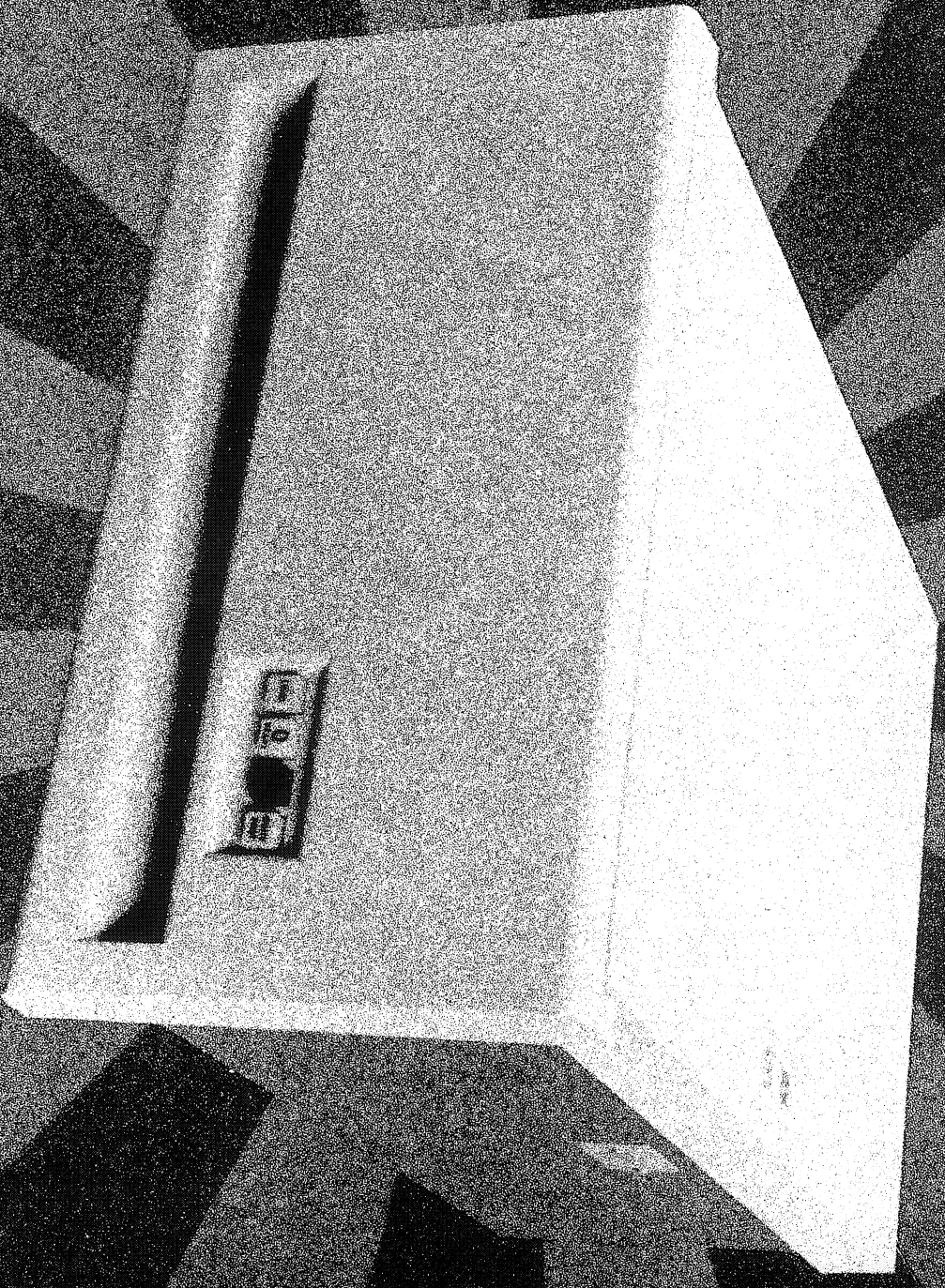


digital

RI.01/RI.02 DISK SUBSYSTEM USER'S GUIDE



EK-RL012-UG-005

RL01/RL02 User Guide

Prepared by Educational Services
Digital Equipment Corporation

1st Edition, December 1978
2nd Printing (Rev), September 1979
3rd Printing (Rev), June 1980
4th Printing (Rev), October 1980
5th Printing (Rev), September 1981

Copyright © 1981 by Digital Equipment Corporation

All Rights Reserved

The material in this manual is for informational purposes and is subject to change without notice.

Digital Equipment Corporation assumes no responsibility for any errors which may appear in this manual.

Printed in U.S.A.

This document was set on DIGITAL's DECset-8000 computerized type-setting system.

- **Class A Computing Devices:**

Notice: This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such radio frequency interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference in which case the user at his own expense may be required to take measures to correct the interference.

The following are trademarks of Digital Equipment Corporation, Maynard, Massachusetts:

DEC	DECnet	OMNIBUS
DECUS	DECsystem-10	OS/8
DIGITAL	DECSYSTEM-20	PDT
Digital Logo	DECwriter	RSTS
PDP	DIBOL	RSX
UNIBUS	EduSystem	VMS
VAX	IAS	VT
	MASSBUS	

CONTENTS

	Page
CHAPTER 1	
INTRODUCTION	
1.1 PURPOSE AND SCOPE	1-1
1.2 REFERENCE DOCUMENTS	1-1
1.3 SUBSYSTEM DESCRIPTION	1-1
1.3.1 RL01/RL02 Disk Drive	1-2
1.3.2 RL Controllers	1-2
1.3.2.1 RL11 Controller Description	1-2
1.3.2.2 RL V11 Controller Description	1-3
1.3.2.3 RL8A Controller Description	1-3
1.3.2.4 RL V12 Controller Description	1-3
1.3.3 RL01K/RL02K Disk Cartridge	1-4
1.3.3.1 Interchangability	1-4
1.3.3.2 Sector Format	1-4
1.4 SECTOR LOCATION	1-7
1.5 BAD SECTOR FILE	1-8
1.6 RL01/RL02 SPECIFICATIONS	1-10
CHAPTER 2	
INSTALLATION	
SITE PREPARATION AND PLANNING	2-1
Environmental Considerations	2-1
Cleanliness	2-1
Space Requirements	2-1
Floor Loading	2-1
Heat Dissipation	2-1
Acoustics	2-2
Temperature	2-2
Relative Humidity	2-2
Altitude	2-2
Power and Safety Precautions	2-2
Radiated Emissions	2-2
Attitude/Mechanical Shock	2-3
Options	2-3
AC Power Requirements	2-5
Standard Applications	2-5
Optional Applications	2-5
Installation Constraints	2-7
Grounding Requirements	2-7
AC CABLING	2-8
INSTALLATION – GENERAL	2-10

CHAPTER 2	INSTALLATION (Cont)	
2.4	RL11 CONTROLLER INSTALLATION.....	2-11
2.5	RLV11 CONTROLLER INSTALLATION.....	2-16
2.5.1	Bus Interface Module.....	2-16
2.5.2	Drive Module.....	2-18
2.5.3	Module Slot Location.....	2-19
2.5.4	Module Installation.....	2-20
2.6	RLV12 CONTROLLER INSTALLATION.....	2-21
2.6.1	Introduction.....	2-21
2.6.2	Device Address Selection.....	2-21
2.6.3	Bus Selection.....	2-26
2.6.4	Interrupt Vector.....	2-26
2.6.5	Interrupt Request Level.....	2-26
2.6.6	Memory Parity Error Abort Feature.....	2-26
2.6.7	Other Jumpers.....	2-27
2.6.8	Installation.....	2-27
2.6.9	Acceptance Testing.....	2-27
2.7	RL8A CONTROLLER INSTALLATION.....	2-28
2.7.1	Introduction.....	2-28
2.7.2	Module Slot Location.....	2-28
2.7.3	Module Installation.....	2-28
2.8	RL01/RL02 DISK DRIVE INSTALLATION.....	2-30
2.8.1	Unpacking and Inspection.....	2-30
2.8.2	RL01/RL02 Disk Drive Unit Mounting.....	2-32
2.8.3	Drive Prestartup Inspection.....	2-37
2.8.4	Drive Startup Operation Check.....	2-39
2.9	CONFIDENCE TESTING.....	2-39
2.9.1	RL11-Based Diagnostics.....	2-40
2.9.2	RLV11-/RLV12-Based Diagnostics.....	2-43
2.9.3	RL8A-Based Diagnostics.....	2-43
2.10	USE OF THE M9312 BOOTSTRAP WITH AN RL11 SUBSYSTEM.....	2-46
CHAPTER 3	OPERATOR'S GUIDE	
3.1	INTRODUCTION.....	3-1
3.2	CONTROLS AND INDICATIONS.....	3-1
3.2.1	Power ON/OFF Circuit Breaker.....	3-2
3.2.2	Run/Stop Switch with LOAD Indicator.....	3-2
3.2.3	UNIT SELECT Switch with READY Indicator.....	3-3
3.2.4	FAULT Indicator.....	3-3
3.2.5	WRITE PROTECT Switch and Indicator.....	3-3
3.3	OPERATING PROCEDURES.....	3-3
3.3.1	Cartridge Loading and Drive Startup Procedure.....	3-4
3.3.2	Cartridge Unloading Procedure.....	3-6
3.4	OPERATOR MAINTENANCE.....	3-6
3.4.1	Introduction.....	3-6
3.4.2	Professional Cartridge Cleaning.....	3-6
3.4.3	User Cartridge Cleaning.....	3-6
3.4.4	Spindle Assembly Cleaning.....	3-7
3.5	CARTRIDGE CARE SUMMARY.....	3-7

CHAPTER 4		11-FAMILY PROGRAMMING INFORMATION	
4.1	GENERAL DESCRIPTION		4-1
4.1.1	RL11 Controller Description		4-1
4.1.2	RLV11 Controller Description		4-1
4.1.3	RLV12 Controller Description		4-1
4.2	ADDRESSABLE REGISTERS		4-1
4.2.1	Control Status Register		4-2
4.2.2	Bus Address Register		4-5
4.2.3	Disk Address Register		4-5
4.2.3.1	DA Register During a Seek Command		4-5
4.2.3.2	DA Register During Read or Write Data Command		4-6
4.2.3.3	DA Register During A Get Status Command		4-7
4.2.4	Multipurpose Register		4-8
4.2.4.1	MP Register After a Get Status Command		4-8
4.2.4.2	MP Register After a Read Header Command		4-10
4.2.4.3	MP Register During Read/Write Data Commands		4-11
4.2.4.4	Bus Address Extension Register		4-11
4.2.5	Register Summary		4-12
4.3	CONTROLLER COMMANDS		4-14
4.3.1	No-Op (RL11) or Maintenance (RLV11) – Function Code 0		4-14
4.3.2	Write Check – Function Code 1		4-15
4.3.3	Get Status – Function Code 2		4-16
4.3.4	Seek – Function Code 3		4-16
4.3.5	Read Header – Function Code 4		4-16
4.3.6	Write Data – Function Code 5		4-16
4.3.7	Read Data – Function Code 6		4-17
4.3.8	Read Data Without Header Check – Function Code 7		4-17
4.4	CSR ERROR CODE DEFINITIONS		4-17
4.4.1	Operation Incomplete (OPI)		4-17
4.4.2	Data CRC (DCRC) or Write Check (WCE)		4-17
4.4.3	Header CRC (HCRC)		4-17
4.4.4	Data Late (DLT)		4-17
4.4.5	Header Not Found (HNF)		4-18
4.4.6	Non-Existant Memory (NXM)		4-18
4.4.7	Memory Parity Error (MPE)		4-18
4.5	OPERATIONAL CONSIDERATIONS		4-18
4.5.1	Interrupt		4-18
4.5.2	Seek Operation		4-18
4.5.3	Overlapped Seeks		4-18
4.5.4	Data Transfer		4-19
4.5.5	Recovery of Data with Bad Headers		4-19
4.5.6	Non-Interchangability of RL01K/RL02K Disk Cartridges		4-19
4.6	ERROR RECOVERY		4-19
4.7	DIFFERENCE SUMMARY (RK05 AND RL01/RL02)		4-21
4.7.1	Spiral Read/Write or Mid-Transfer Seeks		4-21
4.7.2	Implicit Seeks Versus Explicit Seeks		4-21
4.7.3	Recalibrate		4-22
4.7.4	Bad Sector File		4-22
4.7.5	Reformatting		4-22
4.7.6	Seek Interrupt		4-22

CHAPTER 5	RL8A PROGRAMMING INFORMATION	
5.1	GENERAL DESCRIPTION	5-1
5.2	ADDRESSABLE REGISTERS	5-2
5.2.1	Command Register A	5-2
5.2.1.1	Command Register A During a Seek Command	5-2
5.2.1.2	Command Register A During Read or Write Data Command	5-3
5.2.2	Command Register B	5-4
5.2.3	Break Memory Address Register	5-6
5.2.4	Word Count Register	5-6
5.2.5	Sector Address Register	5-6
5.2.6	Error Register	5-7
5.2.7	Silo Data Buffer	5-8
5.2.7.1	Data Buffer Contents Following a Get Status Command	5-9
5.2.7.2	Silo Data Buffer Contents Following a Read Header Command	5-9
5.2.8	Register Summary	5-9
5.3	CONTROLLER COMMANDS	5-9
5.3.1	Maintenance Command	5-16
5.3.2	Reset Command	5-16
5.3.3	Get Status Command	5-16
5.3.4	Seek Command	5-17
5.3.5	Read Header Command	5-17
5.3.6	Write Data Command	5-17
5.3.7	Read Data Command	5-18
5.3.8	Read Data without Header Check Command	5-18
5.3.9	Maintenance Bit	5-18
5.4	OPERATIONAL CONSIDERATIONS	5-20
5.4.1	8-Bit Mode Versus 12-Bit Mode	5-20
5.4.2	Interrupt	5-20
5.4.3	Seek Operation	5-20
5.4.4	Overlapped Seeks	5-20
5.4.5	Recovery of Data with Bad Headers	5-20
5.4.6	Non-Interchangability of Disk Cartridges	5-21
5.4.6.1	RL01K/RL02K	5-21
5.4.6.2	RL8A/RL11/RLV11/RLV12	5-21
5.4.7	Use of Two RL8A Controllers	5-21
5.5	ERROR RECOVERY	5-21
5.6	DIFFERENCE SUMMARY (RK05 AND RL01/RL02)	5-22
5.6.1	Spiral Read/Write or Mid-Transfer Seeks	5-23
5.6.2	Implicit Seeks Versus Explicit Seeks	5-23
5.6.3	Recalibrate	5-23
5.6.4	Bad Sector File	5-23
5.6.5	Reformatting	5-23
5.6.6	Seek Interrupt	5-23
APPENDIX A	RL11 CONFIGURATION AND INSTALLATION CONSIDERATIONS	
A.1	SPC CONSIDERATIONS	A-1
A.2	CONFIGURATIONS CONSIDERATIONS	A-1

FIGURES

	Page
1-1 Typical RL01/RL02 Mass Storage Subsystem Configuration	1-2
1-2 RL01/RL02 Disk Drive	1-3
1-3 RL01K/RL02K Disk Cartridge Format	1-5
1-4 Access Method for Sequential Transfers	1-7
1-5 Sector Relocation	1-8
1-6 Bad Sector File Format	1-9
2-1 RL01/RL02 Disk Drive – Rear View	2-5
2-2 Approved Electrical Plugs and Receptacles	2-6
2-3 Power Panel Grounded Building Frame	2-7
2-4 Power Panel Grounded To Metal Plate	2-8
2-5 Typical 60 Hz Power System	2-9
2-6 Typical 50 Hz Power System	2-10
2-7 Split Phase (2-phase) Power System	2-10
2-8 Three Phase Y Power System	2-10
2-9 RL11 Component Layout	2-11
2-10 RL11 Base and Vector Address Jumper Configuration	2-13
2-11 RL11 Priority Jumper Assembly Connections	2-14
2-12 RL11 Controller Installation	2-15
2-13 RLV11 Bus Interface Module (M8014) (Component Side)	2-17
2-14 RLV11 Base Address Switch Settings	2-18
2-15 RLV11 Vector Address Switch Settings	2-18
2-16 RLV11 Drive Module (M8013)	2-19
2-17 H9273 Backplane Grant Priority Structure	2-20
2-18 RLV12 Jumper Locations	2-24
2-19 RLV12 Device Address Format	2-25
2-20 RLV12 Format Interrupt Vector	2-26
2-21 RL8A Jumpers	2-29
2-22 H950 Shipping Package	2-31
2-23a RL01/RL02 Cabinet Installation	2-32
2-23b RL01/RL02 Cabinet Installation	2-33
2-24 RL01/RL02 Disk Drive – Exposed Drive Logic Module	2-34
2-25 RL01/RL02 – Covers Removed	2-35
2-26 RL01/RL02 Disk Drive – Rear View	2-36
2-27 RL01/RL02 Disk Drive – Front View	2-37
3-1 RL01/RL02 Disk Drive – Front View	3-1
3-2 RL01/02 Disk Drive – Rear View	3-2
3-3 Cartridge Loading Procedure	3-5
4-1 CS Register	4-2
4-2 BA Register	4-5
4-3 DAR Contents to Execute a Seek Command	4-5
4-4 DAR Contents During a Read/Write Data Command	4-6
4-5 DAR Contents to Execute a Get Status Command	4-7
4-6 MPR – Following a Get Status Command	4-8
4-7 MPR – Following a Read Header Command	4-10
4-8 MPR – Used as a Word Counter	4-11
4-9 BAE Register	4-12
4-10 Register Summary	4-12
5-1 Command Register A During a Seek Command	5-3
5-2 Command Register A During a Read/Write Data Command	5-4

FIGURES (Cont)

5-3	Command Register B.....	5-4
5-4	Break Memory Address Register.....	5-6
5-5	Word Count Register.....	5-6
5-6	Sector Address Register.....	5-7
5-7	Error Register.....	5-7
5-8	Silo Buffer for Status Word 1.....	5-9
5-9	Silo Buffer for Status Word 2.....	5-9
5-10	Silo Buffer for Header Words.....	5-12
5-11	Register Summary.....	5-13
5-12	Maintenance Mode Bit.....	5-19

TABLES

1-1	Reference Documents.....	1-1
1-2	RL01/RL02 Disk Drive Physical and Environmental Specification.....	1-10
1-3	RL01/RL02 Disk Drive Operational Specifications.....	1-13
1-4	RL01K/RL02K Disk Cartridge Specifications.....	1-14
2-1	Saleable RL01/RL02 Subsystem Options.....	2-3
2-2	Saleable Cabinet Options: (Includes Skins, Doors, Covers, Trim, and Power Controllers).....	2-4
2-3	Address Selection.....	2-22
2-4	Diagnostic Catalogs and Indexes.....	2-40
2-5	RL11-Based Diagnostics.....	2-40
2-6	RL11 Diagnostic Kit Numbers.....	2-41
2-7	RL11 Diagnostic Components.....	2-41
2-8	User Documents.....	2-42
2-9	RLV11/RLV12 Diagnostic Kit Designations.....	2-43
2-10	RL8/RL01 Diagnostic Kits.....	2-43
2-11	RL8/RL01 Diagnostic Components.....	2-44
2-12	RL8A Diagnostic Kits.....	2-45
2-13	RL8/RL02 Diagnostic Components.....	2-45
4-1	Controller Addressable Registers.....	4-2
4-2	Control Status Register Bit Description.....	4-3
4-3	Disk Address Register Bit Description for Seek Commands.....	4-6
4-4	Disk Address Register Bit Description for Data Transfer Commands.....	4-7
4-5	Disk Address Register Bit Description for Get Status Commands.....	4-7
4-6	MP Register Bit Description for Get Status Commands.....	4-8
4-7	MP Register Bit Description for Read Header Commands.....	4-10
4-8	MP Register Bit Description for Data Transfer Commands.....	4-11
4-9	RL11/RLV11/RLV12 Controller Commands.....	4-14
4-10	Errors.....	4-20
5-1	RL8A Instruction Set.....	5-1
5-2	RL8A Controller Commands.....	5-2
5-3	Command Register A Bit Description for Seek Commands.....	5-3

TABLES (Cont)

5-4	Command Register A Bit Description for Data Transfer	
	Commands	5-4
5-5	Command Register B Bit Description	5-5
5-6	Error Register Bit Description	5-7
5-7	Silo Data Buffer Word 1 of Get Status Command	5-10
5-8	Silo Data Buffer Word 2 of Get Status Command	5-11
5-9	Errors	5-22