

DEC-11-ODBHA-A-D

# THE DOS/BATCH HANDBOOK

FOR THE DOS/BATCH OPERATING SYSTEM

Monitor Version V09

April 1974

Order additional copies as directed on the Software  
Information page at the back of this document.

digital equipment corporation • maynard, massachusetts

The information in this document is subject to change without notice and should not be construed as a commitment by Digital Equipment Corporation. Digital Equipment Corporation assumes no responsibility for any errors that may appear in this manual.

The software described in this document is furnished to the purchaser under a license for use on a single computer system and can be copied (with inclusion of DIGITAL's copyright notice) only for use in such system, except as may otherwise be provided in writing by DIGITAL.

Digital Equipment Corporation assumes no responsibility for the use or reliability of its software on equipment that is not supplied by DIGITAL.

Copyright © 1974 by Digital Equipment Corporation

The HOW TO OBTAIN SOFTWARE INFORMATION page, located at the back of this document, explains the various services available to DIGITAL software users.

The postage prepaid READER'S COMMENTS form on the last page of this document requests the user's critical evaluation to assist us in preparing future documentation.

The following are trademarks of Digital Equipment Corporation:

CDP	DIGITAL	INDAC	PS/8
COMPUTER LAB	DNC	KA10	QUICKPOINT
COMSYST	EDGRIN	LAB-8	RAD-8
COMTEX	EDUSYSTEM	LAB-8/e	RSTS
DDT	FLIP CHIP	LAB-K	RSX
DEC	FOCAL	OMNIBUS	RTM
DECCOMM	GLC-8	OS/8	RT-11
DECTAPE	IDAC	PDP	SABR
DIBOL	IDACS	PHA	TYPESET 8
			UNIBUS

# Table of Contents

INTRODUCTION TO DOS/BATCH
---------------------------

	<u>Page</u>
<u>PART 1 INTRODUCTION TO THE DOS/BATCH HANDBOOK</u>	1-1
<u>PART 2 DOS/BATCH CONCEPTS AND CAPABILITIES</u>	
CHAPTER 1 INTRODUCTION	2-1
1.1    Functions of an Operating System	2-1
1.2    Design Criteria	2-1
1.3    The Role of DOS/BATCH	2-1
1.3.1  Batch Operation	2-1
1.4    Areas of Activity	2-2
1.5    Program Development	2-3
1.6    System Generation and Adaptability	2-3
CHAPTER 2 INPUT AND OUTPUT	2-4
2.1    Devices Supported	2-4
2.2    Objectives	2-4
2.2.1  Device Independence	2-5
2.2.2  Variety of Access Methods	2-5
2.2.3  Memory Economy	2-5
2.2.4  Program Efficiency	2-5
2.3    Data	2-5
2.3.1  Data Definition	2-5
2.3.1.1  Datasets	2-6
2.3.1.2  Files	2-6
2.3.1.3  Device Names	2-7
2.3.1.4  Filenames and Filename Extensions	2-7
2.3.2  Dataset Specification Methods	2-8
2.3.2.1  Within-program Data Specification	2-8
2.3.2.2  The Command String Interpreter (CSI)	2-9
2.3.2.3  The ASSIGN Command	2-10
2.4    Types of Transfer	2-11
2.4.1  Sequential Transfer	2-11
2.4.1.1  Transfer Modes	2-11
2.4.2  Random Access	2-11
2.4.3  Bulk Transfer	2-12
2.5    Design of Input and Output Routines	2-12
2.5.1  Modularity	2-12
2.5.2  Reentrancy	2-13
CHAPTER 3 DATA STORAGE	2-14
3.1    Media	2-14
3.2    Objectives	2-15
3.3    Magnetic Media	2-15
3.3.1  Differences Between Media	2-15
3.3.1.1  Hardware Constraints	2-16
3.3.1.2  Monitor Provisions	2-16
3.4    Services Provided on all Magnetic Media	2-17
3.4.1  User Separation	2-17
3.4.1.1  User Identification Codes (UIC)	2-17
3.4.1.2  File Protection	2-18
3.5    Services Provided on Disk and DECTape	2-19
3.5.1  Directories	2-19
3.5.1.1  User File Directories (UFD)	2-19
3.5.1.2  Master File Directories (MFD)	2-20

	<u>Page</u>	
3.5.2	Types of File	2-21
3.5.2.1	Contiguous Files	2-21
3.5.2.2	Linked Files	2-22
3.5.2.3	Mixing Contiguous and Linked Files	2-22
3.5.3	Verifying Directories with VERIFY	2-23
3.6	Services Provided on Magnetic Tape	2-23
3.7	Services Provided on Cassette	2-23
3.7.1	Multi-Volume Files	2-24
3.8	Non-Magnetic Media	2-24
3.8.1	Paper Tape	2-24
3.8.2	Punched Cards	2-24
3.9	Summary of Facilities on Each Medium	2-24
3.10	Medium Interchangeability	2-25
3.10.1	Manipulating Data with PIP	2-25
3.10.2	Conversion from EBCDIC with EBASCI	2-25
 CHAPTER 4 MEMORY MANAGEMENT		 2-26
4.1	Memory Occupants	2-26
4.2	Memory Management Criteria	2-27
4.3	Overall Strategy	2-27
4.4	The Monitor Area	2-28
4.4.1	Monitor Modularity	2-28
4.4.2	The Resident Monitor	2-29
4.4.2.1	The Minimum Resident Monitor	2-29
4.4.2.2	Extending the Resident Monitor	2-30
4.4.2.3	Making a Module Resident at Run Time	2-30
4.4.3	Non-resident Monitor Modules	2-31
4.4.3.1	The System Device	2-31
4.4.4	Input and Output Routines and Device Drivers	2-32
4.4.4.1	Common Input and Output Routines	2-32
4.4.4.2	Device Drivers	2-32
4.5	The Dynamic Memory Area	2-33
4.5.1	The Stack	2-35
4.5.2	The Data Buffer and Device Driver Area	2-35
4.5.3	Temporary Monitor Tables	2-36
4.6	The Program Area	2-36
4.6.1	User Programs	2-36
4.6.1.1	Overlaid Programs	2-36
4.6.2	System Programs	2-36
4.6.3	The Transient Monitor	2-37
 CHAPTER 5 UTILITY ROUTINES		 2-38
5.1	Program Loading and Unloading	2-38
5.2	Character Conversion	2-38
5.2.1	ASCII/Binary Conversion	2-38
5.2.2	Radix-50 Packed Character Storage	2-39
5.3	System Information	2-39
5.4	File Management	2-40
 CHAPTER 6 USER CONTROL		 2-41
6.1	Communication Between User and Monitor	2-41
6.2	MACRO Program Requests	2-41
6.3	Run-Time Commands	2-42
6.3.1	Interactive Operation	2-43
6.3.2	Batch Operation	2-43
6.3.2.1	Applications	2-43

	<u>Page</u>	
6.3.2.2	Implementation	2-44
6.3.2.3	Input Media	2-44
6.3.2.4	Batch Streams	2-44
6.3.2.5	Batch Mode	2-45
6.3.2.6	Concise Commands	2-45
6.4	Monitor Reporting	2-46
6.4.1	Interactive Reporting	2-46
6.4.1.1	Normal Responses	2-46
6.4.1.2	Error Messages	2-47
6.4.2	Batch Reporting	2-47
 CHAPTER 7 PROGRAM DEVELOPMENT		 2-48
7.1	Input of Source Programs	2-48
7.1.1	Direct Input Through EDIT	2-48
7.1.2	Offline Preparation	2-49
7.2	Compilation, Assembly and Linking	2-49
7.2.1	FORTRAN IV Compilation	2-50
7.2.1.1	Extensions	2-50
7.2.1.2	Optimization	2-50
7.2.2	MACRO Assembly	2-50
7.2.3	Linking with LINK	2-51
7.2.3.1	Linking Overlaid Programs	2-51
7.2.4	Library Building with LIBR	2-53
7.3	Debugging	2-53
7.3.1	Editing with EDIT	2-53
7.3.2	Dumping Files with FILDMP	2-53
7.3.3	Comparing Files with FILCOM	2-53
7.3.4	The On-line Debugging Program ODT	2-54
 CHAPTER 8 SYSTEM DISTRIBUTION, GENERATION, AND MODIFICATION		 2-55
8.1	Distribution Media	2-55
8.2	Monitor Format	2-55
8.2.1	Core Images	2-55
8.2.2	The Monitor Library (MONLIB.CIL)	2-55
8.2.3	The File MONLIB.LCL	2-56
8.3	Establishing the System	2-56
8.3.1	Building the Monitor With SYSLOD	2-56
8.3.2	Building System Programs	2-57
8.3.3	Preserving the System with ROLLIN or PIP	2-57
8.4	Monitor Modification	2-57
8.4.1	CILUS (Core Image Library Update and Save)	2-57

THE DOS/BATCH OPERATING SYSTEM

### PART 3 THE DOS/BATCH MONITOR

CHAPTER 1 INTRODUCTION TO THE MONITOR		3-1
1.1	The DOS/BATCH Monitor	3-1
1.2	Monitor Core Organization	3-4
1.3	Hardware Configurations	3-5
1.4	Monitor Message	3-6
1.5	Starting the Monitor	3-6
1.6	Terminology	3-7
1.7	Standards for Tables	3-9
 CHAPTER 2 MONITOR KEYBOARD COMMANDS		 3-10
2.1	Introduction	3-10
2.1.1	Monitor Commands by Function	3-11

	<u>Page</u>	
2.1.2	When Monitor Commands are Legal	3-11
2.2	Monitor Mode and User Mode	3-12
2.3	Monitor Command Interpretation	3-13
2.4	User Identification and Protection Codes	3-13
2.4.1	User Identification Code (UIC)	3-13
2.4.2	Protection Codes	3-14
2.5	Filenames and Filename Extensions	3-15
2.6	Special Keyboard Characters	3-16
2.6.1	The RETURN Key	3-16
2.6.2	The RUBOUT Key	3-17
2.6.3	The CTRL/C Keys	3-17
2.6.4	The CTRL/U Keys	3-17
2.6.5	The Semicolon Key	3-18
2.6.6	The ESCAPE Key	3-18
2.6.7	How Keyboard Characters are Processed	3-18
2.7	Getting on the System	3-18
2.8	Monitor Keyboard Commands	3-19
2.8.1	The ASSIGN Command	3-20
2.8.2	The BEGIN Command	3-22
2.8.3	The CONTINUE Command	3-23
2.8.4	The DATE Command	3-23
2.8.5	The DUMP Command	3-24
2.8.6	The ECHO Command	3-25
2.8.7	The END Command	3-25
2.8.8	The FINISH Command	3-26
2.8.9	The GET Command	3-26
2.8.10	The KILL Command	3-26
2.8.11	The LOGIN Command	3-27
2.8.12	The MODIFY Command	3-27
2.8.13	The ODT Command	3-28
2.8.14	The PRINT Command	3-29
2.8.15	The RESTART Command	3-29
2.8.16	The RUN Command	3-30
2.8.17	The R System Program Command	3-31
2.8.18	The SAVE Command	3-31
2.8.19	The STOP Command	3-32
2.8.20	The TIME Command	3-33
2.8.21	The WAIT Command	3-33
 CHAPTER 3 PROGRAMMED REQUESTS		 3-34
3.1	Introduction	3-34
3.2	Types of Programmed Requests	3-35
3.2.1	Requests for Input/Output and Related Services	3-37
3.2.1.1	READ or WRITE Level Requests	3-38
3.2.1.2	RECORD Level Requests	3-41
3.2.1.3	BLOCK Level Requests	3-43
3.2.1.4	TRAN Level Requests	3-45
3.2.2	Requests for Directory Management Services	3-47
3.2.3	Requests for Miscellaneous Services	3-47
3.3	Device Independence	3-47
3.4	Overlaying Routines into Core	3-48
3.5	Monitor Restrictions on the User	3-49
3.6	Request for Monitor Services	3-50
3.6.1	.ALLOC - Allocate (create a contiguous file).	3-50
3.6.2	.APPND - Append one linked file to another.	3-52
3.6.3	.BIN2D - Convert one binary word into five decimal ASCII characters.	3-53
3.6.4	.BIN2O - Convert one binary word into six octal ASCII characters.	3-53

		<u>Page</u>
3.6.5	.BLOCK - Read or write a specific block in a file.	3-54
3.6.6	.CLOSE - Close a dataset.	3-55
3.6.7	.CORE - Obtain address of the highest word in core memory.	3-56
3.6.8	Requests for Interfacing with the Command String Interpreter	3-57
3.6.8.1	.CSI1 - Condense command string and check syntax.	3-57
3.6.8.2	.CSI2 - Interpret one dataset specification of a command string.	3-58
3.6.9	.CVTDT - Convert binary representation of date or time to ASCII character string.	3-61
3.6.10	.DATE - Obtain current date.	3-62
3.6.11	.DELET - Delete a file.	3-63
3.6.12	.D2BIN - Convert five decimal ASCII characters into one binary word.	3-64
3.6.13	.EXIT - Exit from a user program to Monitor.	3-64
3.6.14	.GTCIL - Return the address of the first block of the Monitor core image library (CIL).	3-65
3.6.15	.GTCLK - Obtains system clock information.	3-65
3.6.16	.GTOVF - Obtains and sets the overlay flag.	3-66
3.6.17	.GTPLA - Return the current program low address.	3-66
3.6.18	.GTRDV - Gets run device information.	3-67
3.6.19	.GTSTK - Return the current stack base entry.	3-67
3.6.20	.GTUIC - Get the current user's UIC.	3-68
3.6.21	.INIT - Associate a dataset with a device driver and set up the initial linkage.	3-68
3.6.22	.LOOK - Search the device directory for a specified filename.	3-69
3.6.23	.MONF - Obtain the address of the first word above the Monitor's highest allocated free core buffer.	3-71
3.6.24	.MONR - Obtain the address of the first word not within the resident Monitor.	3-72
3.6.25	.OPEN - Prepare a device (which has been INITed) for data transfer and associate the dataset with a file (if the device is file-structured).	3-72
3.6.26	.O2BIN - Convert six octal ASCII characters into one binary word.	3-76
3.6.27	Request to Perform Conversions	3-76
3.6.27.1	.RADPK - Pack three ASCII characters into one Radix-50 word.	3-76
3.6.27.2	.RADUP - Unpack one Radix-50 word into three ASCII characters.	3-79
3.6.28	.READ - Read the next record in the dataset.	3-80
3.6.29	.RECRD - Read or write a specific record in a file.	3-81
3.6.30	.RENAM - Rename a file. Change protection code.	3-82
3.6.31	.RLSE - Remove the linkage between a device driver and a dataset and release the driver.	3-83
3.6.32	.RSTRT - Set the default address for use by the REstart keyboard command.	3-84
3.6.33	.RUN - Load and process the program.	3-84
3.6.34	.SPEC - Special functions.	3-86
3.6.35	.STAT - Obtain device status.	3-87
3.6.36	.STFPU - Initialize the floating-point exception vector.	3-88
3.6.37	.STPLA - Set the program low address.	3-89
3.6.38	.STSTK - Modify the stack base entry.	3-89
3.6.39	.SYSDV - Get the name of the system device.	3-90
3.6.40	.TIME - Obtain current time of day.	3-91

	<u>Page</u>	
3.6.41	.TRAN - Read or write the specified block (file-structured device) or the next block (non-file-structured device).	3-91
3.6.42	.TRAP - Set interrupt vector for the trap instruction.	3-93
3.6.43	.WAIT - Wait for completion of process on dataset.	3-93
3.6.44	.WAITR - Check for completion of processing on dataset and return or transfer.	3-94
3.6.45	.WRITE - Write the next record in the dataset.	3-94
3.6.46	.DUMP - Dump specified core locations to the line printer. This Monitor directive can only be used in Batch mode.	3-95
3.6.47	.FLUSH - Bypasses lines in the batch stream. This Monitor directive can only be used in Batch mode.	3-97
3.7	EMT Code Summary	3-98
CHAPTER 4 USER PROGRAM TABLES AND CONTROL BLOCKS		3-100
4.1	The Link Block (used for all input/output and directory requests)	3-100
4.2	The Filename Block	3-101
4.3	The Line Buffer Header (used by READ and WRITE requests)	3-104
4.3.1	The Transfer Modes	3-106
4.3.2	The Status Byte	3-108
4.4	The RECORD Block	3-110
4.5	The BLOCK Block (used by TRAN request only)	3-111
4.6	The TRAN Block (used by TRAN request only)	3-112
4.7	The RUN Block	3-113
CHAPTER 5 SUBSIDIARY ROUTINES AND OVERLAYS		3-119
CHAPTER 6 COMMAND STRING INTERPRETER		3-121
6.1	System Program/User Program Command Strings	3-121
6.2	CSI Command Format	3-121
6.3	CSI Command Example	3-124
CHAPTER 7 SPECIAL I/O FUNCTIONS		3-125
7.1	Special Function Block and Code	2-125
7.1.1	The Special Functions Block (used for SPEC request only)	3-125
7.1.2	The Special Functions Code	3-126
7.2	Magtape Special Functions	3-126
7.2.1	Special Function Block	3-126
7.2.2	Special Function Code	3-126
7.2.2.1	OFFLINE (Rewind and Unload) - Function Code 1	3-126
7.2.2.2	WRITE END-OF-FILE - Function Code 2	3-127
7.2.2.3	REWIND - Function Code 3	3-127
7.2.2.4	SKIP RECORD(S) - Function Code 4	3-127
7.2.2.5	BACKSPACE RECORD(S) - Function Code 5	3-127
7.2.2.6	SET DENSITY AND PARITY - Function Code 6	3-127
7.2.2.7	TAPE UNIT STATUS - Function Code 7	3-128
7.2.2.8	SET BUFFER SIZE - Function Code 8	3-128
7.2.2.9	REWIND ENABLE/DISABLE - Function Code 9	3-129
7.3	Cassette Tape Special Functions	3-129
7.3.1	Special Function Block	3-129

	<u>Page</u>	
7.3.2	Special Function Code	3-130
7.3.2.1	OFFLINE (Rewind and Unload) - Function Code 1	3-130
7.3.2.2	WEOF (Write End-of-File) - Function Code 2	3-131
7.3.2.3	REWIND - Function Code 3	3-131
7.3.2.4	FBLOCK (Space Forward Blocks) - Function Code 4	3-131
7.3.2.5	RBLOCK (Space Reverse Blocks) - Function Code 5	3-131
7.3.2.6	PARITY (Parity/Density) - Function Code 6	3-132
7.3.2.7	STATUS (Software Formatted Status) - Function Code 7	3-132
7.3.2.8	BLOCK (Record Length Specifications) - Function Code 8	3-135
7.3.2.9	GOVERN (Enable/Disable) - Function Code 9	3-135
7.3.2.10	FFILE (Space Forward Files) - Function Code 10	3-136
7.3.2.11	RFILE (Space Reverse Files) - Function Code 11	3-136
7.3.2.12	VCHECK (Read After Write Verification) - Function Code 12	3-137
7.4	Card Reader Special Function (Code 1)	3-137
7.5	LS11 Printer Special Function (Code 1)	3-138
CHAPTER 8 EXAMPLE PROGRAMS		3-139
CHAPTER 9 SUMMARY OF MONITOR COMMANDS AND PROGRAMMED REQUESTS		3-148
9.1	Summary of Monitor Commands	3-148
9.2	Summary of Monitor Programmed Requests	3-150
<u>PART 4 THE BATCH USER'S GUIDE</u>		
CHAPTER 1 HOW TO USE BATCH		4-1
1.1	Introduction	4-1
1.2	Standard Batch Peripheral Devices	4-5
1.2.1	Use of Pseudo-Device Specifiers (BI, SY)	4-5
1.2.2	Device Assignment	4-6
1.2.2.1	FORTRAN Logical Units	4-6
1.2.2.2	Macro Device Assignment	4-6
1.3	Batch Operating Procedures	4-7
1.3.1	Entering Batch Mode	4-7
1.3.2	Operator-System Communication	4-9
1.3.2.1	Error Messages	4-9
1.3.2.2	Messages to the Operator	4-9
1.3.2.3	Operator Commands	4-10
1.3.2.4	Commands Printed at the Keyboard	4-11
CHAPTER 2 BATCH COMMAND LANGUAGE		4-12
2.1	Batch Command Language	4-12
2.1.1	Batch Commands	4-12
2.1.2	Concise Commands	4-15
2.1.3	Synchronous/Asynchronous Commands	4-15
2.1.4	Monitor Command Statements	4-16
2.1.4.1	\$ASSIGN	4-16
2.1.4.2	\$BEGIN	4-18
2.1.4.3	\$CHANGE	4-18
2.1.4.4	\$CPY	4-19
2.1.4.5	\$DATE	4-20
2.1.4.6	\$DEL	4-20
2.1.4.7	\$DIR	4-21
2.1.4.8	\$DUMP	4-22
2.1.4.9	\$EOD	4-22
2.1.4.10	\$EX[ECUTE]	4-23

	<u>Page</u>
2.1.4.11 \$FINISH	4-24
2.1.4.12 \$FORTRN	4-24
2.1.4.13 \$GET	4-25
2.1.4.14 \$JOB	4-26
2.1.4.15 \$KILL	4-28
2.1.4.16 \$LINK	4-28
2.1.4.17 \$LIST	4-29
2.1.4.18 \$MACRO	4-29
2.1.4.19 \$MESSAGE	4-30
2.1.4.20 \$MODIFY	4-31
2.1.4.21 \$OWN	4-31
2.1.4.22 \$RESTART	4-32
2.1.4.23 \$RNM	4-32
2.1.4.24 \$RUN	4-33
2.1.4.25 \$SAVE	4-33
2.1.4.26 \$TIME	4-34
2.1.4.27 \$WAIT	4-35
2.2 Input to Command String Interpreter	4-35
2.3 System Program Commands	4-36
2.4 Reading Control Characters as Data	4-37
 CHAPTER 3 INPUT/OUTPUT	 4-38
3.1 Batch Input	4-38
3.1.1 Normal Input Mode	4-38
3.1.2 OWN Mode	4-38
3.2 Batch Output	4-39
3.2.1 Job Log	4-39
3.2.2 Dumps	4-39
 CHAPTER 4 BATCH PROGRAMMING CONVENTIONS	 4-42
4.1 Command Datasets	4-42
4.1.1 Command String Input (CMI)	4-42
4.1.2 Command Output (CMO)	4-43
4.1.3 Program Command Input (PCI)	4-43
4.1.4 Command Data Input (CDI)	4-43
4.2 Reads from Batch Stream	4-44
4.3 Pseudo Device Specifiers	4-44
4.4 Use of Assign	4-44
4.5 Note Pertaining to .CSI2 Return Conditions	4-45
4.6 Error Handling	4-45
 CHAPTER 5 BATCH CARDS	 4-46
5.1 Card Codes	4-46
5.2 Read Limitations	4-47
5.3 Binary Data	4-47
5.4 Error Conditions	4-48
 <u>PART 5 DOS/BATCH DEVICE DRIVERS</u>	
 CHAPTER 1 USING DEVICE DRIVERS OUTSIDE DOS/BATCH	 5-1
 CHAPTER 2 DRIVER FORMAT	 5-2
2.1 Structure	5-2
2.1.1 Driver Interface Table	5-2
2.1.2 Setup Routines	5-2

	<u>Page</u>	
2.1.3	Interrupt Servicing	5-3
2.1.4	Error Handling	5-3
2.2	Interface to the Driver	5-3
2.2.1	Control Interface	5-3
2.2.2	Interrupt Interface	5-4
CHAPTER 3 STAND-ALONE USE		5-5
3.1	Driver Assembled with Program	5-5
3.1.1	Setting Interrupt Vector	5-5
3.1.2	Parameter Table for Driver Call	5-6
3.1.3	Calling the Driver	5-7
3.1.4	User Registers	5-7
3.1.5	Returns From Driver	5-8
3.1.6	Irrecoverable Errors	5-9
3.1.7	General Comment	5-10
3.2	Drivers Assembled Separately	5-10
3.3	Device-Independent Usage	5-11
CHAPTER 4 I/O DRIVERS WITHIN THE DOS/BATCH OPERATING SYSTEM		5-15
4.1	Driver Structure	5-15
4.2	Monitor Calling	5-16
4.3	Driver Routines	5-18
4.3.1	Transfer	5-18
4.3.2	Interrupt Servicing	5-18
4.3.3	OPEN	5-19
4.3.4	CLOSE	5-20
4.3.5	SPECIAL	5-21
4.4	Drivers for Terminals	5-21
CHAPTER 5 SAMPLE LINE PRINTER DRIVER LISTING		5-22
<u>PART 6 THE DOS/BATCH ASSEMBLER (MACRO)</u>		
CHAPTER 1 INTRODUCTION TO THE MACRO ASSEMBLER		6-1
CHAPTER 2 SOURCE PROGRAM FORMAT		6-3
2.1	Statement Format	6-3
2.1.1	Label Field	6-4
2.1.2	Operator Field	6-5
2.1.3	Operand Field	6-5
2.1.4	Comment Field	6-6
2.2	Format Control	6-6
CHAPTER 3 SYMBOLS AND EXPRESSIONS		6-7
3.1	Character Set	6-7
3.1.1	Separating and Delimiting Characters	6-8
3.1.2	Illegal Characters	6-10
3.1.3	Operators	6-10
3.2	Terms	6-11
3.3	Expressions	6-11
3.4	Macro Symbols	6-12
3.4.1	Permanent Symbols	6-13
3.4.2	User-Defined and Macro Symbols	6-13
3.5	Direct Assignment	6-14
3.6	Register Symbols	6-15

	<u>Page</u>	
3.7	Local Symbols	6-16
3.8	Assembly Location Counter	6-18
3.9	Numbers	6-19
3.10	Relocation and Linking	6-20
CHAPTER 4 ADDRESSING INFORMATION		6-21
4.1	Mode Forms and Codes	6-21
4.2	Branch Instruction Addressing	6-22
CHAPTER 5 GENERAL ASSEMBLER DIRECTIVES		6-23
5.1	Listing Control Directives	6-23
5.1.1	.LIST and .NLIST	6-23
5.1.2	Page Headings	6-28
5.1.3	.TITLE	6-29
5.1.4	.SBTTL	6-29
5.1.5	.IDENT	6-30
5.1.6	Page Ejection	6-31
5.2	Functions: .ENABL and .DSABL Directives	6-32
5.3	Data Storage Directives	6-35
5.3.1	.BYTE	6-35
5.3.2	.WORD	6-36
5.3.3	ASCII Conversion of One or Two Characters	6-37
5.3.4	.ASCII	6-38
5.3.5	.ASCIZ	6-39
5.3.6	.RAD5Ø	6-40
5.4	Radix Control	6-41
5.4.1	.RADIX	6-41
5.4.2	Temporary Radix Control: †D, †O, and †B	6-42
5.5	Location Counter Control	6-42
5.5.1	.EVEN	6-43
5.5.2	.ODD	6-43
5.5.3	.BLKB and .BLKW	6-43
5.6	Numeric Control	6-44
5.6.1	.FLT2 and .FLT4	6-45
5.6.2	Temporary Numeric Control: †F and †C	6-45
5.7	Terminating Directives	6-46
5.7.1	.END	6-46
5.7.2	.EOT	6-47
5.8	Program Boundaries Directive: .LIMIT	6-47
5.9	Program Section Directives	6-47
5.9.1	.PSECT Directive	6-47
5.9.1.1	Creating Program Sections	6-49
5.9.1.2	Code or Data Sharing	6-51
5.9.2	.ASECT and .CSECT Directives	6-52
5.10	Symbol Control: .GLOBL	6-52
5.11	Conditional Assembly Directives	6-54
5.11.1	Subconditionals	6-56
5.11.2	Immediate Conditionals	6-57
5.11.3	PAL-11R Conditional Assembly Directives	6-58
CHAPTER 6 MACRO DIRECTIVES		6-59
6.1	MACRO Definition	6-59
6.1.1	.MACRO	6-59
6.1.2	.ENDM	6-60
6.1.3	.MEXIT	6-60
6.1.4	MACRO Definition Formatting	6-61

	<u>Page</u>	
6.2	MACRO Calls	6-62
6.3	Arguments for MACRO Calls and Definitions	6-62
6.3.1	Macro Nesting	6-63
6.3.2	Concatenation	6-65
6.3.3	Special Characters	6-65
6.3.4	Numeric Arguments Passed as Symbols	6-66
6.3.5	Number of Arguments	6-67
6.3.6	Automatically Created Symbols	6-67
6.4	.NARG, .NCHR, and .NTYPE	6-68
6.5	.ERROR and .PRINT	6-71
6.6	Indefinite Repeat Block: .IRP and .IRPC	6-72
6.7	Repeat Block: .REPT	6-74
6.8	MACRO Libraries: .MCALL	6-75
CHAPTER 7 OPERATING PROCEDURES		6-76
7.1	Loading MACRO	6-76
7.2	Command Input String	6-76
7.3	Cross-Reference Table Generation	6-78
CHAPTER 8 A SUMMARY OF THE MACRO ASSEMBLY LANGUAGE AND ASSEMBLER		6-82
8.1	Special Characters	6-82
8.2	Address Mode Syntax	6-83
8.3	Assembler Directives	6-84
CHAPTER 9 PERMANENT SYMBOL TABLE		6-88
CHAPTER 10 WRITING POSITION-INDEPENDENT CODE		6-93
<u>PART 7 THE DOS/BATCH FORTRAN COMPILER AND OBJECT TIME SYSTEM</u>		
CHAPTER 1 INTRODUCTION TO FORTRAN		7-1
1.1	DOS/BATCH FORTRAN	7-1
1.2	Software and Hardware Environments	7-2
1.3	How to Use This Manual	7-3
1.4	FORTRAN Statement Structure	7-3
1.4.1	Formatting a FORTRAN Line	7-3
1.4.2	Statement Number Field	7-5
1.4.3	Continuation Lines	7-6
1.4.4	Comment Lines	7-6
1.5	Program Unit Structure	7-6
CHAPTER 2 FORTRAN STATEMENT COMPONENTS		7-7
2.1	FORTRAN Character Set	7-7
2.2	FORTRAN Constants	7-7
2.2.1	Integer Constants	7-8
2.2.2	Real Constants	7-8
2.2.3	Double-Precision Constants	7-9
2.2.4	Octal Constants	7-9
2.2.5	Hexadecimal Constants	7-10
2.2.6	Complex Constants	7-10
2.2.7	Logical Constants	7-11
2.2.8	Hollerith Constants	7-11
2.2.9	Radix-50 Constants	7-12
2.3	FORTRAN Variables	7-13
2.3.1	Integer Variables	7-14

	<u>Page</u>	
2.3.2	LOGICAL*1 Variables	7-14
2.3.3	Array Variables	7-14
2.4	FORTRAN Expressions	7-15
2.4.1	Arithmetic Expressions	7-15
2.4.2	Use of Parentheses	7-16
2.4.3	Mixed Mode Arithmetic Expressions	7-17
2.4.4	Logical Expressions	7-19
2.5	Operator Summary	7-22
CHAPTER 3 ASSIGNMENT STATEMENTS		7-23
3.1	Arithmetic Assignment Statement	7-23
3.2	Logical Assignment Statement	7-25
3.3	ASSIGN Statement	7-25
CHAPTER 4 CONTROL STATEMENTS		7-27
4.1	GOTO Statements	7-27
4.1.1	Unconditional GOTO Statement	7-27
4.1.2	Computed GOTO Statement	7-27
4.1.3	Assigned GOTO Statement	7-28
4.2	IF Statements	7-29
4.2.1	Arithmetic IF Statement	7-29
4.2.2	Logical IF Statement	7-30
4.3	DO Statement	7-30
4.4	CONTINUE Statement	7-33
4.5	PAUSE Statement	7-33
4.6	STOP Statement	7-34
4.7	END Statement	7-34
CHAPTER 5 SPECIFICATION STATEMENTS		7-35
5.1	IMPLICIT Statement	7-35
5.2	TYPE DECLARATION Statement	7-37
5.3	DIMENSION Statement	7-38
5.3.1	Array Storage	7-39
5.4	COMMON Statement	7-40
5.5	EQUIVALENCE Statement	7-43
5.5.1	Equivalencing Array Variables	7-45
5.5.2	EQUIVALENCE and COMMON Interaction	7-45
5.5.3	EQUIVALENCE and BYTE Arrays	7-46
5.6	EXTERNAL Statement	7-47
5.7	DATA Statement	7-47
CHAPTER 6 FORTRAN FUNCTIONS AND SUBROUTINES		7-51
6.1	Procedures	7-51
6.2	FORTRAN Library Functions	7-52
6.3	ARITHMETIC Statement Functions	7-52
6.4	External Subprograms	7-56
6.4.1	Subprogram Arguments	7-56
6.4.2	Adjustable Dimensions	7-58
6.4.3	FUNCTION Subprograms	7-59
6.4.4	SUBROUTINE Subprograms	7-61
6.4.5	CALL Statement	7-62
6.4.6	RETURN Statement	7-62
6.4.7	BLOCK DATA Subprograms	7-63
6.5	Null Arguments in Calls to Subroutines or Functions	7-63

	<u>Page</u>
CHAPTER 7    FORMAT STATEMENTS	7-65
7.1        FORMAT Statements	7-65
7.2        I Format Conversions	7-67
7.3        O Format Conversions	7-68
7.4        F Format Conversions	7-68
7.5        E Format Conversions	7-69
7.6        D Format Conversions	7-70
7.7        G Format Conversions	7-71
7.8        Complex I/O	7-73
7.9        Scale Factors	7-74
7.10       L Format Conversions	7-75
7.11       A Format Conversions	7-75
7.12       Alphanumeric Data Within Format Specifications	7-76
7.13       Q Format Specification	7-78
7.14       Default Field Specifications	7-78
7.15       Short Field Termination on Formatted Input	7-79
7.16       Record Layout Specifications	7-79
7.17       Variable Format Expressions	7-80
7.18       Carriage Control	7-82
7.19       Repetition of Fields, Groups, and Multiple Records	7-83
7.20       Formats Stored as Data	7-84
CHAPTER 8    I/O AND DEVICE HANDLING STATEMENTS	7-86
8.1        Introduction to FORTRAN I/O	7-86
8.1.1      I/O Devices	7-87
8.1.2      I/O Records	7-88
8.1.3      I/O Lists	7-89
8.2        Formatted I/O	7-90
8.2.1      Formatted READ Statement	7-90
8.2.2      Formatted WRITE Statement	7-92
8.2.3      PRINT Statement	7-93
8.3        Unformatted I/O	7-93
8.3.1      Unformatted READ Statement	7-93
8.3.2      Unformatted WRITE Statement	7-94
8.4        Direct Access I/O	7-95
8.4.1      DEFINE FILE Statement	7-95
8.4.2      FIND Statement	7-96
8.4.3      Direct Access READ Statement	7-96
8.4.4      Direct Access WRITE Statement	7-97
8.5        Transfer of Control on Error Condition	7-97
8.6        Device Control Statements	7-98
8.6.1      BACKSPACE Statement	7-98
8.6.2      REWIND Statement	7-99
8.6.3      END FILE Statement	7-99
8.7        ENCODE and DECODE	7-99
CHAPTER 9    OPERATING PROCEDURES	7-102
9.1        Using the FORTRAN System	7-102
9.1.1      Filename Specifications	7-103
9.1.2      Compilation and Linking Procedures	7-104
9.1.3      Compile-Load-and-Go Operation	7-106
9.1.4      FORTRAN Library Usage	7-106
9.2        FORTRAN Output Listing Format	7-107
9.3        Compile-Time Memory Requirements	7-109

	<u>Page</u>
CHAPTER 10 FORTRAN OPERATING ENVIRONMENT	7-110
10.1 FORTRAN Object Time System	7-110
10.2 Threaded Code	7-110
10.2.1 Entry to Polish Mode	7-112
10.2.2 Exit from Polish Mode	7-113
10.2.3 Polish Mode Subroutine Calls	7-113
10.3 FORTRAN Run-Time Memory Organization	7-114
10.4 Debugging FORTRAN Programs	7-116
10.5 FORTRAN OTS Error Processing	7-118
CHAPTER 11 FORTRAN MONITOR I/O CONSIDERATIONS	7-120
11.1 Input/Output Overview	7-120
11.2 File Structures and Formats	7-123
11.2.1 FORTRAN Formatted I/O	7-124
11.2.2 FORTRAN Unformatted I/O	7-124
11.2.3 FORTRAN Direct-Access I/O	7-126
11.3 FORTRAN I/O Error Handling	7-127
11.4 FORTRAN Device Assignments	7-127
11.5 The FORTRAN Device Table, \$DEVTB	7-129
11.6 I/O Example	7-132
CHAPTER 12 FORTRAN WORD FORMATS	7-136
12.1 Integer Format	7-136
12.2 Floating-Point Formats	7-136
12.2.1 Real Format (2-Word-Floating-Point)	7-137
12.2.2 Double Precision Format (4-Word Floating-Point)	7-137
12.3 Complex Format	7-138
12.4 Byte Format	7-139
12.5 Hollerith Format	7-139
12.6 Logical Format	7-139
12.7 Radix-50 Format	7-139
CHAPTER 13 FORTRAN LIBRARY FUNCTIONS	7-140
CHAPTER 14 SYSTEM SUBPROGRAMS	7-145
14.1 Library Arithmetic Functions	7-145
14.2 System Subroutines and Functions	7-145
14.2.1 PDUMP	7-146
14.2.2 SETPDU	7-148
14.2.3 SETFIL	7-148
14.2.4 ASSIGN	7-151
14.2.5 SETERR	7-151
14.2.6 TSTERR	7-152
14.2.7 RANDU,RAN	7-153
14.2.8 EXIT	7-154
14.2.9 DATE	7-154
14.2.10 TIME	7-155
14.2.11 SECNDS	7-157
14.2.12 Radix-50 Conversions	7-157
14.2.12.1 IRAD50	7-157
14.2.12.2 RAD50	7-158
14.2.12.3 R50ASC	7-159
14.2.13 SSWTCH	7-159
14.2.14 Character String Arguments to System Subroutines	7-160

	<u>Page</u>
CHAPTER 15 FORTRAN CALLING SEQUENCE CONVENTIONS	7-161
15.1    PDP-11 FORTRAN "R5" Calling Sequence Convention	7-161
15.1.1    The Call Site	7-161
15.1.2    Return	7-161
15.1.3    Return Value Transmission	7-162
15.1.4    Null Arguments	7-163
15.2    Macros for PDP-11 FORTRAN Calling Sequence	7-163
15.2.1    Introduction	7-163
15.2.2    Calling a FORTRAN Subprogram	7-164
15.2.3    Returning to a FORTRAN Program	7-167
15.2.4    Obtaining the Returned Value	7-168
15.2.5    Obtaining and Using the Macros	7-169
15.2.6    Programming Cautions and Notes	7-170
CHAPTER 16 FORTRAN TRACE PACKAGE	7-171
16.1    Trace Package	7-171
16.2    Trace Output Description	7-171
16.3    Selective Control of Program Tracing	7-171
16.4    Trace Output Dependence on Compilation Options	7-173
16.5    Usage	7-174
CHAPTER 17 FORTRAN DEVICE TABLE LISTING	7-178
 <u>PART 8 THE DOS/BATCH TEXT EDITOR (EDIT)</u>	
CHAPTER 1 INTRODUCTION TO "EDIT" A TEXT EDITOR	8-1
CHAPTER 2 OPERATING PROCEDURES	8-2
2.1    Calling and Using EDIT	8-2
2.2    Creating a New File	8-3
2.3    Restarting an EDIT Session	8-4
2.4    Finishing an EDIT Session	8-5
2.5    Error Recovery	8-5
2.6    Procedure with the Low-Speed Punch	8-5
CHAPTER 3 COMMANDS	8-6
3.1    Mode of Operation	8-6
3.1.1    Command Mode	8-6
3.1.2    Text Mode	8-6
3.2    Command Syntax	8-7
3.2.1    The Character Location Pointer (Dot)	8-7
3.2.2    Mark	8-7
3.2.3    Character-Oriented Command Properties	8-8
3.2.4    Line-Oriented Command Properties	8-8
3.2.5    The Page Unit of Input	8-8
3.2.6    Arguments	8-9
3.2.7    Command Strings	8-9
3.3    Editing Commands	8-10
3.3.1    Input/Output Commands	8-10
3.3.1.1    Read and Edit Read	8-10
3.3.1.2    Write and Edit Write	8-11
3.3.1.3    Next	8-11
3.3.1.4    List	8-12
3.3.1.5    Verify	8-12
3.3.1.6    End File	8-12

	<u>Page</u>	
3.3.1.7	EXit	8-13
3.3.1.8	Form Feed and Trailer	8-13
3.3.2	Commands to Move the Location Pointer	8-13
3.3.2.1	Beginning	8-13
3.3.2.2	Jump	8-14
3.3.2.3	Advance	8-15
3.3.2.4	Mark	8-15
3.3.3	Search Commands	8-15
3.3.3.1	Get	8-15
3.3.3.2	wHole	8-16
3.3.3.3	Edit wHole	8-17
3.3.3.4	Position	8-17
3.3.3.5	Edit Position	8-17
3.3.4	Commands to Modify the Text	8-18
3.3.4.1	Insert	8-18
3.3.4.2	Delete	8-18
3.3.4.3	Kill	8-19
3.3.4.4	Change	8-20
3.3.4.5	Exchange	8-20
3.3.5	Utility Commands	8-21
3.3.5.1	Save	8-21
3.3.5.2	Unsave	8-21
3.3.5.3	Execute Macro	8-22
3.3.5.4	Edit Open	8-22
CHAPTER 4 IMPLEMENTATION NOTES		8-23
4.1	Macro Usage	8-23
4.2	Delimiter Usage	8-24
4.3	Subsidiary I/O	8-24
4.4	Core Usage for Save and Unsave	8-24
CHAPTER 5 EXAMPLES		8-26
CHAPTER 6 COMMAND SUMMARY		8-34
<u>PART 9 THE DOS/BATCH LINKER (LINK)</u>		
CHAPTER 1 INTRODUCTION TO THE LINK LINKER		9-1
1.1	Global Symbols	9-2
1.2	Relinking LINK	9-2
CHAPTER 2 INPUT AND OUTPUT		9-3
2.1	Input Modules	9-3
2.2	Output Module	9-3
2.2.1	Absolute Loader	9-3
2.2.2	Program Transfer Address	9-4
2.3	Load Map	9-4
CHAPTER 3 OPERATING PROCEDURES		9-5
3.1	Loading	9-5
3.2	Command String	9-5
3.2.1	Switches	9-7
3.2.1.1	Top and Bottom Switches	9-7
3.2.1.2	Concatenate Switch	9-8
3.2.1.3	ODT Switch	9-8

	<u>Page</u>	
3.2.1.4	Transfer Address Switch	9-8
3.2.1.5	End Switch	9-9
3.2.1.6	Library Switch	9-9
3.2.1.7	Go Switch	9-10
3.2.1.8	Overlay Mapping Description Switch	9-10
3.2.1.9	Options Switch	9-10
3.2.1.10	Include/Exclude Switches	9-10
3.2.1.11	Long/Short Map Switches	9-11
3.2.1.12	Global Cross-Reference Switch	9-11
3.2.1.13	Contiguous Output Switch	9-11
3.2.1.14	Program Section Sequencing Switch	9-12
3.2.1.15	General Notes on Switches	9-12
3.3	Library Searches	9-12
3.3.1	User Libraries	9-12
3.3.2	Monitor Library	9-13
3.4	Sample Links	9-14
3.4.1	FORTRAN	9-14
3.4.2	Assembly Language	9-14
3.4.3	Overlays	9-15
3.5	Programming Notes	9-15
 CHAPTER 4 OVERLAYS		 9-16
4.1	Terminology	9-17
4.2	Loading Overlays	9-18
4.2.1	Manual Load	9-18
4.2.2	AUTOLOAD	9-20
4.3	Overlay Description Language	9-21
4.3.1	The .ROOT Directive	9-22
4.3.2	The .NAME Directive	9-24
4.3.3	The .FCTR Directive	9-25
4.3.4	The .PSECT Directive	9-26
4.3.5	The .END Directive	9-28
4.4	Autoload Operator Asterisk (*)	9-29
4.5	ODL Usage Specifications	9-29
4.6	Examples of Overlaid Program Building Using LINK	9-29
4.7	Manual Load Overlays from FORTRAN	9-34
4.8	Autoload Overlays from FORTRAN	9-39
4.9	FORTRAN Format Conversions and I/O Routines	9-41
 CHAPTER 5 PROGRAM MEMORY ORGANIZATION		 9-44
5.1	Allocation for a Nonoverlaid Program	9-44
5.1.1	Read/Write Code (and Data) (R/W)	9-44
5.1.2	Read-Only Code (and Data) (R-O)	9-44
5.2	Allocation for an Overlaid Program	9-44
5.2.1	Root Segment Allocation	9-44
5.2.2	The Segment Tables	9-45
5.2.3	Autoload Vectors	9-47
5.3	Overlay Memory Allocation	9-47
5.4	Overall Memory Organization	9-48
 CHAPTER 6 MEMORY ALLOCATION		 9-50
6.1	Memory Allocation Procedures	9-50
6.1.1	Allocating Root Segment Memory	9-50
6.1.2	Allocating Overlay Segment Memory	9-51
6.2	Memory Allocation Map	9-51
6.3	LINK Tree Walk Algorithm	9-52

	<u>Page</u>
CHAPTER 7 LINKING OPTIONS	9-54
7.1 Optional Input	9-54
7.2 Absolute Patch (ABSPAT)	9-55
7.3 Extend Control Section (EXTSCT)	9-56
7.4 Global Symbol Definition (GBLDEF)	9-57
7.5 Global Patch (GBLPAT)	9-57
7.6 Reserved Symbols and Special Files	9-58
CHAPTER 8 LINK INPUT DATA FORMATS	9-60
8.1 Global Symbol Directory	9-62
8.1.1 Module Name	9-64
8.1.2 Control Section Name	9-64
8.1.3 Internal Symbol Name	9-65
8.1.4 Transfer Address	9-65
8.1.5 Global Symbol Name	9-66
8.1.6 Program Section Name	9-67
8.1.7 Program Version Identification	9-69
8.2 End of Global Symbol Directory	9-69
8.3 Text Information	9-70
8.4 Relocation Directory	9-71
8.4.1 Internal Relocation	9-73
8.4.2 Global Relocation	9-73
8.4.3 Internal Displaced Relocation	9-74
8.4.4 Global Displaced Relocation	9-74
8.4.5 Global Additive Relocation	9-75
8.4.6 Global Additive Displaced Relocation	9-75
8.4.7 Location Counter Definition	9-76
8.4.8 Location Counter Modification	9-76
8.4.9 Program Limits	9-77
8.4.10 P-Section Relocation	9-77
8.4.11 P-Section Displaced Relocation	9-78
8.4.12 P-Section Additive Relocation	9-79
8.4.13 P-Section Additive Displaced Relocation	9-80
8.5 Internal Symbol Directory	9-81
8.6 End of Module	9-81
CHAPTER 9 PROGRAM LOAD MODULE FILE STRUCTURE	9-82
9.1 The Header	9-82
9.1.1 The Root Segment	9-84
9.1.2 Overlay Segments	9-84
9.2 Nonoverlaid Program File Structures	9-84
CHAPTER 10 .ASECTS, .CSECTS, AND .PSECTS	9-85
10.1 Program Section Directives	9-85
10.1.1 .PSECT Directive	9-85
10.1.2 Creating Program Sections	9-87
10.1.3 Code or Data Sharing	9-90
10.2 .ASECT and .CSECT Directives	9-90
CHAPTER 11 LOAD MAP EXAMPLES	9-92
11.1 Map Listing	9-92
11.1.1 Map Header	9-92
11.1.2 Segment Descriptions	9-92

	<u>Page</u>	
11.2	Attributes and Statistics	9-92
11.2.1	Read/Write Memory Limits	9-92
11.2.2	Read-Only Memory Limits	9-93
11.2.3	ODT Transfer Address	9-93
11.2.4	Program Transfer Address	9-93
11.2.5	Identification	9-93
11.3	Control Section Allocation Synopsis	9-93
11.4	File Contents	9-94
11.5	Undefined References	9-95
<u>PART 10 THE DOS/BATCH LIBRARIAN (LIBR)</u>		
CHAPTER 1	INTRODUCTION TO LIBRARIAN	10-1
CHAPTER 2	OPERATING PROCEDURES	10-3
2.1	Calling LIBR	10-3
2.2	Command String	10-3
2.2.1	Creating a Library	10-3
2.2.2	Updating a Library	10-4
2.2.2.1	To Delete One or More Object Modules	10-5
2.2.2.2	To Insert One or More Object Modules	10-5
2.2.2.3	To Replace One or More Object Modules	10-6
2.2.3	Listing a Library	10-6
2.2.4	Naming Libraries	10-7
2.2.5	Legal File Specification Combinations	10-8
CHAPTER 3	EXAMPLES	10-9
<u>PART 11 THE DOS/BATCH DEBUGGING PROGRAM (ODT)</u>		
CHAPTER 1	INTRODUCTION TO THE DEBUGGING PROGRAM ODT	11-1
1.1	Relocation	11-1
1.2	Relocatable Expressions	11-2
1.3	Commands	11-3
CHAPTER 2	COMMANDS AND FUNCTIONS	11-6
2.1	Printout Formats	11-6
2.2	Opening, Changing and Closing Locations	11-7
2.2.1	Slash /	11-7
2.2.2	Backslash \	11-8
2.2.3	LINE FEED Key ↓	11-8
2.2.4	Up-Arrow ↑	11-9
2.2.5	Back-Arrow ←	11-9
2.2.6	Open the Addressed Location @	11-10
2.2.7	Relative Branch Offset >	11-10
2.2.8	Return to Previous Sequence <	11-10
2.2.9	Accessing General Registers 0-7	11-11
2.2.10	Accessing Internal Registers	11-11
2.2.11	Radix-50 Mode X	11-12
2.3	Breakpoints	11-13
2.4	Running the Program r;G and r;P	11-14
2.5	Single-Instruction Mode	11-15
2.6	Searches	11-16
2.6.1	Word Search x;W	11-16
2.6.2	Effective Address Search r;E	11-17
2.7	Constant Register r;C	11-18

	<u>Page</u>		
2.8	Core Block Initialization ;F and ;I	11-18	
2.9	Calculating Offsets r;O	11-19	
2.10	Relocation Register Commands r;nR, ;nR, ;R	11-20	
2.11	The Relocation Calculators nR and n!	11-21	
2.12	ODT Priority Level \$P	11-22	
2.13	ASCII Input and Output r;nA	11-22	
2.14	Return to Monitor CTRL/C	11-23	
2.15	Error Detection	11-23	
 CHAPTER 3 PROGRAMMING CONVENTIONS		 11-25	
3.1	Functional Organization	11-25	
3.2	Breakpoints	11-25	
3.3	Search	11-30	
3.4	Terminal Interrupt	11-31	
 CHAPTER 4 OPERATING PROCEDURES		 11-32	
4.1	Loading Procedures	11-32	
4.2	Starting and Restarting	11-32	
4.3	Using ODT with Stand-Alone Systems	11-33	
 <table border="1" style="margin: auto;"><tr><td>GENERAL UTILITY PROGRAMS</td></tr></table> 		GENERAL UTILITY PROGRAMS	
GENERAL UTILITY PROGRAMS			
<u>PART 12 THE DOS/BATCH FILE UTILITY PACKAGE (PIP)</u>			
 CHAPTER 1 INTRODUCTION TO THE PERIPHERAL INTERCHANGE PROGRAM (PIP)		 12-1	
1.1	Calling PIP	12-1	
 CHAPTER 2 COMMAND STRINGS		 12-3	
2.1	General Command String Formats	12-3	
2.2	Device Specification	12-4	
2.3	Filename Specification	12-4	
2.4	Filename Extension Specification	12-5	
2.5	Asterisk Feature	12-5	
2.6	Switch Specifications	12-7	
 CHAPTER 3 FILE MANIPULATION		 12-9	
3.1	File Transfers	12-9	
3.1.1	File Copy Operation	12-9	
3.1.2	Fast Copy and/or Verify Operations	12-10	
3.1.3	File Merge Operation	12-10	
3.1.4	File Transfer Modes	12-11	
3.1.5	Contiguous Files	12-12	
3.1.6	Transfers from the Terminal	12-13	
3.2	Renaming Files	12-14	
3.3	Deleting Files	12-14	
3.4	Inspect Switch	12-15	
3.5	Supersede Operation	12-16	
3.6	Protect Switch	12-17	
3.7	Allocating a Contiguous File	12-17	
 CHAPTER 4 DIRECTORY MANIPULATION		 12-19	
4.1	Entering User Identification into the Master File Directory	12-19	

	<u>Page</u>	
4.2	Directory Listings	12-20
4.2.1	Full Directories	12-20
4.2.2	Brief Directory Listings	12-25
4.3	Free Blocks	12-28
4.4	DECTape and RK11 Disk Initialization	12-29
4.4.1	DECTape	12-29
4.4.2	RK11 Disk	12-29
4.5	Recovering Files	12-30
CHAPTER 5 MAGTAPE OPERATION		12-32
5.1	General Magtape Information	12-32
5.2	Rewind	12-32
5.3	Rewind/Unload	12-34
5.4	Zero (Initialization)	12-34
5.5	Magnetic Tape Format	12-34
CHAPTER 6 CASSETTE TAPE OPERATION		12-35
6.1	General Cassette Tape Information	12-35
6.2	Rewind	12-35
6.3	Zero (Initialization)	12-36
6.4	Cassette Tape Format	12-36
6.5	Read-After-Write Verification	12-37
CHAPTER 7 HELPFUL HINTS		12-38
<u>PART 13 THE DOS/BATCH FILE COMPARE PROGRAM (FILCOM)</u>		
CHAPTER 1 INTRODUCTION TO FILCOM		13-1
CHAPTER 2 FILECOM COMMANDS		13-2
2.1	FILCOM Command Format	13-2
2.2	Option Switches	13-2
2.2.1	LOCAL Switches	13-3
2.2.1.1	The SC (Source Compare) Switch	13-3
2.2.1.2	The BL (Blank Lines) Switch	13-4
2.2.1.3	The TR (Trailing Blanks) Switch	13-4
2.2.1.4	The MB (Multiple Blanks) Switch	13-5
2.2.1.5	The DE (Delete Existing) Switch	13-5
2.2.2	GLOBAL Switches	13-5
2.2.2.1	The DF (Define Default) Switch	13-6
2.2.2.2	The IN (Indirect Commands) Switch	13-7
2.2.2.3	The LO (LOG dataset) Switch	13-7
2.2.2.4	The LS (List dataset) Switch	13-8
CHAPTER 3 SAMPLE OUTPUT		13-9
3.1	Output from FILCOM	13-9
<u>PART 14 THE DOS/BATCH VERIFY PROGRAM (VERIFY)</u>		
CHAPTER 1 INTRODUCTION TO VERIFY		14-1
CHAPTER 2 VERIFY OPTIONS		14-3
2.1	NORMAL Option	14-3
2.2	LIST Option	14-3

	<u>Page</u>
2.3 SEARCH Option	14-5
2.4 FIX Option	14-5
2.5 ALL Option	14-6
CHAPTER 3 VERIFY COMMANDS	14-7
CHAPTER 4 VERIFY OUTPUT	14-10
4.1 Standard VERIFY Output	14-10
4.1.1 MFD Listing	14-10
4.1.2 UFD Listing	14-11
4.1.3 MAP Listing	14-12
4.1.4 Search Information For a Block	14-13
 <u>PART 15 THE DOS/BATCH FILE DUMP PROGRAM (FILDMP)</u>	
CHAPTER 1 INTRODUCTION TO FILDMP	15-1
1.1 Introduction	15-1
1.2 Running FILDMP	15-2
CHAPTER 2 SWITCHES	15-3
2.1 Input Switches	15-3
2.2 Output Switches	15-4
2.3 Output Formats	15-5
2.4 Dumping Entire Files	15-6
2.5 Determining File Blocks, /CH	15-6
2.6 Dumping Block of Data, /BL	15-7
2.7 Dumping Radix-50 Formatted Data, /RA	15-7
CHAPTER 3 SAMPLE OUTPUT	15-9
 <u>PART 16 THE DOS/BATCH EBCDIC CONVERSION PROGRAM (EBASCI)</u>	
CHAPTER 1 INTRODUCTION TO EBASCI	16-1
CHAPTER 2 OPERATING PROCEDURES	16-2
<div style="border: 1px solid black; padding: 2px; display: inline-block;">SYSTEM UTILITY PROGRAMS</div>	
 <u>PART 17 THE DOS/BATCH ROLLIN UTILITY PROGRAM</u>	
CHAPTER 1 ROLLIN COMMANDS	17-1
1.1 Command Format	17-1
CHAPTER 2 TRANSFER OPERATIONS	17-5
2.1 Disk/DEctape Operations	17-5
2.1.1 Disk to DEctape Dump	17-5
2.1.2 Restoring Disk from DEctape	17-6
2.2 Disk/Magtape Operations	17-6
2.2.1 Disk to Magtape Dumps	17-7
2.2.2 Restoring Disk from Magtape	17-9
2.3 Copy and Verifying Operation	17-9
2.3.1 Magtape Procedures	17-10
2.3.2 DECpack Procedures	17-10
2.3.3 RPl1-C Disk Procedures	17-11

	<u>Page</u>
CHAPTER 3 RESTORING THE MONITOR	17-12
<u>PART 18 THE DOS/BATCH DISK INITIALIZATION PROGRAM (DSKINT)</u>	
CHAPTER 1 INTRODUCTION TO DSKINT	18-1
CHAPTER 2 DSKINT COMMANDS AND FUNCTIONS	18-2
2.1 DSKINT Command Switches	18-2
2.1.1 Normal Mode Command Switches	18-2
2.1.1.1 /Z Switch	18-3
2.1.1.2 /V Switch	18-3
2.1.1.3 /R Switch	18-3
2.1.1.4 /L Switch	18-4
2.1.1.5 /M Switch	18-4
2.1.2 Mark Mode Command Switches	18-5
2.1.2.1 /M Switch	18-5
2.1.2.2 /U Switch	18-6
2.1.2.3 /L Switch	18-6
2.1.2.4 /D Switch	18-7
CHAPTER 3 SAMPLE EXECUTIONS	18-8
<div style="border: 1px solid black; padding: 2px; display: inline-block;">APPENDICES</div>	
APPENDIX A CHARACTER CODES	A-1
A.1 ASCII Character Set	A-1
A.2 Radix-50 Character Set	A-8
APPENDIX B CONVERSION TABLES	B-1
B.1 Octal-Decimal Integer Conversions	B-1
B.2 Powers of Two and Eight	B-12
B.3 Scales of Notation	B-13
B.3.1 $2^x$ In Decimal	B-13
B.3.2 $10^+$ In Octal	B-13
B.3.3 $n \log 2$ and $10$ In Decimal	B-13
B.3.4 Addition and Multiplication, Binary and Octal	B-13
B.3.5 Mathematical Constants in Octal	B-13
APPENDIX C PHYSICAL DEVICE NAMES	C-1
APPENDIX D FORTRAN LOGICAL DEVICE ASSIGNMENTS	D-1
APPENDIX E FILENAME EXTENSIONS	E-1
APPENDIX F LISTING OF THE SYSTEM MACRO FILE (SYSMAC.SML)	F-1
APPENDIX G BOOTSTRAP PROCEDURES	G-1
G.1 BM792-YB Bootstrap Loader for Disk/DEctape	G-2
G.2 MR11 (Disk/DEctape), BM792-YA (Paper Tape), BM792-TC (Card Reader), and BM792-YH (Cassette) Bootstrap Loaders	G-2
G.3 Paper Tape Bootstrap Loader	G-2
G.4 Magnetic Tape Bootstrap Loader	G-3
G.5 Cassette Bootstrap Loader	G-4

	<u>Page</u>
APPENDIX H PERIPHERAL DEVICES	H-1
H.1    Operating the Teletype	H-1
H.1.1  Power Controls	H-1
H.1.2  Printer	H-1
H.1.3  Keyboard	H-2
H.1.4  Paper Tape Reader	H-2
H.1.5  Paper Tape Punch	H-3
H.2    Operating the High-Speed Paper Tape Reader and Punch Units	H-3
H.2.1  Reader Unit	H-3
H.2.2  Punch Unit	H-4
H.3    The LP11 Line Printer	H-5
H.3.1  Printer Control Panel	H-5
H.3.2  Maintenance Panel	H-6
H.3.3  Adjustment Controls	H-7
H.3.4  Loading Paper	H-7
H.4    The TU10 Magtape Drive	H-9
H.4.1  Operating Procedures	H-11
H.4.1.1  Loading and Threading Tape	H-11
H.4.1.2  Unloading Tape	H-12
H.4.1.3  Restart After Power Failure	H-13
H.4.1.4  Restart After Fail-Safe	H-13
H.4.1.5  Tape Handling	H-14
H.5    The TC11 DECTape Drive	H-14
H.6    Operation of the LA30 DECwriter	H-15
H.6.1  Controls and Indicators	H-15
H.6.2  Loading Paper	H-17
H.6.3  Changing Ribbon	H-18
H.7    Operation of the VT05 Alphanumeric Display Terminal	H-20
H.7.1  Controls and Indicators	H-20
H.7.2  Filler Characters Required at High Baud Rates	H-22
H.7.3  Local Operation Turn-On Procedure	H-22
H.7.4  Remote Operation Turn-On Procedure	H-23
H.8    CR11 Card Reader	H-24
H.8.1  CR11-A Card Reader	H-24
H.8.2  CR11-B Card Reader	H-26
H.9    Multipunch Cards	H-26
H.10   LP11 Line Printer	H-27
H.10.1  Control Panel	H-27
H.10.2  Maintenance Panel	H-27
H.10.3  Adjustment Controls	H-27
H.10.4  Loading Paper	H-29
APPENDIX I GLOSSARY AND ABBREVIATIONS	I-1
APPENDIX J SWITCH SUMMARIES	J-1
J.1    DSKINT Switches	J-1
J.2    FILCOM Switches	J-2
J.3    FILDMP Switches	J-3
J.4    FORTRAN Switches	J-4
J.5    LIBR Switches	J-6
J.6    LINK Switches	J-6
J.7    MACRO Switches	J-9
J.8    PIP Switches	J-10
J.9    ROLLIN Switches	J-12

		<u>Page</u>
APPENDIX K ERROR MESSAGES		K-1
K.1	MACRO Error Codes	K-1
K.2	FORTRAN Error Diagnostics	K-3
K.2.1	FORTRAM Compiler Error Diagnostics	K-3
K.2.2	FORTRAN Compiler Assembly Phase Errors	K-15
K.2.3	FORTRAN OTS Error Diagnostics	K-16
K.3	EDIT Error Messages	K-23
K.4	LINK Error Diagnostics	K-24
K.5	LIBR Error Messages	K-29
K.6	PIP Error Messages	K-29
K.7	FILCOM Error Messages	K-31
K.7.1	Command Syntax Errors	K-31
K.7.2	I/O Device Initialization Errors and I/O Errors	K-32
K.7.3	Runtime Errors	K-32
K.8	VERIFY Error Messages	K-33
K.9	FILDMP Error Messages	K-35
K.10	ROLLIN Error Messages	K-35
K.11	DSKINT Error Messages	K-36
K.12	DOS/BATCH Error Messages	K-38
K.12.1	Action Message	K-38
K.12.2	Error Messages	K-40
K.12.3	Fatal Messages	K-40
K.12.4	Information Messages	K-47
K.12.5	Keyboard Command Messages	K-47
K.12.6	System Program Messages	K-48
K.12.7	Warning Messages	K-51

TABLES

<u>Number</u>		<u>Page</u>
3-1	PDP-11 DOS/BATCH Monitor Features and Benefits	3-2
3-2	Principal DOS/BATCH System Programs	3-4
3-3	Monitor Commands by Function	3-11
3-4	Summary of Programmed Requests	3-35
3-5	Transfer Levels for Types of Datasets	3-45
3-6	Transfer Requests Which May Follow Open Requests	3-74
3-7	Driver Facilities Word Format	3-88
3-8	Filename Block Error Conditions	3-102
3-9	Key to RUN Block Parameter Word	3-113
3-10	EMT Service Routines	3-120
3-11	.CSI Command String Syntax Rules	3-123
3-12	Function Codes	3-135
4-1	Key to Card Deck in Figure 4-3	4-4
4-2	Standard Batch Peripheral Devices	4-5
4-4	Batch Commands	4-13
5-1	HEADER CARDS	4-46
6-1	MACRO Special Characters	6-7
6-2	Legal Separating Characters	6-8
6-3	Legal Delimiting Characters	6-9
6-4	MACRO Unary Operators	6-10
6-5	MACRO Binary Operators	6-11
6-6	Address Modes - No Instruction Modification	6-21
6-7	Address Modes - Instruction Modifying	6-21
6-8	MACRO Listing Directive Arguments	6-24
6-9	Functions: Symbolic Arguments	6-32
6-10	.PSECT Directive Parameters	6-48
6-11	Non-DOS/BATCH Program Section Defaults	6-52
6-12	Conditional Assembly Directives	6-55
6-13	Subconditional Directives	6-56
6-14	PAL-11R Compatible Directives	6-58
6-15	File Specification Default Values	6-77
7-1	Mixed Mode Arithmetic Results	7-18
7-2	Conversions Rules for Assignment Statements	7-24
7-3	FORTTRAN Library Arithmetic Functions	7-53
7-4	Floating-Point Magnitudes and Resulting G Format Conversions	7-72
7-5	Alphanumeric Data Storage	7-76
7-6	Carriage Control Characters	7-82
7-7	READ and WRITE Statement Summary	7-87
7-8	FORTTRAN Logical Device Assignments	7-88
7-9	Device Specification Codes	7-103
7-10	Filename Extensions	7-104
7-11	Approximate DOS Device Driver Sizes	7-115
7-12	FORTTRAN OTS Error Classes	7-119
7-13	DOS/BATCH FORTTRAN Standard Peripheral Devices	7-122
7-14	File Structures and I/O Modes	7-123
7-15	Segment Control Word	7-125
7-16	FORTTRAN Logical Device Assignments	7-128
7-17	Device Table Entry	7-130
7-18	FORTTRAN Library Subroutines	7-145
7-19	FORTTRAN SETFIL Arguments	7-148
7-20	Trace Output Description	7-172

TABLES (Cont.)

<u>Number</u>		<u>Page</u>
9-1	Format Conversion Packages and I/O Routines	9-43
9-2	.PSECT Directive Parameters	9-85
9-3	Program Section Defaults	9-90
12-1	PIP Switches	12-8
17-1	Device Designators	17-2
17-2	ROLLIN Option Switch Descriptions	17-3
A-1	ASCII Card Codes	A-4
A-2	DEC-029 Card Codes	A-6
A-3	DEC-026 Card Codes	A-7
A-4	Radix-50 Character Set	A-8
H-1	Adjustment Controls	H-7
H-2	Status Indicators	H-10
H-3	Switch Functions	H-11
H-4	LA30 Controls and Indicators	H-16
H-5	VT05 Controls and Indicators	H-20
H-6	Baud Rate Selector Switch Positions	H-22
H-7	Adjustment Controls	H-28
K-1	Recovery from F012 or F024 File Access Violations	K-46

FIGURES

<u>Number</u>		<u>Page</u>
2-1	Disk Directory Structure	2-21
2-2	Main Areas of Memory	2-28
2-3	The Resident Monitor	2-30
2-4	The Dynamic Memory Area	2-34
2-5	Example of an Overlay Structure	2-52
3-1	The Monitor Core Map	3-5
3-2a	The Transfer Path	3-39
3-2b	Sequence of Requests for READ/WRITE	3-39
3-2	.READ/.WRITE Input/Output Transfers	3-39
3-3a	The Transfer Path	3-42
3-3b	Sequence of Requests for .RECRD	3-42
3-3	.RECRD Input/Output Transfers	3-42
3-4a	The Transfer Path	3-44
3-4b	The Sequence of Requests for .BLOCK	3-44
3-4	.BLOCK Input/Output Transfers	3-44
3-5a	The Transfer Path	3-46
3-5b	Sample Sequence of Requests for .TRAN	3-46
3-5	.TRAN Input/Output Transfers	3-46
3-6	Core Map of Resident Monitor and Full Monitor	3-71
3-7	The Link Block	3-100
3-8	The Filename Block	3-101
3-9	Line Buffer Header	3-104
3-10	The Mode Byte	3-105
3-11	Status Byte Format	3-108
3-12	The Record Block	3-110
3-13	The BLOCK Block	3-111
3-14	The TRAN Block	3-112
3-15	The RUN Block Description	3-114
3-16	The RUN Block Function Word	3-114
3-17	The Special Functions Block	3-125
3-18	STATUS Information	3-132
4-1	Sample Batch Job	4-1
4-2	Use of /GO Switch	4-2
4-3	Batch Job Set-Up with User-Specified Job Steps	4-3
4-4	Sample Header Page	4-39
6-1	Assembly Source Listing of MACRO Code Showing Local Symbol Blocks	6-17
6-2	Example of MACRO Line Printer Listing (132 column line printer)	6-26
6-3	Example of Page Heading from MACRO Teleprinter Listing (same format as for 80 column line printer)	6-27
6-4	Assembly Listing Table of Contents	6-31
6-5	Example of .ENABL and .DSABL Directives	6-33
6-6	.IRP Example	6-73
6-7	Assembly Listing	6-80
6-8	Excerpts from CREF Listing to Accompany Figure 6-7	6-81
6-9	Nonposition-Independent Code	6-94
6-10	Position-Independent Code	6-94
6-11	Assembly Listing Showing ' Character	6-96
7-1	FORTTRAN Coding Form	7-4
7-2	Array Storage	7-41
7-3	Sample FUNCTION Subprogram	7-60
7-4	Variable Format Expression Example	7-81
7-5	DECODE Example	7-101
7-6	Steps in Compiling and Executing a FORTTRAN Program	7-102

FIGURES (Cont.)

<u>Number</u>		<u>Page</u>
7-7	Block Summary Example #1	7-108
7-8	Block Summary Example #2	7-108
7-9	Memory Map Organization	7-114
7-10	Example of Run Time Diagnostics	7-117
7-11	FORTRAN I/O Flow	7-120
7-12	Logical Record Segment Format	7-125
7-13	Program Example Using Logical Records	7-126
7-14	Argument List Construction	7-167
7-15	Relationship Between F4CALL and FORTRAN Source Code	7-167
7-16	Returning to the FORTRAN Program	7-168
7-17	Return Value Transmission	7-169
7-18	Console Commands to trace DEMO.FTN on the Line Printer	7-174
7-19	Compilation Listing of DEMO.FTN	7-175
7-20	Trace Output of Program DEMO	7-177
9-1	Overlay File Structure	9-16
9-2	Autoload Vector Entry	9-20
9-3	Sample Structure	9-23
9-4	Simple Global Reference	9-26
9-5	Nonoverlaid Program	9-44
9-6	Root Segment Overlaid Program	9-45
9-7	Segment Descriptor	9-45
9-8	Link Paths	9-47
9-9	Overlay Segment	9-48
9-10	Overall Memory Allocation	9-48
9-11	Tree Walk	9-53
9-12	General Object Module Format	9-61
9-13	GSD Record and Entry Formats	9-63
9-14	Relocation Directory Record Format	9-72
9-15	Overlay Disk Format	9-82
11-1	ODT Communication and Data Flow	11-26
12-1	Magtape General Format	12-34
12-2	Cassette General Format	12-37
13-1	Sample FILCOM Output	13-9
17-1	ROLLIN Magtape Format	17-8
18-1	First Listing Produced in Sample DSKINT Execution (RPØ3)	18-10
18-2	Second Listing Produced in Sample DSKINT Execution (RPØ3)	18-10
18-3	Third Listing Produced in Sample DSKINT Execution (RPØ3)	18-11
18-4	Fourth Listing Produced in Sample DSKINT Execution (RPØ3)	18-12
G-1	PDP-11 Console	G-1
H-1	ASR-33 Teletype Console	H-1
H-2	ASR-33 Teletype Keyboard	H-2
H-3	High-Speed Paper Tape Reader/Punch	H-4
H-4	Line Printer Control Panel	H-5
H-5	Magnetic Tape Drive Control Panel	H-9
H-6	Tape Transport Mechanism	H-13
H-7	TC11 DEctape Drive	H-14
H-8	LA3ØS DEctwriter (Serial Machine)	H-16
H-9	LA3Ø Power Controls	H-17
H-10	Paper Loading and Threading Diagram	H-18
H-11	Securing Ribbon to Reel	H-19
H-12	Ribbon Threading Diagram	H-19
H-13	VTØ5 Rear Panel Connectors and Controls	H-21
H-14	Model CR11-A Card Reader	H-25
H-15	Model CR11-B Card Reader	H-26

