 Module (Fiche)
AK-C678A-MA	AXRLAA0, RL8A DECX8 Module (Paper tape)
AC-C682A-MA	AJRLGA0, RL8A/RL01 Pack Verify (Document)
AH-C683A-MA	AJRLGA0, RL8A/RL01 Pack Verify (Fiche)
AK-C684A-MA	AJRLGA0, RL8A/RL01 Pack Verify (Paper tape)
AL-C685A-NA	AJRLGA0, RL8A/RL01 Pack Verify (DECtape)

There are six free-standing diagnostic programs for the RL8/RL02 subsystem, plus a module for use with the DECX8 System Exerciser. They are available in kit form (Table 2-12) or as individual components (Table 2-13). The Diskless Controller Test (AJRLACO) is simply Revision C of the RL01 test and can test a subsystem with either RL01 or RL02 units. The other diagnostics test RL02-based systems only.

Table 2-12 RL8A Diagnostic Kits

Part Number	Contents
ZF241-RB	Documentation and paper tape
ZF241-RZ	Documentation only
ZF241-PB	Paper tape only
ZF241-FR	Microfiche
ZF241-PH	RL02
ZF241-RH	RL02 and documentation

Table 2-13 RL8/RL02 Diagnostic Components

Part Number	Name	Item
AC-C656C-MA	AJRLAC0 RL8A Diskless Control Test	Documentation
AH-C657C-MA		Fiche
AK-C658C-MA		Paper tape
AL-C659C-NA		DECtape
AK-F362A-MA	AJRLHA0 RL8/RL02 Seek/Function	Documentation
AH-F363A-MA		Paper tape
AH-F364A-MA		Fiche
AL-F365A-MA		DECtape
AF-F362A-M0		DECO/DEPO
AC-F366A-MA	AJRIA0 RL8/RL02 Read/Write	Documentation
AK-F367A-MA		Paper tape
AH-F368A-MA		Fiche
AL-F369A-MA		DECtape
AF-F366A-M0		DECO/DEPO
AC-F370A-MA	AJRLJAO RL8/RL02 Drive Compat.	Documentation
AK-F371A-MA		Paper tape
AH-F372A-MA		Fiche
AL-F373A-MA		DECtape
AF-F370A-M0		DECO/DEPO
AC-F374A-MA	AJRLKA0 RL8/RL02 Perf. Exer.	Documentation
AK-F375A-MA		Paper tape
AH-F376A-MA		Fiche
AL-F377A-MA		DECtape
AF-F374A-M0		DEPO/DECO

Table 2-13 RL8/RL02 Diagnostic Components (Cont)

Part Number	Name	Item
AC-F378A-MA	AJRLLA0 RL8/RL02 Pack Verify	Documentation
AK-F379A-MA		Paper tape
AH-F380A-MA		Fiche
AL-F381A-MA		DECtape
AF-F378A-M0		DECO/DEPO
AC-F382A-MA	AXRLBA0 DEC/X8 MOD RL8/RL02	Documentation
AK-F383A-MA		Paper tape
AH-F384A-MA		Fiche
AF-F38SA-M0		DECO/DEPO

2.10 USE OF THE M9312 BOOTSTRAP WITH AN RL11 SUBSYSTEM

The M9312 module is used on many PDP-11 UNIBUS systems to provide bootstrap capability as well as other functions. The module has five IC sockets for ROM chips, four of which are reserved for peripheral bootstrap programs. There are several ROM chips available for the different peripheral devices, and an M9312 is configured by selecting the appropriate chips for the particular system on which it is used.

The RL subsystem bootstrap program is contained in ROM chip number 23-751A9. This chip can be ordered individually and is also available in kit MR11-EA, which consists of an M9312 module plus all the available ROM chips.

An RL system disk can be booted by a command to the console emulator (a program that is a feature of the M9312). The device mnemonic for the RL11 is DL or DLn, where n is the unit number (0 through 3).

More information on the M9312 is available in the *M9312 Technical Manual*. It is available in printed form (EK-M9312-TM) or on microfiche (EP-M9312-TM).