TABLE of CONTENTS

Volume 1 - Lanuage Reference

1. Introduction 1

2. Litatoms (Symbols) 2-1

Using Symbols as Variables 2-1
Function Definition Cells 2-3
Property Lists 2-4
Print Names 2-5
Characters and Character Codes 2-9

3. Lists 3-1

Creating Lists 3-3
Building Lists from Left to Right 3-4
Copying Lists 3-6
Extracting Tails of Lists 3-6
Counting List Cells 3-8
Logical Operations 3-9
Searching Lists 3-10
Substitution Functions 3-10
Association Lists and Property Lists 3-11
Sorting Lists 3-13
Other List Functions 3-15

4. Strings 4-1

5. Arrays 5-1

6. Hash Arrays 6-1

Hash Overflow 6-3
User-Specified Hashing Functions 6-3

7. Numbers and Arithmetic Functions 7-1

Generic Arithmetic 7-2
Integer Arithmetic 7-3
Logical Arithmetic Functions 7-6
Floating-Point Arithmetic 7-8
Other Arithmetic Functions 7-10

8. Record Package 8-1

FETCH and REPLACE 8-1
CREATE 8-2

TYPE? ... 8-3
WITH ... 8-4
Record Declarations ... 8-4
Record Types ... 8-5
Optional Record Specifications ... 8-10
Defining New Record Types ... 8-12
Record Manipulation Functions ... 8-12
Changetran ... 8-13
Built-in and User Data Types ... 8-15

9. Conditionals and Iterative Statements ... 9-1
Data Type Predicates ... 9-1
Equality Predicates ... 9-2
Logical Predicates ... 9-3
COND Conditional Function ... 9-3
The IF Statement ... 9-4
Selection Functions ... 9-5
PROG and Associated Control Functions ... 9-6
The Iterative Statement ... 9-7
I.s. Types ... 9-8
Iterative Variable I.s.oprs ... 9-9
Condition I.s.oprs ... 9-12
Other I.s.oprs ... 9-13
Miscellaneous Hints on I.s.oprs ... 9-13
Errors in Iterative Statements ... 9-15
Defining New Iterative Statement Operators ... 9-15

10. Function Definition, Manipulation, and Evaluation ... 10-1
Function Types ... 10-2
Lambda-Spread Functions ... 10-2
Nlambda-Spread Functions ... 10-3
Lambda-Nospread Functions ... 10-4
Nlambda-Nospread Functions ... 10-4
Compiled Functions ... 10-5
Function Type Functions ... 10-5
Defining Functions ... 10-7
Function Evaluation ... 10-1
Iterating and Mapping Functions ... 10-1
Function Arguments ... 10-1
Macros ... 10-1
DEFMACRO ... 10-15
Interpreting Macros ... 10-15

11. Variable Binds and the Interlisp Stack ... 11-1
Spaghetti Stack ... 11-2
Stack Functions ... 11-3

Searching the Stack 11-4
Variable Binds in Stack Frames 11-5
Evaluating Expressions in Stack Frames 11-6
Altering Flow of Control 11-6
Releasing and Reusing Stack Pointers 11-7
Backtrace Functions 11-8
Other Stack Functions 11-10
The Stack and the Interpreter 11-10
Generators 11-12
Coroutines 11-14
Possibilities Lists 11-15

12. Miscellaneous 12-1
Greeting and Initialization Files 12-1
Idle Mode 12-3
Saving Virtual Memory State 12-5
System Version Information 12-9
Date and Time Functions 12-11
Timers and Duration Functions 12-13
Resources 12-15
A Simple Example 12-16
Trade-offs in More Complicated Cases 12-18
Macros for Accessing Resources 12-18
Saving Resources in a File 12-19
Pattern Matching 12-19
Pattern Elements 12-20
Element Patterns 12-20
Segment Patterns 12-21
Assignments 12-23
Place-Markers 12-23
Replacements 12-24
Reconstruction 12-24
Examples 12-25

Volume 2 - Environment Reference

13. Interlisp Executive 13-1
Input Formats 13-3
Programmer's Assistant Commands 13-4
Event Specification 13-4
Commands 13-6
P.A. Commands Applied to P.A. Commands 13-15
Changing the Programmer's Assistant 13-16
Undoing 13-19

Undoing Out of Order ... 13-20
SAVESET ... 13-21
UNDONLSETQ and RESETUNDO ... 13-22
Format and Use of the History List ... 13-23
Programmer's Assistant Functions ... 13-26
The Editor and the Programmer's Assistant ... 13-32

14. Errors and Breaks ... 14-1
Breaks ... 14-1
Break Windows ... 14-2
Break Commands ... 14-3
Controlling When to Break ... 14-10
Break Window Variables ... 14-11
Creating Breaks with BREAK1 ... 14-12
Signalling Errors ... 14-14
Catching Errors ... 14-16
Changing and Restoring System State ... 14-18
Error List ... 14-20

15. Breaking, Tracing, and Advising ... 15-1
Breaking Functions and Debugging ... 15-1
Advising ... 15-7
Implementation of Advising ... 15-7
Advise Functions ... 15-8

16. List Structure Editor ... 16-1
SEdit ... 16-1
Local Attention-Changing Commands ... 16-10
Commands That Search ... 16-14
Search Algorithm ... 16-15
Search Commands ... 16-16
Location Specification ... 16-18
Commands That Save and Restore the Edit Chain ... 16-21
Commands That Modify Structure ... 16-22
Implementation ... 16-23
The A, B, and : Commands ... 16-24
Form Oriented Editing and the Role of UP ... 16-26
Extract and Embed ... 16-26
The MOVE Command ... 16-28
Commands That Move Parentheses ... 16-30
TO and THRU ... 16-31
The R Command ... 16-34
Commands That Print ... 16-35
Commands for Leaving the Editor ... 16-37
Nested Calls to Editor ... 16-39
Manipulating the Characters of an Atom or String ... 16-39

Manipulating Predicates and Conditional Expressions 16-40
History Commands in the Editor 16-41
Miscellaneous Commands 16-41
Commands That Evaluate 16-43
Commands That Test 16-45
Edit Macros 16-46
Undo 16-48
EDITDEFAULT 16-50
Editor Functions 16-51
Time Stamps 16-57

17. File Package 17-1

Loading Files 17-3
Storing Files 17-8
Remaking a Symbolic File 17-12
Loading Files in a Distributed Environment 17-13
Marking Changes 17-13
Noticing Files 17-15
Distributing Change Information 17-16
File Package Types 17-16
Functions for Manipulating Typed Definitions 17-19
Defining New File Package Types 17-23
File Package Commands 17-25
Functions and Macros 17-26
Variables 17-27
Litatom Properties 17-29
Miscellaneous File Package Commands 17-30
DECLARE: 17-31
Exporting Definitions 17-33
FileVars 17-34
Defining New File Package Commands 17-35
Functions for Manipulating File Command Lists 17-37
Symbolic File Format 17-38
Copyright Notices 17-40
Functions Used Within Source Files 17-42
File Maps 17-42

18. Compiler 18-1

Compiler Printout 18-2
Global Variables 18-3
Local Variables and Special Variables 18-4
Constants 18-5
Compiling Function Calls 18-6
FUNCTION and Functional Arguments 18-7
Open Functions 18-8
COMPILETYPELST 18-8

Compiling CLISP 18-9
Compiler Functions 18-9
Block Compiling 18-12
Block Declarations 18-13
Block Compiling Functions 18-15
Compiler Error Messages 18-16

19. DWIM 20-1

Spelling Correction Protocol 20-3
Parentheses Errors Protocol 20-4
Undefined Function T Errors 20-4
DWIM Operation 20-5
DWIM Correction: Unbound Atoms 20-6
Undefined CAR of Form 20-7
Undefined Function in APPLY 20-8
DWIMUSERFORMS 20-8
DWIM Functions and Variables 20-10
Spelling Correction 20-11
Synonyms 20-12
Spelling Lists 20-12
Generators for Spelling Correction 20-14
Spelling Corrector Algorithm 20-14
Spelling Corrector Functions and Variables 20-15

20. CLISP 21-1

CLISP Interaction with User 21-4
CLISP Character Operators 21-5
Declarations 21-9
CLISP Operation 21-10
CLISP Translations 21-12
DWIMIFY 21-13
CLISPIFY 21-16
Miscellaneous Functions and Variables 21-18
CLISP Internal Conventions 21-20

21. Performance Issues 22-1

Storage Allocation and Garbage Collection 22-1
Variable Bindings 22-4
Performance Measuring 22-5
BREAKDOWN 22-7
GAINSPACE 22-9
Using Data Types Instead of Records 22-9
Using Incomplete File Names 22-10
Using "Fast" and "Destructive" Functions 22-10

22. Processes 23-1

Creating and Destroying Processes 23-1
Process Control Constructs 23-4
Events 23-5
Monitors 23-7
Global Resources 23-8
Typein and the TTY Process 23-9
Switing the TTY Process 23-9
Handling of Interrupts 23-11
Keeping the Mouse Alive 23-12
Process Status Window 23-12
Non-Process Compatibility 23-14

Volume 3 - I/O Reference

23. Streams and Files 24-1
Opening and Closing File Streams 24-1
File Names 24-4
Incomplete File Names 24-7
Version Recognition 24-9
Using File Names Instead of Streams 24-10
File Name Efficiency Considerations 24-11
Obsolete File Opening Functions 24-11
Converting Old Programs 24-11
Using Files with Processes 24-12
File Attributes 24-12
Closing and Reopening Files 24-15
Local Hard Disk Device 24-16
Floppy Disk Device 24-18
I/O Operations To and From Strings 24-22
Temporary Files and the CORE Device 24-23
NULL Device 24-24
Deleting, Copying, and Renaming Files 24-24
Searching File Directories 24-24
Listing File Directories 24-25
File Servers 24-28
PUP File Server Protocols 24-28
Xerox NS File Server Protocols 24-28
Operating System Designations 24-29
Logging In 24-30
Abnormal Conditions 24-31

24. Input/Output Functions 25-1
Specifying Streams for Input/Output Functions 25-1
Input Functions 25-2

Output Functions 25-6
PRINTLEVEL 25-8
Printing Numbers 25-10
User Defined Printing 25-12
Printing Unusual Data Structures 25-13
Random Access File Operations 25-14
Input/Output Operations with Characters and Bytes 25-17
PRINTOUT 25-17
Horizontal Spacing Commands 25-19
Vertical Spacing Commands 25-20
Special Formatting Controls 25-20
Printing Specifications 25-20
Paragraph Format 25-21
Right-Flushing 25-21
Centering 25-22
Numbering 25-22
Escaping to Lisp 25-23
User-Defined Commands 25-23
Special Printing Functions 25-24
READFILE and WRITEFILE 25-25
Read Tables 25-25
Read Table Functions 25-26
Syntax Classes 25-26
Read Macros 25-29

25. User Input/Output Packages 26-1

Inspector 26-1
Calling the Inspector 26-1
Multiple Ways of Inspecting 26-2
Inspect Windows 26-3
Inspect Window Commands 26-3
Interaction with Break Windows 26-4
Controlling the Amount Displayed During Inspection 26-4
Inspect Macros 26-4
INSPECTWs 26-5
PROMPTFORWORD 26-7
ASKUSER 26-9
Format of KEYLST 26-10
Options 26-12
Operation 26-13
Completing a Key 26-14
Special Keys 26-15
Startup Protocol and Typeahead 26-16
TTYIN Typein Editor 26-17
Entering Input with TTYIN 26-17
Mouse Commands (Interlisp-D Only) 26-19

Display Editing Commands 26-19
Using TTYIN for Lisp Input 26-22
Useful Macros 26-23
Programming with TTYIN 26-23
Using TTYIN as a General Editor 26-25
?= Handler 26-26
Read Macros 26-27
Assorted Flags 26-28
Special Responses 26-29
Display Types 26-30
Prettyprint 26-31
Comment Feature 26-33
Comment Pointers 26-34
Converting Comments to Lowercase 26-35
Special Prettyprint Controls 26-36

26. Graphics Output Operations 27-1

Primitive Graphics Concepts 27-1
Positions 27-1
Regions 27-1
Bitmaps 27-2
Textures 27-5
Opening Image Streams 27-6
Accessing Image Stream Fields 27-8
Current Position of an Image Stream 27-10
Moving Bits Between Bitmaps with BITBLT 27-11
Drawing Lines 27-13
Drawing Curves 27-14
Miscellaneous Drawing and Printing Operations 27-15
Drawing and Shading Grids 27-17
Display Streams 27-18
Fonts 27-19
Font Files and Font Directories 27-24
Font Profiles 27-24
Image Objects 27-27
IMAGEFNS Methods 27-28
Registering Image Objects 27-30
Reading and Writing Image Objects on Files 27-31
Copying Image Objects Between Windows 27-31
Implementation of Image Streams 27-32

27. Windows and Menus 28-1

Using the Window System 28-1
Changing the Window System 28-6
Interactive Display Functions 28-7
Windows 28-9

Window Properties 28-10
Creating Windows 28-10
Opening and Closing Windows 28-11
Redisplaying Windows 28-12
Reshaping Windows 28-13
Moving Windows 28-14
Exposing and Burying Windows 28-16
Shrinking Windows into Icons 28-16
Coordinate Systems, Extents, and Scrolling 28-18
Mouse Activity in Windows 28-21
Terminal I/O and Page Holding 28-22
TTY Process and the Caret 28-23
Miscellaneous Window Functions 28-24
Miscellaneous Window Properties 28-25
Example: A Scrollable Window 28-26
Menus 28-28
Menu Fields 28-29
Miscellaneous Menu Functions 28-32
Examples of Menu Use 28-32
Attached Windows 28-34
Attaching Menus to Windows 28-37
Attached Prompt Windows 28-38
Window Operations and Attached Windows 28-39
Window Properties of Attached Windows 28-41

28. Hardcopy Facilities 29-1
Hardcopy Functions 29-1
Low-Level Hardcopy Variables 29-4

29. Terminal Input/Output 30-1
Interrupt Characters 30-1
Terminal Tables 30-4
Terminal Syntax Classes 30-4
Terminal Control Functions 30-5
Line-Buffering 30-7
Dribble Files 30-10
Cursor and Mouse 30-10
Changing the Cursor Image 30-11
Flashing Bars on the Cursor 30-13
Cursor Position 30-13
Mouse Button Testing 30-14
Low-Level Mouse Functions 30-15
Keyboard Interpretation 30-15
Display Screen 30-18
Miscellaneous Terminal I/O 30-19

30. Ethernet 31-1

Ethernet Protocols....31-1
Protocol Layering....31-1
Level Zero Protocols....31-2
Level One Protocols....31-2
Higher Level Protocols....31-3
Connecting Networks: Routers and Gateways....31-3
Addressing Conflicts with Level Zero Mediums....31-3
References....31-4
Higher-Level PUP Protocol Functions....31-4
Higher-Level NS Protocol Functions....31-5
Name and Address Conventions....31-5
Clearinghouse Functions....31-7
NS Printing....31-9
SPP Stream Interface....31-9
Courier Remote Procedure Call Protocol....31-11
Defining Courier Programs....31-11
Courier Type Definitions....31-12
Pre-defined Types....31-13
Constructed Types....31-13
User Extensions to the Type Language....31-15
Performing Courier Transactions....31-16
Expedited Procedure Call....31-17
Expanding Ring Broadcast....31-18
Using Bulk Data Transfer....31-18
Courier Subfunctions for Data Transfer....31-19
Level One Ether Packet Format....31-20
PUP Level One Functions....31-21
Creating and Managing Pups....31-21
Sockets....31-22
Sending and Receiving Pups....31-23
Pup Routing Information....31-23
Miscellaneous PUP Utilities....31-24
PUP Debugging Aids....31-24
NS Level One Functions....31-28
Creating and Managing XIPs....31-28
NS Sockets....31-28
Sending and Receiving XIPs....31-29
NS Debugging Aids....31-29
Support for Other Level One Protocols....31-29
The SYSQUEUE Mechanism....31-31

Glossary GLOSSARY-1

Index....INDEX-1

[This page intentionally left blank]