

**P R O M A L**

**(PROgrammer's Micro Application Language)**

**THE PROMAL PROGRAMMING SYSTEM MANUAL**

**For The APPLE IIe and IIc**

**-or-**

**COMMODORE 64**

**PART 1: MEET PROMAL!**

**PART 2: PROMAL USER'S GUIDE**

**PART 3: PROMAL LANGUAGE**

**PART 4: PROMAL LIBRARY**

**SYSTEMS MANAGEMENT ASSOCIATES, INC.**

**3325 Executive Drive**

**Raleigh, North Carolina 27609**

**(919) 878-3600**

**Rev. C - September 1986**

## **ACKNOWLEDGEMENTS**

The PROMAL Language, Compiler, Executive,  
and Library were designed and written by:

**Bruce D. Carbrej**

The PROMAL Editor and portions of the Apple IIe/IIc and  
Commodore 64 I/O Interface were written by:

**Larry Isaacs**

with programming assistance from

**David Long**

## **COPYRIGHT NOTICE**

Copyright (C) 1984, 1985, 1986 Systems Management Associates, Inc.  
(Programs & Manuals). All rights reserved worldwide.

## **TRADEMARKS**

PROMAL and DYNODISK are trademarks of Systems Management Associates, Inc.  
Apple II and ProDOS are trademarks of Apple Computer, Inc.  
Commodore 64 is a trademark of Commodore Business Machines, Inc.  
Thunderclock is a trademark of Thunderware Inc.  
IBM is a trademark of International Business Machines.  
RAMWORKS is a trademark of Applied Engineering.  
1541 Flash is a trademark of Skyles Electric Works.

## **DISCLAIMER**

Systems Management Associates, Inc. makes no claims or warranties with  
respect to the contents of this publication or the product it describes, beyond  
the limited warranty which accompanies this product. The right is reserved to  
make any changes to this publication or the product it describes without  
obligation to notify any person of such revision or changes.

## TABLE OF CONTENTS

**PART 1: MEET PROMAL!**

Hardware Requirements, Copyright Notice, Trademarks.....	1-2
Notice from Apple Computer Inc.....	1-2
Meet PROMAL!.....	1-3
About the Promal Demo Diskette.....	1-3
Audience.....	1-3
About this Manual.....	1-3
What is PROMAL?.....	1-3
Duplicating the Demo Diskette.....	1-4
Loading PROMAL.....	1-5
Using the PROMAL Executive.....	1-6
Writing a Program with the Editor.....	1-9
Compiling your first Program.....	1-11
Executing your Program.....	1-12
Where does PROMAL put the Program?.....	1-12
Revising your Program.....	1-14
A Sample PROMAL Text-processing Program (FIND).....	1-15
Real (floating point) Numbers & Simple Business Program.....	1-24
An Advanced Program (CALC).....	1-24
Advanced Editor Features.....	1-25
Some Special Capabilities.....	1-29
A Database Application Program (Apple II).....	1-30
Sprites, Animation & Sound Synthesis (Commodore 64).....	1-30
In Conclusion.....	1-32
Developer's Version, Source Code, & Graphics Toolbox.....	1-33
Customer Service.....	1-34

**PART 2: PROMAL USER'S GUIDE**

Introduction.....	2-2
Manuals & System Startup.....	2-3
Executive Commands and Command Editing.....	2-4
Built-in Executive Commands.....	2-8
Arguments for Executive Commands.....	2-9
File Names.....	2-9
File Name Extensions.....	2-12
Numeric Arguments.....	2-12
Device Names.....	2-13
I/O Redirection.....	2-14
PROMAL Executive Command Summary.....	2-14
BUFFERS (Apple II only).....	2-15
COLOR.....	2-16
COPY (EXTCOPY).....	2-17
CS.....	2-19
DATE.....	2-20
DELETE.....	2-20
DISKCMD (Commodore 64 only).....	2-21
DYNO (Commodore 64 only).....	2-22
DUMP.....	2-23
EDIT.....	2-24
FILES (EXTDIR).....	2-24
FILL.....	2-26
FKEY.....	2-26
GET.....	2-27
GO.....	2-28

## TABLE OF CONTENTS

HELP.....	2-29
JOB.....	2-30
LOCK (Apple II only).....	2-32
MACRO.....	2-32
MAP.....	2-33
NEWDIR (Apple II only).....	2-36
NOREAL.....	2-36
PAUSE.....	2-37
PREFIX (Apple II only).....	2-38
QUIT.....	2-38
RENAME.....	2-39
SET.....	2-39
SIZE.....	2-40
TYPE.....	2-41
UNLOAD.....	2-42
UNLOCK (Apple II only).....	2-42
WS.....	2-43
 The PROMAL Editor.....	 2-44
Display Screen for New File.....	2-45
Editing Keys.....	2-47
Inserting and Deleting Lines.....	2-49
Searching with the FIND Key.....	2-50
Search and Replace.....	2-51
Cut and Paste Operations.....	2-52
Saving a Block to a File.....	2-52
Exiting the Editor.....	2-53
Technical Notes on the Editor (C-64 only).....	2-47
 The PROMAL Compiler.....	 2-56
Command line Arguments and Options.....	2-56
Dialogue of the Compilation Process.....	2-58
Differences between Demo and Full Compiler.....	2-60
PROMAL Cross-Reference Map Utility (XREF).....	2-60

## PART 3: PROMAL LANGUAGE MANUAL

<b>Chapter 1: Introduction.....</b>	<b>3-2</b>
<b>Chapter 2: PROMAL Programming Language Overview.....</b>	<b>3-3</b>
<b>Chapter 3: Elements of the PROMAL Language.....</b>	<b>3-7</b>
Vocabulary and Names.....	3-7
Data Types.....	3-8
Literal Numbers, Characters, and Strings.....	3-9
Variables.....	3-12
Constant Definition.....	3-13
Array Variables.....	3-14
DATA Definition.....	3-15
Operators and Arithmetic Expressions.....	3-17
Relational Operators.....	3-21
Logical Operators.....	3-21
Shift Operators.....	3-22
Indirect and Address Operators.....	3-22
Global Variables.....	3-24
<b>Chapter 4: Statements.....</b>	<b>3-25</b>
Introduction.....	3-25
PROGRAM Statement (& OVERLAY Statement).....	3-25
Assignment Statement.....	3-26

## TABLE OF CONTENTS

Conditional Statements.....	3-26
IF.....	3-26
WHILE.....	3-28
REPEAT.....	3-29
FOR.....	3-29
CHOOSE.....	3-30
BREAK.....	3-31
NEXT.....	3-32
NOTHING.....	3-32
ESCAPE and REFUGE.....	3-33
<b>Chapter 5: Procedures and Functions.....</b>	<b>3-36</b>
Built-in Procedures and Functions.....	3-36
Simple Output & Formatted Numeric Output.....	3-37
Simple Input.....	3-38
Numeric Input.....	3-39
User-Defined Subroutines.....	3-41
Passed Arguments.....	3-42
Local Variables.....	3-45
OWN Variables.....	3-46
Good Programming Practices with Subroutines.....	3-46
Recursion.....	3-47
INCLUDE Statement for Multiple Source Files.....	3-48
LIST Statement for Selective Listing.....	3-48
Conditional Compilation.....	3-49
<b>Chapter 6: Interfacing.....</b>	<b>3-51</b>
Opening and Closing Files and Devices.....	3-51
Functions for File and Device I/O.....	3-52
STDIN and STDOUT File Handles.....	3-53
Output to Printer, Control and ESCape Sequences.....	3-54
Argument Passing from the Executive.....	3-56
EXTERNAL Variables for Special Memory Locations.....	3-57
PROMAL Interface to Machine Language.....	3-60
<b>Chapter 7: Strings and Arrays Revisited.....</b>	<b>3-61</b>
Strings.....	3-61
Address Versus Content of an Array Element.....	3-62
Multidimensional Arrays & Arrays of Strings.....	3-64
Presetting Global Variables.....	3-66
<b>Chapter 8: The Loader.....</b>	<b>3-67</b>
Definitions.....	3-67
Modules & How the Loader Works.....	3-68
Calling the Loader and Options.....	3-70
Exporting & Importing Variables and Subroutines.....	3-73
Executing the Logical Program with Separate Modules.....	3-75
Using a Bootstrap to Control Loading.....	3-76
Using Overlays.....	3-77
Considerations for the Executive and Editor.....	3-79
Successful Use of Overlays & Separate Compilation.....	3-81
 <b>PART 4: PROMAL LIBRARY MANUAL</b>	
Summary of Library Routines.....	4-2
How to use the Library Routine Descriptions.....	4-4
PROC ABORT, FUNC ABS.....	4-5
FUNC ALPHA, PROC BLKMOV.....	4-6
FUNC CHKSUM, PROC CLOSE.....	4-7
FUNC CMPSTR.....	4-8
FUNC CURCOL, FUNC CURLINE.....	4-9
PROC CURSET, FUNC DIR.....	4-10

## TABLE OF CONTENTS

FUNC DIROPEN (Apple II only).....	4-11
FUNC EDLINE.....	4-12
PROC EXIT, PROC FILL.....	4-14
PROC FKEYGET.....	4-15
PROC FKEYSET.....	4-16
FUNC GETARGS.....	4-17
FUNC GETBLKF.....	4-18
FUNC GETC.....	4-19
FUNC GETCF, FUNC GETKEY.....	4-20
PROC GETL.....	4-21
FUNC GETLF.....	4-22
FUNC GETPOSF (Apple II only).....	4-23
FUNC GETTST, FUNC GETVER.....	4-24
FUNC INLINE, FUNC INLIST.....	4-25
FUNC INSET.....	4-27
PROC INTSTR.....	4-28
PROC JSR, FUNC LENSTR.....	4-29
PROC LOAD, FUNC LOOKSTR.....	4-30
FUNC MAX.....	4-31
FUNC MIN, FUNC MLGET.....	4-32
PROC MOVSTR.....	4-33
FUNC NUMERIC.....	4-34
FUNC ONLINE (Apple II only).....	4-35
FUNC OPEN.....	4-36
PROC OUTPUT.....	4-41
PROC OUTPUTF.....	4-43
PROC PROQUIT, PROC PUT.....	4-44
PROC PUTBLKF.....	4-45
PROC PUTF, FUNC RANDOM.....	4-47
PROC REALSTR.....	4-48
PROC REDIRECT.....	4-49
FUNC RENAME.....	4-50
PROC SETPOSF (Apple II only).....	4-51
FUNC SETPREFIX (Apple II only), FUNC STRREAL.....	4-52
FUNC STRVAL.....	4-53
FUNC SUBSTR, FUNC TESTKEY.....	4-55
FUNC TOUPPER.....	4-56
PROC WORDSTR, FUNC ZAPFILE.....	4-57

## APPENDICES

APPENDIX A: ASCII CHARACTER SET.....	A-1
APPENDIX B: PROMAL KEY CODES RETURNED BY FUNCS GETKEY AND TESTKEY....	B-1
APPENDIX C: ERROR MESSAGES & MEANINGS.....	C-1
APPENDIX D: LOCATING RUNTIME ERRORS & VARIABLES IN MEMORY.....	D-1
APPENDIX E: PRINTER SUPPORT.....	E-1
APPENDIX F: DATA COMMUNICATIONS SUPPORT.....	F-1
APPENDIX G: PROMAL MEMORY MAPS.....	G-1
APPENDIX H: DYNAMIC MEMORY ALLOCATION.....	H-1
APPENDIX I: MACHINE LANGUAGE INTERFACING.....	I-1
APPENDIX J: RECURSION AND FORWARD REFERENCES.....	J-1
APPENDIX K: REAL FUNCTION SUPPORT.....	K-1
APPENDIX L: COMPATIBILITY ISSUES.....	L-1
APPENDIX M: COMMODORE 64 RELATIVE FILE SUPPORT.....	M-1
APPENDIX N: OPERATING SYSTEM NOTES.....	N-1
APPENDIX O: BACKING UP & FORMATTING DISKETTES.....	O-1
APPENDIX P: SYNTAX DIAGRAMS FOR THE PROMAL LANGUAGE.....	P-1
APPENDIX Q: PROMAL DEMO PROGRAMS.....	Q-1

## INDEX

### A

ABORT (PROC).....4-5  
ABS (FUNC).....4-5  
ALPHA (FUNC).....4-6  
AND operator.....3-17,3-21/22  
ARG statement.....3-42

#### Arguments:

-- cmmd line..1-14/15,1-21/22,3-56/57  
-- defining.....3-42  
-- passing.....3-42/45  
-- substituting in JOB file.....2-31  
Arithmetic expressions.....3-17/20  
Arithmetic operators.....3-17

#### Arrays:

-- of DATA strings.....1-27,3-15/16  
-- of strings.....3-65  
-- declaring.....3-14/15  
-- multi-dimensional.....3-15,3-64

ASCII character set.....A-1

ASM routine, declaring..I-7/10,I-12/13

#### Assembly language subroutines:

-- calling LIB routines from.....I-10  
-- interfacing to.....I-1/15  
-- relocatable.....I-11/15

Assignment statement.....1-19,3-26

AT keyword in EXT statement..1-29,3-58

ATAN (FUNC).....K-1

Audience, for PROMAL.....1-3

### B

Backing up disks.....0-1/4

Batch job capability.....2-30/31

BEGIN statement.....3-41

BILLIARDS.S (sample program).....Q-1

Blank lines, as comments.....1-16

BLKMOV (PROC).....4-6

BOOTSCRIPT.J file.....2-30

Bootstrap, to control loading.....3-76

BREAK statement.....3-31/32

BUDGET.S (sample program).....1-24,Q-1

BUFFERS (APPLE II EXEC cmd).....2-15

Built-in functions & procedures...3-36

BYTE, data type.....1-18,3-8/9

### C

CARG variable..1-14/15,1-21/22,3-56/57

CALC.S (sample program)....1-24/25,Q-1

Characters, literal.....3-10

Characters, string extraction.....3-23

Checksum.....1-13,4-7

Checksum, MAP display.....1-13

CHECKSUM.S (sample program).....Q-1

CHKSUM (FUNC).....4-7

CHOOSE statement.....3-30/31

CLEARBIT7.S (utility program)..N-2,Q-1

Clearing screen from program.4-43,4-45

CLOSE (PROC).....4-7

CMPSTR (FUNC).....4-8

COLOR (EXEC cmd).....2-16

Command line args.....1-14/15,3-56/57

**Commands:** (see EXECUTIVE, EDITOR)

-- user defined.....2-4

-- case insensitivity.....2-4

-- line editing, (TABLE 1).....2-5/7

-- notation conventions.....2-9

-- system-dependent keys.....2-7

-- EDITOR (TABLE 5).....2-47/49

-- EXECUTIVE (TABLE 2).....2-8

Comment lines.....1-16

Compatibility with IBM PROMAL....L-1/2

COMPILE (EXEC cmd).....2-56/58

**Compiler:**.....2-2,2-56/60

-- command options.....2-56/58

-- cross reference utility.....2-60

-- dialog.....2-58/60

-- edit after error.....2-59

-- introduction to.....2-56

-- invoking.....1-11,2-56

-- screen displays.....1-11

Compiling, conditional.....3-49/50

Compiling, sample program.....1-11

Compiling, very large prgrms...2-57/58

CON statement.....1-26,3-13

Conditional compilation.....3-49/50

Conditional stmts, short-cuts.....3-33

Constants, defining.....1-26,3-13

COPY (EXEC cmd).....2-17/19

Copyright Notice.....ii,1-2

COS (FUNC).....K-1

CS (EXEC cmd).....2-19

CTRL ^ (Adj. rt.-APPLE II)...1-28,2-48

CTRL \ (Clr. end -APPLE II)...2-5,2-48

CTRL [ (Start of line -C64)...2-6,2-48

CTRL A (Alphalock).....1-9,2-6,2-48

CTRL B (Cmd recall).....1-9,2-6,2-49

CTRL C (Abort cmd.-APPLE II).....2-7

CTRL D (Del char.-APPLE II)...2-5,2-47

CTRL E (Insert -APPLE II).....2-5,2-47

CTRL F (Strt of ln -APPLE II).2-6,2-48

CTRL I (Indent).....2-48

CTRL J (Adj. rt. -C64).....1-28,2-48

CTRL K (Clr. end -C64).....2-5,2-48

CTRL L (End of ln -APPLE II)..2-5,2-48

CTRL N (Next page).....2-48

CTRL O (Adjust left).....1-28,2-49

CTRL P (Previous page).....2-48

CTRL Q (Un-indent -APPLE II).....2-48

CTRL RESET (Abort cmd.-APPLE II)...2-6

CTRL STOP (Abort cmd.-C64).....2-6

## INDEX

CTRL U (Un-indent -C64).....2-48  
CTRL V (Normalize window -C64)....2-49  
CTRL W (Set window -C64).....2-49  
CTRL X (Clr line).....2-5,2-48  
CTRL Y (End of line -C64).....2-5,2-48  
CTRL Y (Home -APPLE II).....2-48  
CTRL Z (End of file mark).....2-6  
CTRL <-- (Del char. -C64).....2-5,2-47  
CURCOL (FUNC).....4-9  
CURLINE (FUNC).....4-9  
CURSET (PROC).....4-10

### D

#### **DATA:**

-- arrays of strings.....1-27,3-16  
-- defining arrays of.....3-15/16  
-- definition.....3-15  
-- REAL.....3-15  
-- statement example.....1-27,3-15/16  
Data communications support.....F-1/6  
Data types.....3-8/9  
Date, entering.....1-6  
DATE (EXEC cmd).....2-20  
DEL key (C64).....2-5,2-47  
Delete key (APPLE II).....2-5,2-47  
DELETE (EXEC cmd).....2-20/21  
Demo diskette, limitations of.....1-3  
Demo programs.....Q-1/3  
Device names (TABLE 4).....2-13  
Device numbers (C64).....E-1,N-1  
DIR (FUNC).....4-10/11  
DIROPEN (FUNC).....4-11  
DISKCMD (EXEC cmd).....2-21/22  
Disk drives, dual support of.....N-1  
DISKETTE utility (C64).....O-2/4  
DUMP command, example.....1-8  
DUMP (EXEC cmd).....2-23  
DUMPFIL.S (utility program).....Q-2  
Dynamic memory allocation.....H-1  
DYNO (EXEC cmd).....2-22/23  
DYNODISK.....1-5,2-22/23,4-18

### E

EDIT (EXEC cmd).....2-24,2-44  
**Editor:**.....1-9,2-2,2-44/55  
-- CHANGE (F6).....1-26,2-51  
-- COPY (F7).....2-52  
-- char. sets & modes (C-64).....2-55  
-- cut & paste operations.....2-52  
-- DEL LN (F1).....2-49  
-- display format.....2-44/46  
-- EDIT (EXEC cmd).....2-24,2-44  
-- edit buffer & workspace....2-54/55  
-- editing keys (TABLE 5).....2-47/49

-- entering from EXECUTIVE.....2-44  
-- features of.....2-44  
-- FIND (F5).....1-25/26,2-50/51  
-- FKEYs legend after MARK..1-27,2-52  
-- HELP (F7).....2-46  
-- initial screen display.....2-45  
-- inserting & deleting lines....2-49  
-- inserting block or file....2-52/53  
-- INS LN (F2).....2-49  
-- introduction to.....1-9/10  
-- invoking.....1-9,2-24,2-44  
-- MARK (F3).....1-27,2-52  
-- MOVE (F6).....2-52  
-- QUIT display.....1-10,2-53  
-- QUIT (F8).....2-53  
-- RECALL (F4).....2-49,2-53  
-- sample sessions.....1-9/10,1-25/29  
-- saving block to file.....2-52/53  
-- scrolling.....2-46  
-- search & replace.....1-26,2-51  
-- searching.....2-50/51  
-- status area.....2-46  
-- WRITE (F4).....2-52/53  
EDLINE (FUNC).....4-12/14  
Error messages.....C-1/12

#### **Errors:**

-- from LOADER.....3-71  
-- after OPEN.....4-36  
Executing sample program.....1-12

#### **Executive:**.....2-2/43

-- arguments for commands.2-9,2-12/13  
-- arg passing fm cmd line....3-56/57  
-- commands, search order.....2-4  
-- commands, summary (TABLE 2)....2-8  
-- entering commands.....1-6/7  
-- guided tour of.....1-6/9  
-- HELP screen.....1-8  
-- line editing keys.....2-5/6  
-- user defined commands.....2-4

EXIT (PROC).....4-14  
EXP (FUNC).....K-1  
EXPORT Keyword.....3-73  
EXPORT (.E) files.....3-74/75  
Exporting, definition.....3-73/74

#### **Expressions:**

-- arithmetic.....3-17/20  
-- logical.....3-21/22  
-- mixed mode.....3-18/20  
-- relational.....3-21  
EXT keyword.....1-29,3-57/59  
EXTCOPY (utility command).....2-18  
EXTDIR: (utility command).....1-7,2-25  
-- example of.....2-25  
Extensions, file name.....2-12



## INDEX

### **F**

FALSE (0).....1-21,3-21  
FILECRC.S (sample program).....Q-2  
Field spec., formatted output.....4-41  
File descriptor.....3-51  
File name extensions (TABLE 3)....2-12

#### **File names, rules for:**

-- Commodore 64.....2-10  
-- Apple IIe/IIc.....2-11/12

#### **Files:**

-- converting APPLE II DOS 3.3....N-2  
-- COPY (EXEC cmd).....2-17/19  
-- DELETE (EXEC cmd).....2-20/21  
-- DISKETTE utility.....0-2/4  
-- handle, definition of....1-22,3-51  
-- JOB (.J).....2-30/31  
-- locked.....2-32  
-- opening.....3-51/52,4-36/40  
-- RENAME (EXEC cmd).....2-39  
-- TYPE (EXEC cmd).....2-41  
FILES (EXEC cmd).....2-24/25  
FILL (EXEC cmd).....2-26  
FILL (PROC).....4-14/15  
FIND.S (sample program)....1-15/23,Q-2  
FKEY (EXEC cmd).....2-26/27  
FKEYGET (PROC).....4-15/16  
FKEYSET (PROC).....4-16  
FOR statement.....3-29/30  
Format string, output spec...3-37,4-41  
Formatted output.....3-37/38,4-41/43  
Formatting disks.....0-1/3  
Forward references.....J-1  
FUNC, function header.....3-41

#### **Function keys:**

-- default setting....1-6,2-3,2-26/27  
-- editor's display.....1-9  
-- redefining.....2-26/27,4-16  
-- use of.....2-4

#### **Functions & procedures:...**

-- arguments in.....3-42/45  
-- built-in.....3-36/37  
-- intro to.....3-36  
-- REAL.....K-1/2

### **G**

GET (EXEC cmd).....2-27/29  
GETARGS (FUNC).....4-17  
GETBLKF (FUNC).....4-18  
GETC (FUNC).....4-19  
GETCF (FUNC).....4-20  
GETKEY (FUNC).....4-20/21,B-1/4  
GETL (PROC).....4-21/22  
GETLF (FUNC).....4-22/23  
GETPOSF (FUNC) (APPLE II).....4-23

GETTST (FUNC).....4-24  
GETVER (FUNC).....4-24/25  
GO (EXEC cmd).....2-28/29  
GRAPHDEMO.S (sample program).....Q-2  
Graphics, Hi-Res.....1-33,2-15,Q-2

### **H**

Hardware requirements.....1-2  
HELP display screen.....1-8,2-29  
HELP (EXEC cmd).....2-29/30  
Hexadecimal, literal numbers....3-9/10  
Hexadecimal, used in EXEC cmds....2-12  
Hi-res graphics.....1-33,2-15,Q-2  
HOME key (C64).....2-48

### **I**

IBM PROMAL compatibility.....L-1/2  
IF statement.....3-26/28  
IMPORT keyword.....3-74  
Importing, definitions.....3-74/75  
INCLUDE statement..1-11,3-37,3-48,3-74  
Indentation.....1-20,1-28,3-27  
Indirect operators.....3-23/24  
INFILTRATOR (sample program)..1-32,Q-2  
Initialization, PROMAL system....2-3/4  
INLINE (FUNC).....4-25  
INLIST (FUNC).....4-25/27  
Input, numeric.....3-39/41  
Input, simple.....3-38/39  
INSET (FUNC).....4-27/28  
INST key (C64).....2-5,2-47  
INT, data type.....3-8/9  
**Interfacing:**.....3-51/60  
-- to C64 graphics & sound....3-58/59  
Interrupt service routines.....I-15  
INTSTR (PROC).....4-28

#### **IOERROR:**

-- error code variable...3-51/52,4-36  
-- errors, codes for.....4-36

#### **I/O:**

-- functions GETLF, PUTF.....3-52/53  
-- redirection.....2-14  
-- redirection, example of..1-23,2-14  
-- with files STDIN/STDOUT....3-53/54

### **J**

JOB (EXEC cmd).....2-30/31,2-33  
**JOB files (.J):**.....2-30/31  
-- substitution arguments in....2-31  
JSR (PROC).....4-29,I-1/4

## INDEX

### K

Keyboard (K) device.....2-13  
Key codes.....B-1/4

### L

LENSTR (FUNC).....4-29/30  
**LIBRARY:**.....1-11,2-3,3-51,4-2  
-- (L) device.....2-13  
-- routine description notation...4-4  
-- summary of routines.....4-2/3  
Line editing, keys (TABLE 1).....2-5/6  
LIST statement.....3-48  
**Literals:**.....3-9/12  
-- characters.....3-10  
-- numbers.....3-9/10  
-- strings.....3-10/11  
LOAD (PROC).....3-70/73,4-30  
**LOADER:**.....3-67/82  
-- bootstrap program with.....3-76/77  
-- calling.....3-70/73  
-- definitions used.....3-67/68  
-- errors from.....3-71  
-- EXPORTing definitions.....3-73/74  
-- IMPORTing definitions.....3-74/75  
-- memory diagram.....3-70,3-78  
-- operation of.....3-68/70  
-- options for.....3-72  
-- overlays.....3-77/79  
-- separate compilation.....3-75/76  
Loading, PROMAL diskette.....1-4/6  
Loading, programs.....2-27/28,4-32/33  
Local variables.....1-19,3-45/46  
LOCK (EXEC cmd).....2-32  
Locked file.....2-32,2-42  
LOG (FUNC).....K-1  
LOG10 (FUNC).....K-1  
Logical operators.....3-21/22  
LOOKSTR (FUNC).....4-30

### M

M array.....3-24,3-44  
**Machine language programs:**  
-- calling LIB routines from.....I-10  
-- calling with JSR.....4-29,I-1/4  
-- embedded in DATA.....I-4/6  
-- effect of BRK.....I-3  
-- executing with GO.....2-28/29  
-- interfacing to.....I-1/15  
-- interrupt service with.....I-15  
-- loading with GET.....2-27/28  
-- loading with MLGET.....4-32/33  
-- passing arguments to.....I-8/10  
-- relocatable.....I-11/15

MACRO (EXEC cmd).....2-32/33  
**MAP (EXEC cmd):**.....1-12,2-33/35  
-- display screens...1-12/13,2-33/35  
**Memory allocation:**  
-- MAP display definitions....2-33/36  
-- dynamic.....H-1  
Memory map, PROMAL internal.....G-1/6  
MAX (FUNC).....4-31  
MIN (FUNC).....4-32  
MLGET (FUNC).....4-32/33  
MOVSTR (PROC).....4-33/34  
MSD dual disk support (C64).....N-1

### N

Names, rules for.....3-7/8  
NCARG variable.....1-21/22,3-56/57  
NEWDIR (EXEC cmd).....2-36  
NEXT statement.....3-32  
NOREAL (EXEC cmd).....2-36/37  
NOT operator.....3-17,3-21/22  
Notation, conventions.....2-9  
NOTHING statement.....3-32  
Null (N) device.....2-13/14  
Numbers, literal.....3-9/10  
NUMERIC (FUNC).....4-34  
Numeric input.....3-39/41

### O

O, compiler option.....2-56/57  
Object program.....1-4  
ONLINE (FUNC) (APPLE II).....4-35  
OPEN (FUNC).....1-22,3-51/55,4-36/40  
OPEN, error codes.....4-36  
Opening files.....3-51/52,4-36/40  
Operating system notes.....N-1/2  
**Operators:**  
-- arithmetic.....3-17/18  
-- indirect & address.....3-22/23  
-- list of all.....3-17  
-- logical.....3-21/22  
-- relational.....3-21  
-- shift.....3-22  
Options for loader.....3-72  
OR operator.....3-17,3-21/22  
Output, field descriptors.....4-41  
OUTPUT (PROC).....4-41/43  
OUTPUTF (PROC).....4-43/44  
**Output:**  
-- formatted numeric..3-37/38,4-41/44  
-- PROC, example.....3-37/38  
-- simple.....3-37  
OVERLAY statement.....3-25,3-77/79  
**Overlays:**  
-- definition of.....3-68

## INDEX

-- using.....3-77/79  
-- guidelines for.....3-81/82  
-- memory map.....3-78  
-- sample program.....3-78  
OWN variables.....3-46,H-1

### P

Pathnames.....2-11  
PAUSE (EXEC cmd).....2-37  
Pointers.....3-22/24  
POWER (FUNC).....K-1  
PREFIX (EXEC cmd).....2-11,2-38  
Printer (P) device.....2-13,3-54/55  
Printer support.....E-1/2  
PROC, procedure header.....3-41  
**Procedures & functions:**...1-18,3-36/47  
-- introduction to.....3-36  
-- passing arguments to.....3-42/45  
-- local variables in.....3-45/46  
ProDOS, special functions.....N-2  
Program authors.....ii  
PROGRAM statement.....3-4,3-25  
**Programs, demo:**.....Q-1/3  
-- BUDGET.....1-24  
-- CALC.....1-25  
-- FIND.....1-16/23  
**PROMAL:**  
-- definition of.....1-3  
-- initialization.....2-3/4  
-- loading.....1-4/6  
-- signon screen.....1-6  
-- special capabilities.....1-29  
-- system components.....2-2  
-- vs. BASIC.....1-4  
**PROMAL language:**  
-- applications of.....3-2  
-- data types.....3-8/9  
-- introduction to.....3-2  
-- overview.....3-3/6  
-- names.....3-7/8  
-- reserved words.....3-7,L-2  
-- rules for.....1-18  
-- syntax diagrams.....P-3/8  
PROQUIT (PROC).....4-44  
PUT (PROC).....1-10,3-37,4-44/45  
PUTBLKF (PROC).....4-45/46  
PUTF (PROC).....1-22,4-47

### Q

QUIT (EXEC cmd).....2-38/39

### R

RANDOM (FUNC).....4-47/48  
**REAL:**  
-- constants disallowed.....3-13  
-- DATA.....3-15  
-- data type.....3-8/9  
-- literals.....3-10  
-- numbers.....1-24  
-- variables, internal format.....D-2  
REALSTR (PROC).....4-48/49  
Recursion & forward references.....J-1  
REDIRECT (PROC).....4-49/50  
Redirection, I/O.....1-23,2-14  
REFUGE statement.....3-33/34  
Relative file support (C64).....M-1/5  
RELDEMO.S (sample program).....M-5,Q-2  
RELOCATE utility.....I-11/15  
RELOCATE.S (utility program).....Q-3  
RENAME (EXEC cmd).....2-39  
RENAME (FUNC).....4-50/51  
REPEAT statement.....3-29  
Reserved words.....3-7,L-2  
RETURN key.....2-5,2-46  
RETURN statement.....3-41/42  
Reverse video.....3-11,4-43,4-45  
RS-232 support.....F-1/6  
Runtime errors.....C-2/3  
Runtime errors, locating.....D-1

### S

Screen (S) device.....2-13  
Scrolling, left & right.....1-20,2-47  
Scrolling, up & down.....1-16,2-47  
SET (EXEC cmd).....2-39/40  
SETPOSF (PROC) (APPLE II).....4-51  
SETPREFIX (FUNC) (APPLE II).....4-52  
Shift operators.....3-22  
Signon display.....1-6  
SIN (FUNC).....K-1  
SIZE (EXEC cmd).....2-40/41  
SORTDEMO.S (sample prog.)...1-30/31,Q-3  
SORTSTRING.S (sample program).....Q-3  
SPLIT.S (utility program).....Q-3  
SRECEIVE.S (utility prog.)...F-4/5,Q-3  
SSEND.S (utility program)....F-4/5,Q-3  
SQRT (FUNC).....K-1  
Stack overflow.....3-47  
Starting, system.....1-4/6,2-3/4  
**Statements:**.....3-25/34  
-- (=) assignment.....3-26  
-- BREAK.....3-31/32  
-- CHOOSE.....3-30/31  
-- ESCAPE & REFUGE.....3-33/34  
-- FOR.....3-29/30

## INDEX

- IF.....1-21/22,3-26/28
  - NEXT.....3-32
  - NOTHING.....3-32
  - PROGRAM.....3-25
  - REPEAT.....3-29
  - RETURN.....3-41/42
  - WHILE.....1-20,3-28/29
  - STDIN, SDTOUT file handles.....3-53/54
  - STOP key (C64).....2-6/7
  - String operations:**.....3-45/46,3-23
    - arrays of.....3-65
    - compare.....1-20/21,4-8
    - conversion.....4-28,4-52/53,4-57
    - editing.....4-12/14,4-25
    - length.....4-29/30
    - move.....4-33/34
    - searching.....4-25/28,4-30,4-55
  - STRREAL (FUNC).....4-52/53
  - STRVAL (FUNC).....4-53/54
  - Subroutines:**.....1-18,3-41/42,3-46/47
    - passed arguments.....3-42/45
    - user defined.....3-41/47
  - Subscripts, arrays.....3-14/15,3-64
  - SUBSTR (FUNC).....4-55
  - Syntax diagrams, how to read.....P-1/2
  - Syntax diagrams.....P-3/8
  - System data areas.....G-5/6
- T**
- TAN (FUNC).....K-1
  - Telephone (T) device.....2-13,F-1/6
  - TINYTERM.S (sample program)....F-5,Q-3
  - TO keyword.....3-29
  - TESTKEY (FUNC).....4-55/56,B-1/4
  - TOUPPER (FUNC).....4-56
  - Trademarks.....ii,1-2
  - TRUE (1).....1-21,3-21
  - TYPE (EXEC cmd).....2-41
- U**
- UNLOAD (EXEC cmd).....2-42
  - UNLOCK (EXEC cmd).....2-42
  - UNTIL keyword.....3-29
  - Unprintable codes, embedding.....3-11
  - Upper & lower case mode (C64).....2-55
  - Upper case & graphics mode (C64).....2-55
  - User-defined commands.....2-4
  - User-defined subroutines.....3-41/47
- V**
- Variables:**
- arrays, declaring.....3-14/15
  - command line argument.....3-56/57
  - declarations.....3-12/13
  - external (EXT).....1-29,3-57/59
  - global.....1-19,3-44
  - initializing all to zero.....3-66
  - introduction to rules.....1-18
  - local.....1-19,3-45/46
  - locating in memory.....D-1/2
  - non-initialization of.....3-13
  - OWN.....3-46
  - types supported.....1-18,3-8/9
- Volume names (APPLE II).....2-11
- W**
- WHILE statement:**.....3-28/29
    - example of.....1-20
  - WORD data type.....1-18,3-8/9
  - WORDSTR (PROC).....4-57
  - Workspace:**
    - and edit buffer.....2-54/55
    - auto update after edit.....2-54
    - changing size of.....2-43
    - clearing of.....2-43
    - writing to.....1-10
    - (W) device.....2-13
  - WS (EXEC cmd).....2-43
- X**
- XOR operator.....3-17,3-21/22
  - XREF (utility program).....2-60
- Z**
- ZAPFILE (FUNC).....4-57/58