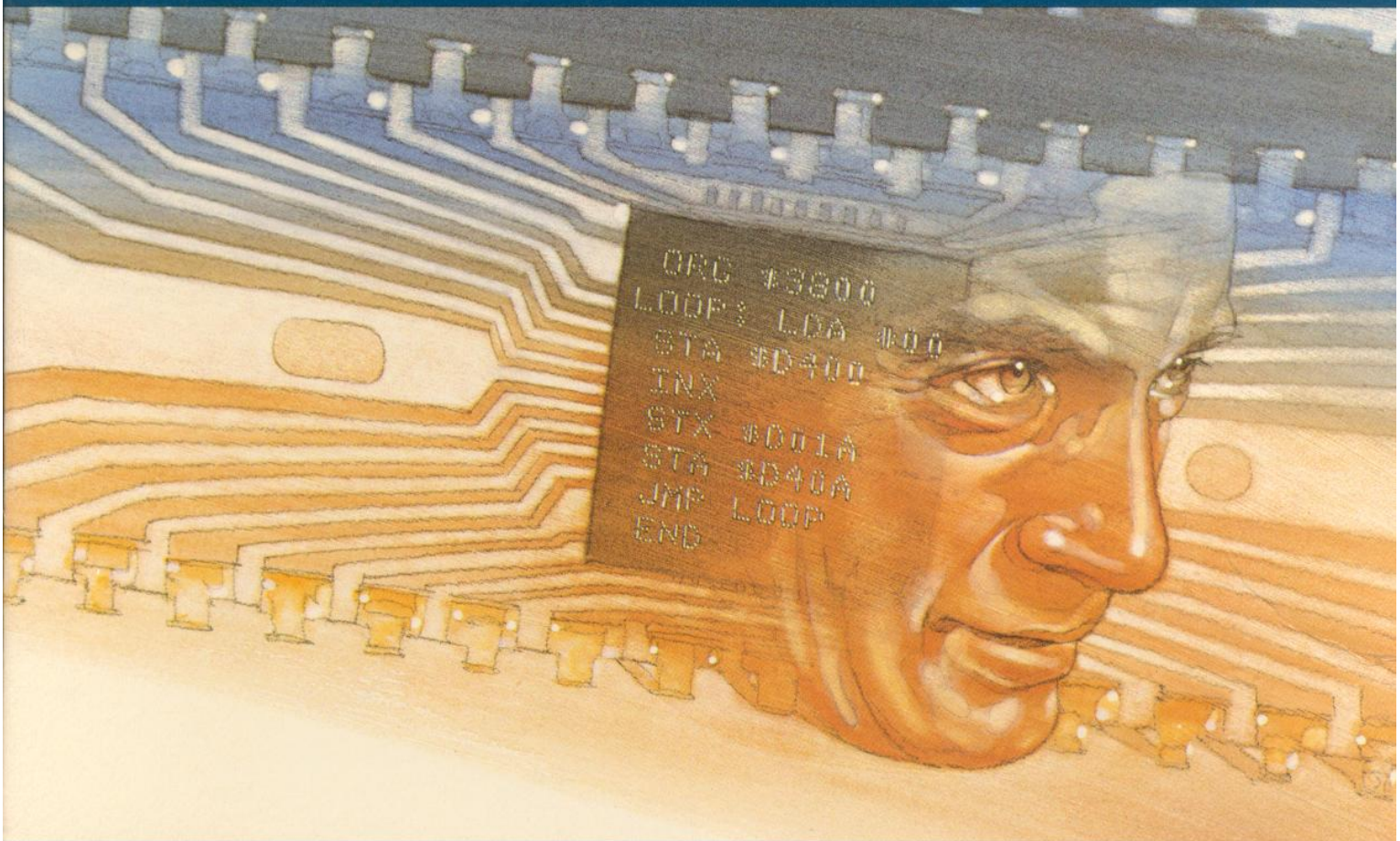


ATARI® 800™

COMPUTER PROGRAM DISKETTE
MACRO ASSEMBLER
AND PROGRAM-TEXT EDITOR™

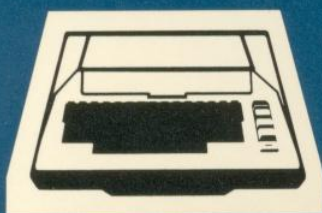
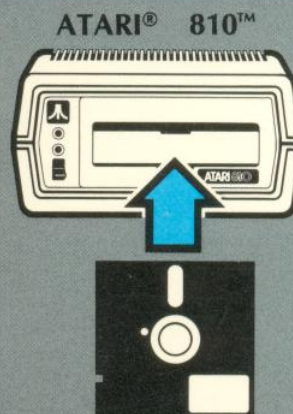



ATARI® A Warner Communications Company 

CONTAINS ONE PROGRAM DISKETTE CX8121
WITH TWO INSTRUCTION MANUALS
AND A QUICK-REFERENCE CARD
USE WITH ATARI 800™
HOME COMPUTER
ACCESSORIES REQUIRED

The ATARI Macro Assembler is a software development tool for the experienced programmer. The editor and assembler allow you to write and edit programs in 6502 assembly language for fast efficient execution. Features include macros and conditional assemblies.

CONTAINS ONE PROGRAM DISKETTE CX8121
WITH TWO INSTRUCTION MANUALS
AND A QUICK-REFERENCE CARD



SYSTEM REQUIREMENTS

- ATARI® 800™ Home Computer
- ATARI 810™ Disk Drive
- Minimum 32K RAM
- Blank Diskette (Model CX8100 or equivalent)

OPTIONAL ACCESSORY:

- ATARI 820™ 40-Column Printer, ATARI 822™ Thermal Printer, or ATARI 825™ 80-Column Printer
(ATARI 850™ Interface Module required to use the ATARI 825 80-Column Printer.)

ATARI, INC., Computer Division • PO Box 427 • Sunnyvale CA 94086
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ATARI® MACRO ASSEMBLER



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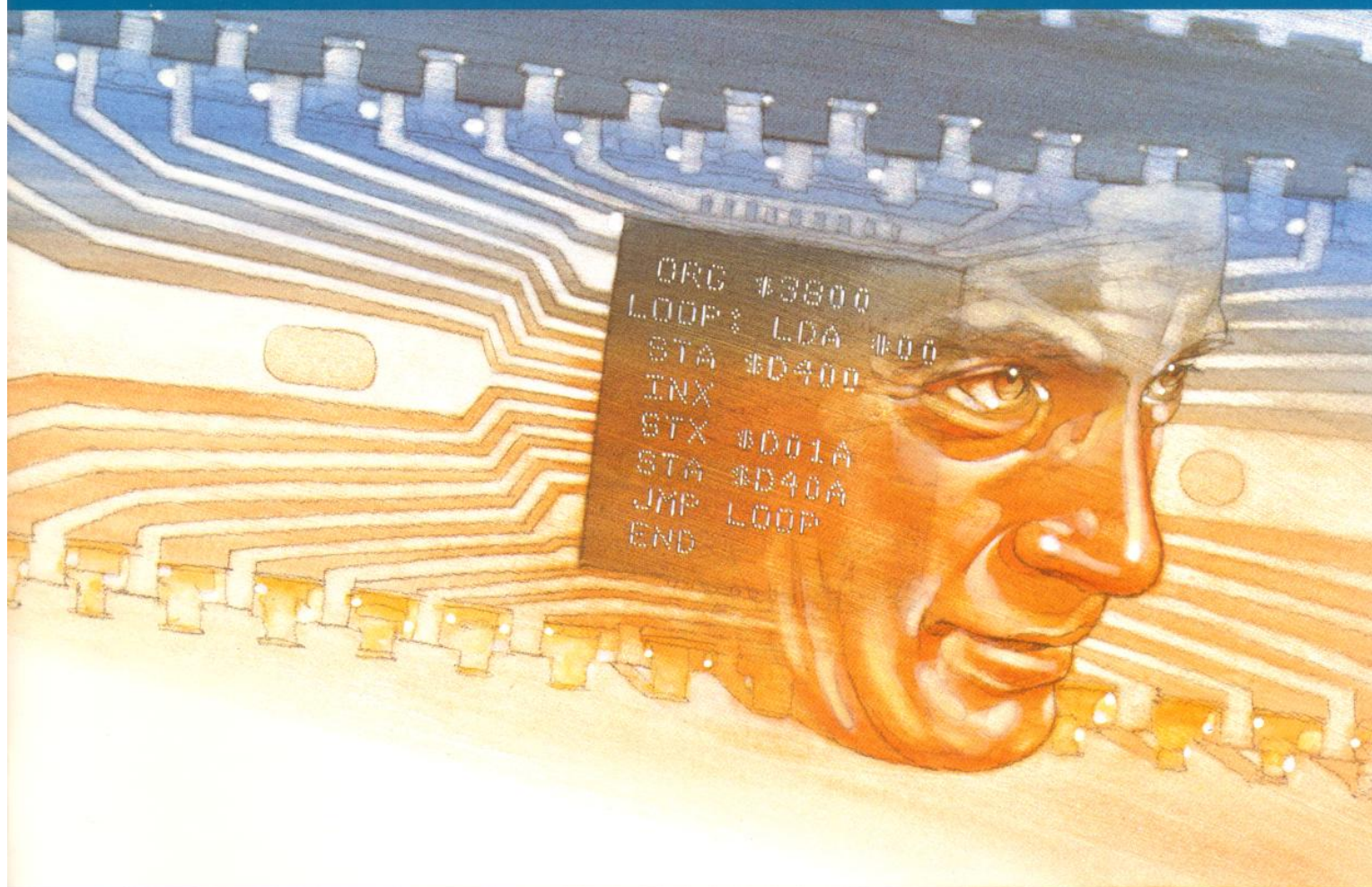
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ATARI[®] 800[™]

ATARI[®] MACRO ASSEMBLER



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Use with ATARI 800[™]
PERSONAL COMPUTER SYSTEM

INTRODUCTION

FEATURES OF THIS PACKAGE

The **ATARI® Macro Assembler** is a software development tool for writing 6502 assembly language programs for the **ATARI 800™ Home Computer**. The features of this assembler include macros, conditional assembly, code duplication, access to library definitions, program-listing control, and cross-reference tables. It offers fast compilation and uses standard 6502 mnemonics.

MACROS

The macro feature allows you to define code words to represent multiple instructions. It makes it easy for you to use a sequence of code many times in a program.

CONDITIONAL ASSEMBLY AND CODE DUPLICATION

Conditional assembly allows the generation of source code based on certain conditions. Combined with macros this offers a powerful and versatile way of coding assembly language programs. An ECHO pseudo-operation enables you to repeat sections of code (similar to the macro feature, but it does not allow parameter passing).

SYSTEXT FILES

Often you will want to create and store symbols and macro definitions on a library file. Once created, the symbols can be referenced by any of your source programs. Such a library file can ease your program development effort.

PROGRAM LISTING CONTROL

The LIST pseudo-op lets you tailor and annotate programs to fit your exact needs. The pseudo-op makes documentation easier by allowing listing control and page headings.

CROSS-REFERENCE TABLES

The Macro Assembler also includes an optional cross-reference table so that you can reference labels and variables in the source program quickly.

STANDARD ATARI COMPUTER AND 6502 MNEMONICS

A file containing the ATARI Home Computer Hardware Register addresses and OS Shadow Register addresses is included on your Macro Assembler diskette. You may reference standard ATARI Computer mnemonics in your programs using this file. See Systext reference in "Command Line Options" in Section 2.

Standard MOS Technology 6502 microprocessor coding format is used in this assembler. The formation of expressions also follows the standard conventions.

CONTENTS OF THIS SOFTWARE PACKAGE

The Macro Assembler includes:

- A diskette containing both the Macro Assembler and Program-Text Editor™ software
- A reference card giving pseudo-ops, error codes, and Program-Text Editor commands and messages
- This reference manual for the ATARI Macro Assembler
- An operators manual for the ATARI Program-Text Editor

PROCEDURES

PROGRAM LOADING INSTRUCTIONS

1. Connect the ATARI 800 Home Computer to a television set and to a wall outlet as instructed in the operators manual.
2. Connect the **ATARI 810™ Disk Drive** to the computer console and to a wall outlet as instructed in the *ATARI 810 Disk Drive Operators Manual*. Verify that the disk drive is set to DRIVE CODE 1 as instructed in the operators manual.
3. Open the cartridge door on the top of the computer console. Remove all cartridges from the top front cartridge slots. Close the cartridge door.
4. Turn on your television set.
5. Turn the disk drive POWER (PWR) switch to ON. Two red lights (the BUSY light and the PWR ON light) will come on.
6. When the BUSY light goes out, open the disk drive door by pressing the door handle release lever.
7. Insert the diskette containing the Macro Assembler and Program-Text Editor programs into disk drive 1.
8. Switch the POWER (PWR) switch on the computer console to ON.

The DOS II Menu will now appear on your screen.

CREATING A SOURCE PROGRAM

To use the editor, refer to the *ATARI Program-Text Editor Manual*.

After you create your source program, exit the Program-Text Editor using the commands that will return you to DOS:

1. Press **OPTION**.
2. Type **EXIT** and press **START**. (This returns you to DOS.)

Then, to assemble your source program:

1. Type the letter **L** and press **RETURN**.
2. Type **AMAC** and press **RETURN**.

ASSEMBLING A SOURCE PROGRAM

1. Refer to “Command Line Syntax” (in Section 2) for the command line syntax and command line options. Press **RETURN** after the command line.
2. After the assembly, press the **RETURN** key to return to DOS. Your DOS directory will now show that you have created an object file with an extension, OBJ.

PURPOSE OF THIS MANUAL

This manual is intended to show you how to use the Macro Assembler. If you plan to use the Program-Text Editor for creating your source program, it is suggested that you read the *ATARI Program-Text Editor Manual*, then practice creating files.

A knowledge of assembly language and ATARI DOS II is also necessary. The texts listed below will assist in your study of assembly language. If you wish to become familiar with the special features of the ATARI Home Computer, a copy of the *ATARI Technical Users Notes* will be needed.

REFERENCES

We recommend the following books:

MOS Programming Manual by MOS Microcomputers
SY6500/MCS6500 Microcomputer Family Programming Manual by SYNERTEK
6502 Assembly Language Programming by Lance Leventhal
6502 Software Design by Leo Scanlon
6502 Software Gourmet Guide and Cookbook by Robert Findley

ATARI publications:

ATARI DOS II Reference Manual
ATARI Technical Users Notes

ASSEMBLER EXECUTION

COMMAND LINE SYNTAX

The Macro Assembler is accessed by the ATARI DOS II Menu option L. When DOS asks for a filename to load, type:

AMAC RETURN

Once AMAC is loaded into memory, it will ask you to "Enter source filename and options." The source filename must always be specified. Any options you wish to use should follow the filename, separated by either a comma or space. The command line is terminated by a carriage return. The command line cannot be edited using the cursor control keys.

The general form of the command line is: <filespec> opt1,...optn. Where <filespec> is the source file to be assembled and is of the form <device>:<filename>.<extension>. The above command line could have been typed with any mixture of upper- or lowercase characters. The assembler will convert all command line characters to uppercase before interpretation.

COMMAND LINE OPTIONS

The 'opt1,...optn' are optional parameters (in any order) chosen from this list:

H=Dn: (Default is H=Dn: where n is the same disk drive as the source file)	Generate object output file to the specified disk drive where n may be 1, 2, 3, or 4. If no filename is specified, the object file will be named with the input source filename and the extension, OBJ.
H= <filespec>	Write object code to <filespec>.
H=0	Do not generate any object code.
L=P:	List output to printer.
L=Dn:	List output to specified disk drive (n= 1, 2, 3, or 4). List filename has the input source filename and the extension PRN.
L=S:	Output listing to the screen.
L=0 (Default)	Do not produce listing for this assembly.
O=n	Preset the value of the run address of the object program. Specifying "O=n" on the command line is exactly like the statement "END n" found at the end of an assembly program.
O=0 (Default)	Set the value of the run address to zero.

PS = n (Default is PS = 63)	Set page size to <n> source lines per page. Page size must be less than 127. When page size is less than 10, no title or subtitle lines nor page ejects are printed in the list file, and a full cross-reference is disallowed.
PS = 0	Do not print title and subtitle lines and page ejects to list file for this assembly.
S = <filespec>	Specify systext file. The S option may be repeated. The user may specify as many systexts as desired, so long as combined number of systexts and link files does not exceed the file limit of 40.
S	Use the default systext D:SYSTEXT.AST.
S = 0 (Default)	Specify no systext for this assembly.
R = F	Generate full reference map. List all global symbols and their references on the file specified by the L parameter.
R = S	Generate short reference map. List all global symbols and their values only on the file specified by the L parameter.
R = 0 (Default)	Do not generate reference map.
SL = n (Default is SL = 80 for P; and SL = 38 for S;)	Set the line length. Maximum length of the line output to the list file will be <n> characters; the rest of the line is discarded if <n> is greater than the device line length.

All numeric argument values (for O = n, PS = n, and SL = n) may be specified according to the general syntax for numbers. In particular, an explicit radix (decimal, binary, octal, or hexadecimal) can be used. Refer to Section 4, "Numbers," for radix specification.

All lowercase letters on the command line are converted to uppercase before interpretation.

COMMAND LINE EXAMPLES

D:TESTIT.ASM

will read input file D1:TESTIT.ASM (D: implies D1:), no listing will be produced, and the ATARI binary format object file will be D1:TESTIT.OBJ.

D:TESTIT.ASM H=0 R=F L=S:

will assemble D1:TESTIT.ASM, suppress object file generation, and send a listing with full reference map to the screen.

D2:TESTIT.ASM H=D: L=D2: R=F O=\$200

The assembler will assemble the file D2:TESTIT.ASM generating the object file D1:TESTIT.OBJ, and will produce a listing and full reference map in D2:TESTIT.PRN. In addition, it will also set the run address to \$200.

D2:TESTIT.ASM S S=D2:MSYS.AST L=P: R=F H=D: O=\$1700

The assembler will process the two systext files D1:SYSTEXT.AST and D2:MSYS.AST, assemble the file D2:TESTIT.ASM, produce the object file D1:TESTIT.OBJ with a run address of \$1700, and print a listing with full reference map on the printer.

USER INTERFACE

The assembler execution may be prematurely terminated by pressing the **BREAK** key. When output listing is directed to the screen, its execution can be temporarily halted by simultaneously pressing the **CTRL** key and the **1** key. Pressing those two keys again will restart execution.

If a disk-write error happens (usually disk or directory full), the offending file (object or list file) is erased, an error message is issued to the screen, and further attempts to write to the file are suppressed. Assembly then continues normally.

Assembly time errors are printed to the screen as well as to the list file.

FILE USAGE

SOURCE INPUT FILES

You can specify source input files by using the:

- First command line argument
- Systext file argument (S parameter)
- LINK pseudo-instruction
- INCLUDE pseudo-instruction

All input files must be in Program-Text Editor format. They consist of a line or lines of ATASCII characters terminated by ATASCII End-of-Lines <EOL>.

SYSTEM TEXT FILES

A system text file (systext) is an assembly language file of symbols and macro definitions. The programmer can predefine symbols here for many different programs. Some examples are:

- ATASCII control characters (BS, TAB, ESC, EOL,...)
- Addresses (entry points into CIO, SIO, and channel locations)
- Macros

If an assembly error is encountered while scanning a systext file, the assembler aborts with an error message.

OBJECT OUTPUT FILE

The object output file generated by the assembler has a default file extension of OBJ and is in ATARI binary format. Refer to the *ATARI DOS II Reference Manual* for detail specifications of binary format.

LISTING FILE

The output listing of the source program generated by the assembler has a default extension of PRN.

The Macro Assembler has a flexible set of listing control pseudo-ops which allows the user to generate only the desired program content.

Page heading (unless suppressed via PS=0) contains the assembler version and page number as well as optional user-specified title information (see TITLE and SUBTTL pseudo-ops).

The LIST pseudo-op (or L command line argument) controls which source lines are listed. Each code line listed begins with 20 columns of information generated by the assembler.

Column 1 of the listing output is reserved exclusively for errors; a listing free of assembly errors will not have any printing in column 1. An error count is reported at the end of the assembly. (See Section 10, "Error Codes.")

SOURCE LISTING
FORMAT

1	2
123456789.123456789.	
E addr# hhhhhhhhhh	Line that generates code.
R addr = vvvv	EQU, SET, IF, etc.
R -	Line that is skipped.
O addr = vvvv #	Location and origin counters are unequal.
R addr	
+ hhhhhhhhhh	Macro-generated line.
addr hhhh ^addr	Destination address of PC relative jumps.

Column	Description
1	Error flag or blank. See Section 10 for the meaning of error flags.
2	Blank.
3-6	Address location of this instruction (value of the location counter).
6	— sign means line not assembled due to IF...ELSE. Line only listed if LIST F in effect.
7	# sign means the location and origin counters are unequal.
8	+ sign means assembler-generated line. Line listed if LIST M in effect.
9-18	hhhhhhhhh is the resultant code. Up to five bytes are listed. If LIST G or D is in effect, multiple lines will be listed with up to five bytes on each.
11-14	vvvv = value of expression.
19-20	Always blank.
21-80	Source statement.

SAMPLE LISTING

	I/O EQUATES
=009B	EOL = \$9B
=0030	IOCB3 = \$30
=0340	ICHID = \$0340
=0341	ICDNO = ICHID+1
=0342	ICCOM = ICDNO+1
=0343	ICSTA = ICCOM+1
=0344	ICBAL = ICSTA+1
=0345	ICBAH = ICBAL+1
=0346	ICPTL = ICBAH+1
=0347	ICPTH = ICPTL+1
=0348	ICBLL = ICPH+1
=0349	ICBLH = ICBLL+1
=034A	ICAX1 = ICBLH+1
=034B	ICAX2 = ICAX1+1

```

=0003      OPEN =      $03
=0005      GETREC =    $05
=0009      PUTREC =    $09
=000C      CLOSE =    $0C
=0004      OREAD =     $04
=0008      OWRT =      $08
=0088      EOF =       $88
=E456      CIOV =      $E456
=0040      IOCB4 =     $40
;
;FIRST INIT THE IOCB FOR OPEN
;
0000#      = 5000      ;          ORG $5000

;DATA REGION
5000      44323A5445  ;NAME1  DB      'D2:TEST1',EOL
           =0050      BUF1SZ   =      80
           =5009      BUF1     =      *
5009      =5059      ORG      * + BUF1SZ
5059      50323A9B   NAME2    DB      'P2:',EOL
505D      A230       START    LDX      #IOCB3
505F      A900       LDA      #LOW NAME1
5061      9D4403     STA      ICBAL,X
5064      A950       LDA      #HIGH NAME1
5066      9D4503     STA      ICBAL,X
5069      A900       LDA      #0
506B      9D4B03     STA      ICAX2,X
;
;“OPEN” THE DISK
;
506E      A903       LDA      #OPEN
5070      9D4203     STA      ICCOM,X
5073      2056E4     JSR      CIOV
5076      BC4303     LDY      ICSTA,X
5079      1003 ^507E BPL      L1
507B      4CA250     JMP      ERR2
;
;CHANNEL 4 IS PRINTER
;
507E      A240       L1      LDX      #IOCB4
5080      A959       LDA      #LOW NAME2
5082      9D4403     STA      ICBAL,X
5085      A950       LDA      #HIGH NAME2
5087      9D4503     STA      ICBAL,X
508A      A908       LDA      #OWRT
508C      9D4A03     STA      ICAX1,X
508F      A900       LDA      #O
5091      9D4B03     STA      ICAX2,X
;
;“OPEN” THE PRINTER
;
5094      A903       LDA      #OPEN
5096      9D4203     STA      ICCOM,X
5099      2056E4     JSR      CIOV
509C      BC4303     LDY      ICSTA,X
509F      1004 ^50A5 BPL      TP10

```

```

;
;ERROR — JUST BRK
;
50A1      00      ERR1      BRK
50A2      00      ERR2      BRK
50A3      00      ERR3      BRK
50A4      00      ERR4      BRK
;
;SETUP TO READ A RECORD
;
50A5      A230    TP10      LDX      #IOCB3
50A7      A905          LDA      #GETREC
50A9      9D4203         STA      ICCOM,X
50AC      A909          LDA      #LOW BUF1
50AE      9D4403         STA      ICBAL,X
50B1      A950          LDA      #HIGH BUF1
50B3      9D4503         STA      ICBAH,X
;
;READ RECORDS
;
50B6      A950    LOOP      LDA      #LOW BUF1SZ
50B8      9D4803         STA      ICBLL,X
50BB      A900          LDA      #HIGH BUF1SZ
50BD      9D4903         STA      ICBLLH,X
50C0      2056E4        JSR      CIOV
50C6      1004 ^50CC    BPL      PRNTR
;
;NEG STATUS ON READ — EOF
;
50C8      C088    TP20      CPY      #EOF
50CA      D0D7 ^50A3      BNE      ERR3
;
;PRINT A RECORD
;
50CC      BD4803    PRNTR   LDA      ICBLL,X
50CF      A240          LDX      #IOCB4
50D1      9D4803         STA      ICBLL,X
50D4      A230          LDX      #IOCB3
50D6      BD4903         STA      ICBLLH,X
50D9      A240          LDX      #IOCB4
50DB      9D4903         STA      ICBLLH,X
50DE      A909          LDA      #PUTREC
50E0      9D4203         STA      ICCOM,X
50E3      A909          LDA      #LOW BUF1
50E5      9D4403         STA      ICBAL,X
50E8      A950          LDA      #HIGH BUF1
50EA      9D4503         STA      ICBAH,X
50ED      2056E4        JSR      CIOV
50F0      BC4303        LDY      ICSTA,X
50F3      1003 ^50F8    BPL      L3
50F5      4CA450        JMP      ERR4
50F8      A230          L3     LDX      #IOCB3
50FA      BC4303        LDY      ICSTA,X
50FD      C088          CPY      #EOF
50FF      F003 ^5104    BEQ      L2
5101      4CA550        JMP      TP10

```


5104	A90C	L2	LDA	#CLOSE
5106	9D4203		STA	ICCOM,X
5109	2056E4		JSR	CIOV
510C	A90C		LDA	#CLOSE
510E	A230		LDX	#IOCB3
5110	9D4203		STA	ICCOM,X
5113	2056E4		JSR	CIOV
5116	00		BRK	
5117			END	

No ERRORS, 39 labels, \$A3E6h free.

BUF1	5009	1#36	2/28	2/30	2/60	3/ 2		
BUF1SZ	0050	1#35	1/37	2/35	2/37			
CIOV	E456	1#25	1/51	2/12	2/39	3/ 4	3/18	3/23
CLOSE	000C	1#21	3/16	3/20				
EOF	0088	1#24	2/45	3/12				
EOL	009B	1#3	1/34	1/38				
nERR1	50A1	2#18						
ERR2	50A2	1/54	2#19					
ERR3	50A3	2#20	2/46					
ERR4	50A4	2#21	3/ 8					
GETREC	0005	1#19	2/26					
ICAX1	034A	1#15	1/16	2/ 4				
ICAX2	034B	1#16	1/45	2/ 6				
ICBAH	0345	1#10	1/11	1/43	2/ 2	2/31	3/ 3	
ICBAL	0344	1# 9	1/10	1/41	1/60	2/29	2/61	
ICBLH	0349	1#14	1/15	2/38	2/54	2/56		
ICBLL	0348	1#13	1/14	2/36	2/50	2/52		
ICCOM	0342	1# 7	1/ 8	1/50	2/11	2/27	2/59	3/17
		3/22						
ICDNO	0341	1# 6	1/ 7					
ICHID	0340	1# 5	1/ 6					
ICPTH	0347	1#12	1/13					
ICPTL	0346	1#11	1/12					
ICSTA	0343	1# 8	1/ 9	1/52	2/13	2/40	3/ 6	3/11
IOCB3	0030	1# 4	1/39	2/25	2/53	3/10	3/21	
IOCB4	0040	1#26	1/58	2/51	2/55			
L1	507E	1/53	1#58					
L2	5104	3/13	3#16					
L3	50F8	3/ 7	3#10					
nLOOP	50B6	2#35						
NAME1	5000	1#34	1/40					
NAME2	5059	1#38	1/59	1/61				
OPEN	0003	1#18	1/49	2/10				
nOREAD	0004	1#22						
OWRIT	0008	1#23	2/ 3					
PRNTR	50CC	2/41	2#50					
PUTREC	0009	1#20	2/58					
nSTART	505D	1#39						
TP10	50A5	2/14	2#25	3/14				
nTP20	50C8	2#45						

SYMBOL MAP FORMAT

When R=S is selected, the short symbol map is printed at the end of the program listing. For each symbol name in the program, the following is printed:

sa symbol hhhh, where:

<s> is blank or "s" for a name introduced in a systext file.

<a> is either blank or

U = undefined, or

D = doubly defined, or

n = not referenced.

<symbol> is the name of the symbol.

<hhhh> is the symbol value in hexadecimal, or "mac" if the name is a macro. Four symbols are printed on each line, using the default line length.

When R=F is selected, the full cross-reference map follows the source listing. On each line, in addition to the R=S information above, cross-reference information is listed. Each reference has the form:

ppp/ll

where <ppp> equals page number and <ll> equals line number. For a definition reference, the / is replaced by #.

Names beginning with a : (local symbols) and a ? (usually macro invented) are not included in either type of symbol map output.

Symbols defined in a systext file appear in the cross-reference only if they are used during the assembly; they are flagged with an s.

LANGUAGE STRUCTURE

A Macro Assembler source program consists of a sequence of statements, comments, and definitions. Statements are the fundamental units of assembly. Comments do not affect assembler operation or object output. Definitions may be conditionally assembled, saved for later assembly, or repeated.

All characters in a statement are converted to uppercase except those in the comment field.

STATEMENTS

A statement is divided into three fields: a label field, an operation field, and a variable field.

LABEL FIELD

The label field begins with the first character of the statement and is terminated by a blank or an end of statement. If a colon (:) is the last character of the label field, it is discarded. For example:

```
SYMBX:    ADC    MEM,X    ;comment
```

SYMBX is the defined label.

OPERATION FIELD

The operation field begins with the first nonblank character after the label field and terminates with the next blank character. Machine op codes, pseudo-ops, and macro calls all occur in the operation field. If this field is empty, the variable field must be empty also. For example:

```
SYMBX:    ADC    MEM,X    ;comment
```

ADC is the machine op code.

VARIABLE FIELD

The variable field begins with the first character after the operation field and is terminated by an end of statement. Variables, expressions, and other arguments used by the operation field appear in this field. For example:

```
SYMBX:    ADC    MEM,X    ;comment
```

MEM,X is the variable.

STATEMENT TERMINATION

A statement is terminated by:

Beginning of comment (;), or
End-of-Line, or
Logical end of statement mark (!).

```
SYMBX:   ADC      MEM,X      ;comment
SYMBY:   ADC      MEM,X
SYMBZ:   ASL      ! ASL      ! ASL      ! ASL      ; 4 statements
```

In the last example (SYMBZ), one source line contains four statements. Three of them are terminated with an !, the last by a ;. Identical object code would be generated if the ! were replaced by End-of-Line <EOL>. When an ! and a ; occur inside quotation marks, they do not function as separators.

COMMENTS

A comment begins with a ; following the variable field of a statement. A comment affects neither the assembler operation nor the object code generated.

Comments that begin in column 1 are full-line comments; they begin with a ; or an *. (Please note that an * signifies a comment only when found in column 1 — column 1 of input is listed at column 21 on an output listing.) A comment is terminated by EOL.

```
LABEL:   LDA      129          ;This is a "comment."
;This is a full-line comment.
*This is another full-line comment.
FROG:    STA      MEM,X       This is not a legal comment.
                                   ;(above comment needs a ;)
```

DEFINITIONS

Definitions begin with specific types of statements (MACRO, ECHO, IF). The end of a definition is dependent on what started the definition, for example, ENDM is used to terminate MACRO and ECHO definitions, while ENDIF terminates an IF range.

SYMBOLS AND NAMES

A symbol is a sequence of characters that identifies a value or a macro. The first character cannot be a digit. Symbols may be any length, but they must be unique in the first six characters. The following characters may be used in a symbol name:

A-Z	The uppercase letters of the alphabet
a-z	The lowercase letters of the alphabet (converted to uppercase by the assembler)
:	May only be first character indicating a local symbol
?	If first character, then the symbol is excluded from the reference map
@	Additional alpha extension. Cannot be first character of an identifier, since it is also a prefix for octal numbers.
0-9	Digits

The underline character () may occur in a name as written but is discarded. Lowercase letters are mapped into the corresponding uppercase. When a colon occurs as the first character in a name, it denotes a name local to the current PROC (see PROC pseudo-op in Section 6). A colon at the end of a name in the label field is interpreted as a terminator but in any other position, it is ignored.

Examples:

ERROR__5:			;the assembler ignores __, label is ERROR5
	JMP	RESTART	;the assembler uses first 6 characters: 'RESTAR'
TEST	LDA	COUNT	
	BNE	Error5	; 'Error5' converted to ERROR5
:LOCAL:	DEC		;:local: is a local symbol

NUMBERS

A number can be in any one of three forms, depending on the prefix.

Prefix	Base	
%	2	Binary
@	8	Octal
\$	16	Hexadecimal

The lack of a prefix implies decimal.

Digits greater than the radix are not allowed. The underline character () is ignored.

The Macro Assembler provides constant conversion formatting for 6-byte real numbers as specified in the current ATARI BASIC. Real numbers are not valid expression arguments in variable fields. (See "REAL6," pseudo-op in Section 6).

Examples:

BINVAL	EQU	%10 001 010
OCTVAL	EQU	@212
HEXVAL	EQU	\$8A

CHARACTER STRINGS

The assembler accepts ATASCII characters \$20-\$7E as valid characters. A character string consists of any sequence of characters surrounded by single quotation marks ('n . . . n'). Within a string, a single quotation mark character is represented by two successive single quotation marks.

Character strings can be used in the TITLE and SUBTTL statements, as a DB or DC subfield, or as operands of relational operators.

The LSTR operator returns the length of a character string (see "Expressions" in this section).

Examples:

TITLE	'Sample Expressions'
DB	'This is a STRING.', \$9B
DB	'Control characters are illegal in a long string'
DB	\$9B
	;Nonprintable characters may be represented
	;by using their hexadecimal values, ',
	;such as \$9B for EOL',
DW	\$2766, 'bp', 'BP' ;2-byte values
LDA	#43 ;a decimal number
ADC	#'C' ;an ATASCII character
CMP	#''' ;an ATASCII character

EXPRESSIONS

An expression consists of operands combined with operators to produce a value. Operators of equal precedence are evaluated left to right. Brackets can be used to override the order of evaluation, since 6502 instructions use parentheses for indirect addressing. Expressions are evaluated using 16-bit two's complement (unsigned) arithmetic. Overflow is ignored.

Real numbers are not valid arguments in expressions.

Examples:

DB	'Here are some fancy expressions:'
DB	43 + 22 shl 3 mod 6
DB	'Q' + REF1 xor [99 and REF2]
AND	low ['ZZ' - ['A' xor 'a' + ['A' xor 'a'] shl 8]]
DW	rev [*O - *L]

OPERANDS

An operand is either a symbol, an expression enclosed in brackets, a number, a character string, or one of the following special elements:

*	= current location counter
*L	= same as *
*O	= current value of origin counter
*P	= current position counter number of defined byte

See LOC and ORG pseudo-ops for further discussion of *L and *O. Refer to the VFD pseudo-op for details on *P.

The comparison operators return a value of zero for false and \$FFFF for true. Numeric tests treat values as unsigned, so that $[-1 < 0]$ will produce the answer false. Character string tests use the ATASCII collating sequence.

Operators

+		Sum or positive sign
−		Difference or negative sign
*		Multiply
/		Divide
NOT		Bit-by-bit complement
AND		Logical product, conjunction
&		Logical product, conjunction (same as AND)
OR		Logical sum, disjunction, inclusive OR
XOR		Logical difference, inequivalence, exclusive OR
=	EQ	Equality
< >	NE	Inequality
<	LT	Less than
< =	LE	Less than or equal to
>	GT	Greater than
> =	GE	Greater than or equal to
SHL		Shift left n bits
SHR		Shift right n bits
HIGH		Unary, high value to 8-bit field = $x / 256$
LOW		Unary, low value to 8-bit field = $x \text{ MOD } 256$
MOD		Modulus function
REV		Unary Reverse = $((\text{LOW } x) \text{ left and right SHL } 8) + (\text{HIGH } x)$
DEF		Test symbol previously defined
LSTR		Return the length of a character string

Precedence Levels

Highest	Brackets														
	HIGH	LOW		DEF		REV		LSTR							
	*	/	MOD		SHL		SHR								
	+	−	unary												
	+	−	binary												
	=	<>	<	<=	>	>=	NE	EQ	LT	LE	GT	GE			
	NOT														
	& AND														
	Lowest	OR XOR													

MACRO FACILITY

A macro is a sequence of source statements that are saved and then assembled through a macro call. A macro call consists of a reference to a macro name in the operation field of a statement. It often includes actual parameters to be substituted for formal parameters in the macro code sequence, so that code generated can vary with each assembly of the definition.

Use of a macro requires two steps: definition of the macro and reference to the macro.

MACRO DEFINITION

A macro definition consists of three parts: heading, body, and terminator.

Heading A macro definition starts with the name of the macro and the substitute parameter names in the variable field.

Body The body begins with the first statement after the heading that is not a comment line. The body consists of a series of instructions. All instructions other than END, including other macro definitions and calls, are legal within the body. However, a definition within a definition is not defined until the outer definition is called. Therefore, an inner definition cannot be called directly. Substitute parameters can occur anywhere in the body. They are prefixed by a percent sign (%):

```
%1 = first parameter
%2 = second
...
%9 = ninth parameter
%K = 4 hex digits, representing the serial number
    of this macro call
%L = the label field of the macro call
%M = the name of the macro
%% = replaced by a single percent
```

Terminator A macro definition is terminated by an ENDM pseudo-instruction. The assembler counts the nesting level of MACRO/ECHO and ENDM pairs occurring in a macro body, so that the definition is terminated only by the corresponding ENDM.

Note: The ENDM pseudo-op must be preceded by a tab (►) character. Press **ESC** **CLR SET TAB** to get the tab character.

MACRO CALL

A previously defined macro is called when its name occurs in the operation field of a statement. If actual parameters appear in the call, they are substituted for the corresponding formal parameter in the macro body without evaluation. Only after the entire body has been expanded does assembly resume. Thus the statements generated by the macro may themselves contain further macro calls or definitions, with the nesting limited only by available memory.

Note: When writing recursive macros, take care in the coding of the termination condition(s). A macro that repeatedly calls itself will cause the assembler to terminate (eventually) with the message "Memory Overflow."

CODE DUPLICATION

The ECHO pseudo-instruction is used to repeat a code sequence. It is written similarly to a macro definition but with the following differences: heading is ECHO, not MACRO; no parameters are involved; the variable field of the ECHO statement specifies how many times the body is to be repeated. ENDM is also used to terminate an ECHO sequence (see ECHO pseudo-op).

NESTING

ECHO, MACRO, and IF blocks may be nested in completely arbitrary fashion, subject only to the constraint that it be properly nested; i.e., each block must be contained within the surrounding block.

PSEUDO-OPERATIONS

The Macro Assembler provides a comprehensive set of pseudo-operations (pseudo-ops) that permits you to control the assembly process.

For ease of comprehension, the following notations are used in this manual:

iglab	means the label field is ignored by the pseudo-op
<exp>	means that an expression is required
[exp]	means that an expression may appear, at your option
{exp}	means that the item inside the braces { } may appear zero or more times

ASSERT

CHECK ASSEMBLY CONDITION

iglab ASSERT <exp>

where: iglab = ignored label field
 exp = any legal expression: Nonzero implies true
 Zero implies false

ASSERT allows you to check for and flag illogical assembly conditions such as incorrect parameter values, programs that are too large, and undefined symbols.

The expression is evaluated and a P error will be generated if the expression is false; i.e., if the expression evaluates to zero.

The expression is not examined in Pass 1 of the assembler, so ASSERT can correctly check any condition. Forward references in the expression are evaluated correctly.

Examples:

To check that the location counter in a given piece of code is within bounds, in this case below \$2000, add the following line at the end of the assembly:

```
ASSERT * < $2000;test for limit exceeded
```

If the location counter reaches \$2000, a P error will generate.

If you are writing a utility subroutine and wish to check that a required symbolic definition has been supplied by the user of the subroutine, you might code:

ASSERT DEF [SYMB1]

If the required symbol SYMB1 is not defined by the user within the assembly, a P error will be generated. Note that the check for symbol definition is postponed until after Pass 1, allowing you to define SYMB1 anywhere in the source code.

DB

DEFINE BYTE

LABEL: DB <exp> ..., <exp>

where: <exp> = any legal expression, value, or string

DB allows you to directly specify the content of individual bytes of memory.

A string will generate as many bytes as it has characters; the first character will be the first byte generated. Characters in the string generate their 7-bit ATASCII codes without parity.

DB is used to intersperse code with text strings and for data tables.

The label field is significant; it will address the first byte generated.

Examples:

```
PNCHRS: DB ',./;@@<>?!'#$%&'()_*= + (tm):-[]@',0
          DB $80
          DB LAB,LAB2,3,$46,$0AF,'xX',17+QVAL*4,'coffee'
```

DC

DEFINE CHARACTER

LABEL: DC <exp> ..., <exp>

where: <exp> is any legal expression, value, or string

DC operates like DB, but the high-order bit (parity bit) of the last byte of each expression is set.

DC is used just like DB. The only difference is the parity bit of the last byte of each term.

Examples:

```
TBLHDR   DC 'This is a table of offsets'
ADRLST   DC 128, $36, $15, @21, 159
```

DS

DEFINE SPACE

LABEL: DS <exp16>

where: <exp16> = any legal expression, value, or string

DS allows you to reserve large blocks of memory. The expression <exp16> will be evaluated as an unsigned 16-bit value, and that value will be used to increment the assembler's internal origin and location counters.

Memory allocated is **not** initialized, and will contain unknown values at program execution time. The label field is significant; it will address the first memory byte allocated.

DS reserves space for use at execution time; it can be used to “skip over” an existing piece of ROM or provide for uninitialized data storage.

Example:

```
STORG:    DS    256 ;allocate 256 bytes
```

DW

DEFINE WORD

```
LABEL:    DW    <exp16> ..., <exp16>
           <exp16> = any expression or value or 1 to 2
                   character string
```

where: <exp16> = any expression, value, or string

DW defines the contents of blocks of memory. Values and expressions in the operand field are computed as unsigned 16-bit values and placed in memory as a machine word; the assembler places the Least Significant Byte (LSB) first, followed by the Most Significant Byte (MSB).

The label field is significant; it will address the first byte generated.

DW is intended to build tables of 16-bit values.

Examples:

```

;                               Table of Addresses
DW    PWRON    ;Power on
DW    MSTRST   ;Master reset
DW    SYSCAL   ;System calibrate
DW    RECAL    ;Recalibration
DW    PWRDN    ;Power down
DW    BUTTON   ;Button press
DW    EMERG    ;Emergency shutdown
DW    ACTN1,ACTN2,ACTN3 ;Action numbers 1,2,3
DW    0        ;End of table
```

ECHO...ENDM

ECHO BLOCK

```
LABEL:    ECHO    <exp>
           ...
           ENDM
```

where: <exp> = numeric expression

ECHO ... ENDM is a simple code-duplication facility. Code between an ECHO and its ENDM will be assembled as many times as specified by the <exp>.

The label field is significant; it addresses the value of *O when the ECHO pseudo-op is encountered.

An ECHO . . . ENDM construct may not exceed 255 repetitions; 0 (zero) repetitions means the ECHO . . . ENDM code is skipped. ECHO . . . ENDM is convenient for repetitious coding problems. An ECHO . . . ENDM sequence is much easier to create and maintain than, say, 127 repetitions of a 6-line procedure.

Note: The ENDM pseudo-op must be preceded by a tab (►) character.

Example:

```
; The following example will create a table
; of 20 entries of 4 bytes each and
; initialize each entry to a value of
; $10 37 00 00.
;
TABLE:    ECHO    20                ;20 times
          DB      $10, $37, $00, $00
          ENDM                    ;End table
```

EJECT

EJECT PAGE

```
iglab    EJECT
iglab    = ignored label field
```

EJECT forces a page eject in the assembly listing if the listing is currently turned on.

EJECT can be used anywhere in an assembly source program.

The TITLE pseudo-op sets the internal title string and forces an EJECT.

Example:

```
EJECT
```

END

END PROGRAM

```
LABEL:    END [exp]
```

END tells the assembler where to stop assembly and begin the cross-reference map. The optional address field expression specifies the run address for an object program.

END must be the last statement of the last link file of an assembly.

The label field is significant, and addresses the value of the internal *O counter when the END is processed.

Example:

```
FREESP:    END    ;end of program
```

EQU or =

EQUATE VALUE TO SYMBOL

```
LABEL: EQU <exp16>
LABEL: = <exp16>
```

where: <exp16> = 16-bit expression or value or
1 to 2 character string

EQU defines the symbol on the left as the value of the 16-bit expression in the operand field.

EQU creates symbols (labels) for use with other assembler instructions. Unlike SET, EQU defines a fixed value to a symbol that cannot be changed during the assembly.

The operand <exp16> must be an absolute value at the time of evaluation; any symbols used in the expression must have been previously defined.

Examples:

```
TSTCHR EQU '$'
TS2CHR: EQU '@'
ZAP EQU $900
ZONK: = ZAP * 2
```

ERR

FORCE ERROR FLAG

ERR allows you to force an assembly error. The address field is ignored. When the assembler detects an impossible or undesirable condition at assembly time, ERR allows this to be flagged.

Examples:

```
IF * > 4000h
ERR ;Program too long
ENDIF
```

IF...ENDIF, IF...ELSE...ENDIF

```
iglab IF <exp>
      <code for special situation>
iglab ENDIF
```

```
iglab IF <exp>
      <assembly code>
iglab ELSE
      <assembly code>
iglab ENDIF
```

where: <exp> = expression: nonzero => true
zero => false

IF ... ENDIF and IF ... ELSE ... ENDIF control textual input to the assembler. At assembly time, <exp> is evaluated and the result determines where the assembler will resume assembling the input file.

Whenever a single program should be configured as two (or more) distinct versions, IF ... ENDIF and IF ... ELSE ... ENDIF can test assembly-time values and assemble only the appropriate source lines.

Expression <exp> values for an IF must be numeric; strings greater than two characters are not allowed.

IF ... ENDIF and IF ... ELSE ... ENDIF constructs are “nestable”; depth of nesting is limited only by memory space available at assembly time.

Any “label” in the label field is ignored; a descriptive name can be placed here to help associate an IF with its ELSE (if used) and ENDIF.

Examples:

```
IF      1      ;1 is nonzero, therefore true
JSR     OUTM
JMP     BOOT   ;these two lines will be assembled
ENDIF
LABEL:  IF     DEF X   ;Condition
JSR     PATH1   ;LABEL is ignored, but
LABEL:  JMP     ELSE   ;assists readability.
JMP     PATH2
ENDIF
```

INCLUDE

INCLUDE ANOTHER SOURCE FILE

LABEL: INCLUDE <filespec>

where: <filespec> = <Dn:filename.ext>, n can be 1, 2, 3, or 4

INCLUDE specifies another file to be included in the assembly as if the contents of the referenced file appeared in place of the INCLUDE statement itself. The included file may contain other INCLUDE statements. The listing of code in INCLUDE files is controlled by the I option of the LIST pseudo-op. (See INCLUDE example.)

INCLUDE allows you to divide large programs into manageable pieces for ease of editing, common use of libraries, file manipulations, and so forth.

Example:

The command line

D:INCLDEX.ASM

combined with the following, file setup:

```
<INCLDEX.ASM contents>
TITLE      'INCLUDE example'
ORG        $100
INCLUDE    D:L1
INCLUDE    D:L2
INCLUDE    D2:L3.ACD
;*** End INCLDEX.ASM
```



```

<D:L1 contents>
        LDA                L1VAL
;*** End L1. ASM

<D:L2 contents>
        LDA                L2VAL
;*** End L2.ASM

<D2:L3.ACD contents>
L1VAL    DB                '*'
L2VAL    DB                0
        END                ;Stop assembly here.
;*** End L3.ACD

```

This would input to the assembler the following sequence of code:

```

        TITLE              'INCLUDE example'
        ORG                $100
        LDA                L1VAL
;*** End L1.ASM
        LDA                L2VAL
;*** End L2.ASM
L1VAL    DB                '*'
L2VAL    DB                0
        END                ;Stop assembly here.
;*** End L3.ACD
;*** End INCLDEX.ASM

```

LINK

LINK TO ANOTHER SOURCE FILE

```
iglab LINK <filespec>
```

where: <filespec> = <Dn:filename.ext>, n can be 1, 2, 3, or 4

The LINK pseudo-op is similar to the INCLUDE facility, except that link files are not assembled until the assembler reaches the end of the current input file. Whenever a LINK pseudo-op is found, it is stored away for processing along with any other LINK statements encountered when the current file is finished processing.

Each source file that contains links to other files will be completely processed, and its links will then be processed in order of occurrence. Any link that contains sublinks will be processed in an identical manner; link files may nest arbitrarily deep, as long as the total number of files does not exceed 40.

If A, Q, S, T, U, and X are assembly-code files, and if A links to Q, S, and X, and S links to T, and T links to U, then the order of assembly will be:

A, Q, S, T, U, X.

If the <filespec> extension is missing, it defaults to the extension used in the current input file; i.e., the file that contains the LINK pseudo-op.

Examples:

```
Link    D2:PART1      ;Assemble file 'D2:PART1'
                        ;using the same extension as
                        ;the primary file
BLORP:  LINK    D:UTIL.ACD
        LINK    D2:PART2.ASM ;'BLORP' is ignored
```

LINK allows you to divide large programs into manageable pieces for ease of editing, common use of libraries, file manipulations, and so forth. The LINK facility supports linking across diskettes, so the entire source program does not have to be contained on the same diskette.

Example:

The command line

```
AMAC D:LINKEG.ASM
```

combined with the following link file setup:

```
<LINKEG.ASM contents>
        TITLE    'LINK example'
        ORG      $100
        LINK     D:L1
        LINK     D:L2
        LINK     D2:L3.ACD
;***     Endx     LINKEG.asm

<D:L1 contents>
        LDA      L1VAL
;***     Endx     L1.asm

<D:L2 contents>
        LDA      L2VAL
;***     Endx     L2.asm

<D2:L3.ACD contents>
L1VAL    DB      '*'
L2VAL    DB      0
        END      ;Stop assembly here.
;***     Endx     L3.acd
```

would input to the assembler the following sequence of code:

```
        TITLE    'LINK example'
        ORG      $100
;***     Endx     LINKEG.asm
        LDA      L1VAL
;***     Endx     L1.asm
        LDA      L2VAL
;***     Endx     L2.asm
L1VAL    DB      '*'
L2VAL    DB      0
        END      ;Stop assembly here.
;***     Endx     L3.acd
```

LIST

OUTPUT LISTING CONTROL

```
iglab LIST *  
iglab LIST <opt> ..., <opt>
```

where: <opt> = optional minus sign followed by one of the following.

- C** List listing controls: EJECT, PAGE, SPACE, SUBTTL, and TITLE lines. (Default OFF.)
- D** List **detailed** code: i.e., list every byte generated by DB, DW, VFD, multi-line statements, and so forth.
- F** List code skipped by IF...ENDIF or IF...ELSE...ENDIF. (Default ON.)
- G** List **all** generated code: i.e., list every byte placed in the output object file, regardless of origin. Overrides -L. (Default OFF.)
- I** List code in INCLUDE files. (Default OFF.)
- L** Master LIST control. When -L option is in effect, nothing is listed except lines with errors, or when -L is overridden by the G option. (Default ON.)
- M** List all lines generated by macro references. (Default ON.)
- R** Accumulate cross-references. (Default ON.)
- S** List code referenced in a systext file. (Default OFF.)

LIST controls the listing produced during an assembly. However when an L=0 command line option is selected, LIST pseudo-op has no effect. The variable-field argument to LIST must be an *, or a set of options.

The LIST pseudo-op operates on a stack: each element of the stack is a set of option flags. The flag on top of the stack controls the content of the listing produced. Each call to the LIST pseudo-op will push, or pop, a flag on or from the stack.

“LIST *” means pop the list-option stack.

“LIST M” means make a copy of the current flag, setting the M-flag to ON, and push the new flag setting onto the stack.

LIST has obvious applications for detailed listing of newly written code, detailed listing of untested macro expansions, and suppressing the listing of library code.

Example:

A common code library may contain a set of routines all having the following IF block at the beginning:

```
IF      ILIST = 0    ;if common code list turned off  
LIST    -L, -R      ;no listing, no references  
ENDIF
```

Assume that the global symbol ILIST equals zero. A new flag setting is pushed onto the LIST option stack; the options (-L, -R) specify no listing is to be printed, and no cross-reference accumulation is to be done.

Each common code routine also has this IF...ENDIF at its end:

```
IF      ILIST = 0    ;if common code listing was off
LIST    *           ;go back to original list options
ENDIF
```

Now that the common code routine has been assembled, the LIST option stack will be popped. This returns the LIST option stack to its condition before the library was assembled.

LOC

SET LOCATION COUNTER

LABEL: **LOC** <exp16>

where: <exp16> = 16-bit expression or value

LOC sets the location counter. The expression is evaluated as an unsigned 16-bit value and assigned to the Macro Assembler's internal location counter (*L).

Code generated while the internal LOC counter (*L or *) does not equal the internal ORG counter (*O) will be flagged with # in column 7 of the listing.

The label field is significant; the label defined there will be set to the value of *L **before** *L is changed to <exp16>.

LOC assists you in generating self-overlaying programs. Code generated that way can be positioned anywhere in memory (using ORG), and the code will assemble as if it was located at the address expressed in the LOC statement. Of course, the code must be moved at run time to the address specified in its LOC statement before it can be executed.

Code assembled in one place for execution elsewhere can be especially handy for ROM-resident software, when pieces of code are copied from ROM to RAM before execution.

LOC is also useful for enhancing the readability of data tables for code conversion. The following example is a table of external BCD codes. The location counter is set to the ATASCII value of the first character in the table. In that way, the location field of the assembly listing contains an ATASCII value and the generated code field contains its associated external BCD value.

Examples:

```
;Example of using LOC to enhance readability of
;listings. The location counter will be set to
;the ATASCII value that corresponds to the first
;entry of a table of external BCD values.
;
```

```
0000    = 5000          ORG    $5000
5000    = 0041#        LOC    'A'
```


0041#	61	EBCTBL:	DB	\$61	;The LOC field of the listing
0042#	62		DB	\$62	;contains the ATASCII value
0043#	63		DB	\$63	;which corresponds to the
0044#	64		DB	\$64	;external BCD value in the
0045#	65		DB	\$65	;generated code field.
...					
END					

No ERRORS, 1 labels, \$2403 free.

```

nEBCTBL 0041                                1# 8
                                           ;Example of code to be assembled at $2000
                                           to be
                                           ;transferred to a ROM at $0F000

```

	= 0500	COUNT	EQU	\$0500	;RAM working storage
0000	= 2000	ORG	\$2000		
2000	= F000#	LOC	\$0F000		
F000#	A907	LDA	#07		
F002#	8D0005	STA	COUNT		
F005#	4C0AF0	JMP	L1		
F008#	EA	NOP			
F009#	EA	NOP			
F00A#	CE0005	L1 DEC	COUNT		
F00D#	EA	NOP			
F00E#		END			

No ERRORS, 2 labels, \$23F7 free.

COUNT	0500	1# 4	1/ 8	1/12
L1	F00A	1/ 9	1#12	

MACRO...ENDM

MACRO DEFINITION

```

MACNAM:  MACRO    parm1, ..., parmn
          <body>
          ENDM      ;end of MACNAM definition

```

where: <body> = any desired text which may include:

%1..%9	= parameters number 1 ... 9
%K	= hexadecimal number of this macro call
%L	= label field of macro call
%M	= name of the macro

MACRO ... ENDM is the macro definition construct.

The symbols in the variable field represent substitutable parameters. The symbol names are for documentation purposes only and may **not** appear in the body of the macro.

Parameters within the macro are represented by %x, where x is replaced with a decimal digit (1-9). %K within the body will be replaced with the serial number of the macro call as four hexadecimal digits. %L within the body will be replaced with the label field of the macro call. %M within the body will be replaced with the macro call.

The label field is significant; it denotes the name of the macro during an assembly.

Note: The ENDM pseudo-op must be preceded by a tab (►) character.

Macros may generate lines which turn out to be macro calls. Thus, a macro may directly or indirectly call itself. Care must be taken so that such a “recursive macro” does not call itself indefinitely.

Macros can be used to generate many copies of a procedure with different internal constants, or in conjunction with VFD to assemble fancy machine op codes (see VFD pseudo-op). There are many other potential uses for macros; these examples are only intended to demonstrate some of these uses.

Example:

One way to find the number of bits needed to contain a value is to compute the logarithm base 2 of the value. To do that at assembly time, we can use recursive macro calls to achieve a looping effect. Note that the condition tested on VAL ensures that the series of nested calls must eventually terminate.

```
;          COMPUTE SYM=Log 2
LOG2:      MACRO SYM,VAL
            IF          [%2] > 1
            LOG2        %1,[%2]/2
%1:         SET         %1+1
            ELSE
%1:         SET         0
            ENDIF
            ENDM
```

Example:

```
;macro to take the high nibble from a memory location
;and the low nibble from the accumulator, storing the
;result in the accumulator
```

```
NPACK:     MACRO      ADDR
            EOR        %1
            AND        #0F
            EOR        %1
            ENDM
```

Example:

It is sometimes necessary to be able to create a symbol name that is different for each call of a macro. The %K implicit parameter feature provides the means to do this. In the following macro, a unique jump-target label is created on each call. Note that all the labels begin with the ? character so that they will not clutter up the symbol table map.

```
;          Set accumulator = 0 if sign bit is set.
PARVAL:    MACRO
            BMI        ?%k
            LDA        #0
?%K:
            ENDM
```

ORG

ORIGIN COUNTER

LABEL: ORG <exp16>

where: <exp16> = any absolute, previously defined 16-bit value or expression

ORG sets the address of the first byte of a piece of code (or data) to a physical location in memory.

The label field is significant; it will address the value of *L, **before** <exp16> is evaluated.

The ORG command can be used in a program as often as desired. ORG cannot change the current USE block. (See USE pseudo-op.) ORG changes the block-relative value of the origin and location counters of the current USE block.

ORG is almost always used at the beginning of an assembly to define the starting position in memory of the resultant code. If not explicitly set by ORG (or the O= command-line parameter), the default value of the origin and location counters is zero.

Example:

```
PROG:          ORG          $100          ;Assemble at location $0100
SOCK:          ORG          *O          ;assign *O to *O and *L
```

PROC...EPROC

DEFINE LOCAL SYMBOL RANGE

LABEL: PROC
 <body>
 EPROC

PROC tells the assembler that the following code is a procedure that may contain local symbols. A local symbol is a symbol that begins with a colon (:). It does not appear in the cross-reference map and cannot be referenced outside of the PROC range.

The label field is significant; it addresses the value of the *O counter when the PROC statement is processed.

PROC should be the first instruction of any procedure that contains local symbols.

A PROC is terminated by EPROC or the next PROC.

When assembling large programs where symbol table space is at a premium, local symbols can be used whenever appropriate to reduce memory requirements.

Example:

```
INIT:          PROC                      ;procedure
                LDA                      #0                      ;let A=0
                LDY                      #0                      ;Y indexes through memory
:Loop:          STA                      (BEGMEM),Y              ;:Loop: is local symbol
                INY                      ;won't appear in cross-reference
                BNE                      :LOOP                  ;Write 256 locations
```

REAL6

DEFINE REAL NUMBER VALUE

LABEL: REAL6 <fpnum>

where: <fpnum> is a floating point number

REAL6 provides constant conversion into 6-byte real numbers as supported by the ATARI operating system.

The label is significant because it denotes the starting location of 6 bytes of the converted number.

Example:

PI: REAL6 3.14159

SET

DEFINE VALUE FOR SYMBOL

LABEL: SET <exp>

where: <exp> = numeric expression

The SET pseudo-op defines a symbol to a value representing the 16-bit expression of the operand field. SET works just like EQU, except that LABELs defined with SET may be redefined.

The expression in the variable field must be an absolute value at the time of evaluation. Any symbols used must have been previously defined.

Example:

TSTVAL	SET	027h	
		...	
		DB	TSTVAL
		...	
TSTVAL	SET	099h	
		...	
TSTVAL	SET	063h	

SPACE

OUTPUT BLANK LINES TO LISTING

iglab SPACE <exp1>
iglab SPACE <exp1>,<exp2>

where: <exp1>,<exp2> = unsigned, numeric expressions

SPACE places blank lines in a listing. If SPACE has one argument, it will output that many blank lines only if doing so will not exceed the length of the current page. If <exp1> lines will not fit on the current page, SPACE will force an EJECT.

If SPACE has two arguments, they are both evaluated and <exp1> blank lines will be placed in the (currently on) listing **only if** the current page will have <exp2> lines left afterwards. If the current page does not have that sufficient room, SPACE will force an EJECT.

SPACE is useful when inserted just before a small procedure if X is the length of the procedure (X lines),

```
SPACE      4,X
<procedure>
```

will output 4 lines to the listing if the procedure will still fit on the current page. If the spacing and the procedure will not fit on the current page, SPACE will force an EJECT.

SUBTTL

DEFINE SECOND LINE OF OUTPUT LISTING

```
iglab SUBTTL <string>
```

where: <string> = any string up to 32 characters

SUBTTL allows you to specify secondary title information. SUBTTL without a <string> argument is ignored. To erase the current subtitle, use an empty string.

Example:

```
TITLE      'Section 8 — Pseudo-Ops'
SUBTTL     'SUBTTL syntax and description'
SUBTTL     ' ' ; erase current subtitle
```

TITLE

DEFINE FIRST LINE OF OUTPUT LISTING

```
iglab TITLE <string>
```

where: <string> = any string up to 32 characters

TITLE allows you to set/reset the assembler's internal page-heading string. TITLE with a string argument will place that string in the page header (see "Sample Listing," Section 3). If the string contains zero characters, the page header is reset to empty. TITLE without a string argument does not alter the current page header.

The first call to TITLE * will **not** eject a listing page; successive calls will always force an EJECT after any arguments are processed.

TITLE is commonly placed at the beginning of each file used in an assembly. Each linked file will begin assembly on a fresh page, topped with an appropriate header to describe its general contents.

Example:

```
TITLE      'XONC.asm — Interface Subroutines.'
```

DEFINE BLOCK AREA

```
iglab  USE  name
```

USE establishes a new “USE block” or resumes use of a previously established block. The block in use is the block into which code is subsequently assembled. A program may contain up to 60 different USE blocks. The assembler is responsible for computing the length and actual origin of each block. Origins are assigned to each block in the order they are first encountered.

Associated with each USE block are registers to maintain the last values of the origin and position counters (*O and *P). See ORG and VFD for a description of those counters. Initially, the values of these counters default to zero for each USE block. The value of the location counter (*L) is not saved, but set equal to the value of the origin counter. If a LOC had been in effect previously, resetting of the location counter to produce the desired results is the responsibility of the programmer.

USE allows the programmer to specify consecutive pieces of code in discontinuous source segments. It is more convenient than using ORG.

Example:

```
BTABL:      USE      BTABL      ;(at beginning of program)
           USE      *           ;define base of jump vector
           ;(return to normal org)
NXLAB:      ...
           LDX      Something
           USE      BTABL
           DW       NXLAB      ;add address to jump vector
           USE      *
           STX      Addr      ;more
           ...
           USE      BTABL      ;(at end of program)
           DW       0          ;mark end of vector
           USE      *
           END
```

VARIABLE FIELD DEFINITION

```
LABEL:      VFD      <Fexp>\<exp>, ..., <Fexp>\<exp>
```

where: 1 <= <Fexp> <= 16
 <exp> = any numeric expression

VFD defines variable fields. Each <Fexp> denotes a field width. Each <exp> denotes an expression to be placed into that field; <exp> values that exceed their associate <Fexp> field width values are truncated to match the <Fexp> value.

Negative values are evaluated with unsigned twos-complement arithmetic. For example, -32768 is 32768 and -1 will be represented by 65535. The resultant values are truncated to match the <Fexp> field width.

VFD manipulates the position counter (*P) to keep track of the bits remaining in a byte at the end of a VFD pseudo-op. If the next pseudo-op encountered is another VFD, the next field generated will begin with the unused bits left in the current byte. If the next code-generating pseudo-op is not VFD, the assembler will pad out the unused byte field with zeros.

VFD allows you to specify arbitrarily complex data fields without regard to byte or word boundaries.

Example:

```
MVINST:      VFD 2\01,3\DDD,3\SSS
```

VFD can be used this way inside MACRO-ENDM constructs to assemble code for unusual processors, special peripheral chips, and so forth.

Example:

```
SPEC:         VFD  7\@43,9\I'&&'
               VFD 13\ $429
```

SPEC is a label point to a 29-bit field definition. The first 7 bits contain the value 43 octal. The next 9 bits contain the truncated string &&. The next 13 bits contain the value 429 hexadecimal. The *P counter currently points into the fourth byte after SPEC, with 3 bits left in the current byte.

PSEUDO-OP QUICK REFERENCE

iglab	ASSERT	<exp>	;Check assembly condition
LABEL:	DB	<exp>,<exp>	;Define bytes
LABEL:	DB	'ABCDE','f',\$0D	;Define long strings
LABEL:	DC	'ABCDE'	;DB with 80h added onto the last byte
LABEL:	DS	<exp>	;Define space
LABEL:	DW	<exp>,<exp>	;Define words
LABEL:	DW	'Xu',1234,'y'	;Define 1- or 2-character strings
LABEL:	ECHO	<exp>	;Duplicate code <exp> times
iglab	EJECT		;Page eject
iglab	ELSE		;Part of conditional assembly
LABEL:	END	[exp]	;End of assembly
iglab	ENDIF		;Terminate range of IF
iglab	ENDM		;Terminate MACRO or ECHO
iglab	EPROC		;Terminates local symbol range
LABEL:	EQU	<exp>	;Define LABEL equals <exp>
iglab	ERR		;Force error flag
iglab	IF	<exp>	;Begin conditional assembly
LABEL:	INCLUDE	<filespec>	;Include another source file
iglab	LINK	<filespec>	;Include another source file at the end of this source file
iglab	LIST	<opt>	; <opt> = list control option
iglab	LIST	*	;Pop list control stack
LABEL:	LOC	<exp>	;Set location counter
NAME:	MACRO	<parms>	;Begin macro definition
LABEL:	ORG	<exp>	;Set origin counter
LABEL:	PROC		;Begin local symbol range
LABEL:	REAL6	<exp>	;6-byte real constant conversion
LABEL:	SET	<exp>	;Reset LABEL to <exp>
iglab	SPACE	<exp1>,<exp2>	;Space <exp1> lines if <exp2> lines left on this page
iglab	SUBTTL	'text'	;Set listing subtitle
iglab	TITLE	'text'	;Set listing title
iglab	USE	<name>	;Use block declaration
LABEL:	VFD	<exp> <exp> ,...	;Variable field definition
LABEL:	=	<exp>	;Synonym for EQU

<exp> = required expression

[exp] = optional expression

'text' = strings

<filespec> = <device>:<filename>.<extension>

iglab = ignored label

INSTRUCTION MNEMONICS

The instruction mnemonics provided by the Macro Assembler are identical to the standard mnemonics defined by MOS Technology, with these exceptions:

- Quotation marks denoting character strings must be properly paired. (Some 6502 assemblers allow an unterminated quote for a 1-character string.)
- In this assembler, the symbols `<` and `>` are binary operators (less than and greater than). Some 6502 assemblers define these symbols as unary operators (high and low). See Section 4 for operator definitions.

Examples:

AMAC		MOS	
CMP	#'?'	CMP	#'?
LDX	#high EXP	LDX	#>EXP
LDY	#low EXP	LDY	#<EXP

Notation

dd	8-bit signed displacement: $-128 \leq dd \leq +127$
mmmm	16-bit address expression
nn	8-bit constant: $0 \leq nn \leq 255$
rel	16-bit address within: $*-126 \leq rel \leq *+129$
zz	Page 0 location: $0 \leq zz \leq 255$

HEX	OPCODE	ADDRESS	REMARKS
DATA MOVEMENT			
	Register to register transfer.		
AA	TAX		;Transfer A to X
A8	TAY		;Transfer A to Y
BA	TSX		;Transfer S to X
8A	TXA		;Transfer X to A
9A	TXS		;Transfer X to S
98	TYA		;Transfer Y to A
	Load constant into register.		
A9	LDA	#nn	
A2	LDX	#nn	
A0	LDY	#nn	

Load register from memory.		
A5	LDA	zz
B5	LDA	zz,X
A1	LDA	(zz,X)
B1	LDA	(zz),Y
AD	LDA	mmmm
BD	LDA	mmmm,X
B9	LDA	mmmm,Y
A6	LDX	zz
B6	LDX	zz,Y
AE	LDX	mmmm
BE	LDX	mmmm,Y
A4	LDY	zz
B4	LDY	zz,X
AC	LDY	mmmm
BC	LDY	mmmm,X

Store register into memory.		
85	STA	zz
95	STA	zz,X
81	STA	(zz,X)
91	STA	(zz),Y
8D	STA	mmmm
9D	STA	mmmm,X
99	STA	mmmm,Y
86	STX	zz
96	STX	zz,Y
8E	STX	mmmm
84	STY	zz
94	STY	zz,X
8C	STY	mmmm

Stack load/stores.		
48	PHA	;Push accumulator
08	PHP	;Push processor status
68	PLA	;Pop accumulator
28	PLP	;Pop processor status

DYADIC ARITHMETIC

Add operand and carry.		
69	ADC	#nn
65	ADC	zz
75	ADC	zz,X
61	ADC	(zz,X)
71	ADC	(zz),Y
6D	ADC	mmmm
7D	ADC	mmmm,X
79	ADC	mmmm,Y

	Subtract operand and borrow.	
E9	SBC	#nn
E5	SBC	zz
F5	SBC	zz,X
E1	SBC	(zz,X)
F1	SBC	(zz),Y
ED	SBC	mmmm
FD	SBC	mmmm,X
F9	SBC	mmmm,Y

Compare 8-bit operand with accumulator.
Set flags as if subtracting, but do not alter accumulator.

C9	CMP	#nn
C5	CMP	zz
D5	CMP	zz,X
C1	CMP	(zz,X)
D1	CMP	(zz),Y
CD	CMP	mmmm
DD	CMP	mmmm,X
D9	CMP	mmmm,Y

Compare 8-bit operand with index register.

E0	CPX	#nn
E4	CPX	zz
EC	CPX	mmmm
C0	CPY	#nn
C4	CPY	zz
CC	CPY	mmmm

MONADIC ARITHMETIC

Decrement by 1.

C6	DEC	zz
D6	DEC	zz,X
CE	DEC	mmmm
DE	DEC	mmmm,X
CA	DEX	
88	DEY	

Increment by 1.

E6	INC	zz
F6	INC	zz,X
EE	INC	mmmm
FE	INC	mmmm,X
E8	INX	
C8	INY	

Arithmetic control.

18	CLC	;Clear carry flag
D8	CLD	;Clear decimal mode
B8	CLV	;Set overflow flag
38	SEC	;Set carry flag
F8	SED	;Set decimal mode

DYADIC LOGICAL/BOOLEAN OPERATIONS

8-bit logical product, conjunction.

29	AND	#nn
25	AND	zz
35	AND	zz,X
21	AND	(zz,X)
31	AND	(zz),Y
2D	AND	mmmm
3D	AND	mmmm,X
39	AND	mmmm,Y

Logical sum, disjunction, inclusive OR.

09	ORA	#nn
05	ORA	zz
15	ORA	zz,X
01	ORA	(zz,X)
11	ORA	(zz),Y
0D	ORA	mmmm
1D	ORA	mmmm,X
19	ORA	mmmm,Y

Logical difference, inequivalence, exclusive OR.

49	EOR	#nn
45	EOR	zz
55	EOR	zz,X
41	EOR	(zz,X)
51	EOR	(zz),Y
4D	EOR	mmmm
5D	EOR	mmmm,X
59	EOR	mmmm,Y

Logical compare.

Set flags as follows:

Z=1 if A AND mem = 0

Z=0 if A AND mem = 1

S = bit 7 of mem

V = bit 6 of mem

(mem = mmmm or zz).

24	BIT	zz
2C	BIT	mmmm

ROTATE AND SHIFT

Arithmetic shift left.

0A	ASL	A
06	ASL	zz
16	ASL	zz,X
0E	ASL	mmmm
1E	ASL	mmmm,X

Logical shift right.		
4A	LSR	A
46	LSR	zz
56	LSR	zz,X
4E	LSR	mmmm
5E	LSR	mmmm,X
Rotate left.		
2A	ROL	A
26	ROL	zz
36	ROL	zz,X
2E	ROL	mmmm
3E	ROL	mmmm,X
Rotate right.		
6A	ROR	A
66	ROR	zz
76	ROR	zz,X
6E	ROR	mmmm
7E	ROR	mmmm,X
JUMPS		
90	BCC	;If carry clear
B0	BCS	;If carry set
F0	BEQ	;If equal (=0)
30	BMI	;If minus
D0	BNE	;If not equal (<>0)
10	BPL	;If plus
50	BVC	;If overflow clear
70	BVS	;If overflow set
4C	JMP	mmmm
6C	JMP	(mmmm)
CALL SUBROUTINE		
00	BRK	;Software interrupt
20	JSR	mmmm ;Jump subroutine
RETURN FROM SUBROUTINE		
40	RTI	;Return from interrupt
60	RTS	;Return from subroutine
MISCELLANEOUS CPU CONTROL		
58	CLI	;Clear interrupt mask (EI)
EA	NOP	
78	SEI	;Set interrupt mask (DI)

USING THE ATARI MACRO ASSEMBLER WITH THE ATARI ASSEMBLER EDITOR SOURCE FILES

If you have a source program that has been developed using the ATARI Assembler Editor cartridge, and you want to use the Macro Assembler to assemble it, you will have to be aware of the following differences:

- The Macro Assembler does not accept line numbers.
- The = for EQU must be embedded between at least two blanks.
- Comments must be preceded by a semicolon.
- The following pseudo-ops are recognized by the Macro Assembler:
 - .BYTE is equivalent to DB
 - .END is equivalent to END
 - .PAGE is equivalent to TITLE
 - .SKIP is equivalent to SPACE
 - .WORD is equivalent to DW
- The following are **not** recognized by the Macro Assembler:
 - BYTE
 - WORD
- The Macro Assembler does not recognize * = for setting the origin counter; use ORG instead.
- All strings must be bracketed by quotation marks (") for the Macro Assembler to interpret them properly.

ERROR CODES

Errors are flagged by a single-letter code in column one of the output listing. Lines containing errors are always written to the screen, regardless of the output selection.

- A** = Address error. Instruction specified does not support the addressing mode specified.
- D** = Duplicate label error. The last one defined is used.
- E** = Expression error. An expression on the source line in the address field is unrecognizable.
- F** = Bad nesting of control statements. Bad nesting of IF . . . ELSE . . . ENDIF statements. When this occurs on the END line, it means an IF was not terminated.
- I** = Instruction field not recognized. Three NOP bytes are generated.
- L** = Label field not recognized. Three NOP bytes are generated.
- M** = MACRO statement error. Improper macro definition.
- N** = Error in number: digit exceeds radix; value exceeds 16 bits, and so forth.
- O** = Stack table overflow occurred in evaluating expression; user should simplify expression. Too many LINK files. Too many PROCs. Too many USE blocks.
- P** = Programmer-forced error. See ASSERT and ERR pseudo-ops.
- R** = Expression in variable field not computable.
- S** = Syntax error in statement. Too many or too few address subfields.
- U** = Reference to an undefined symbol.
- V** = Expression overflow: resultant value is truncated.
- W** = Not within VFD field width ($1 \leq \text{width} \leq 16$).
- Y** = Misplaced instruction: extraneous ENDM. When this occurs on the END line, it means a MACRO or ECHO was not terminated. Make sure that ENDM is preceded by a tab (►) character.

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CO60028 REV. 1

ATARITM PROGRAM-TEXT EDITOR



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PREFACE

Your Program-Text Editor is a versatile tool. You can use it to edit source programs written in various programming languages. The addition of a printer and a pertinent software package to your system will make the editor an effective word processor.

Introductory sections of this manual supply simple instructions for diskette operations as well as rudimentary editing functions. Advanced and specialized editing techniques are treated factually. The error messages displayed on the back cover and the enclosed reference card provide quick and easy fingertip access to information.

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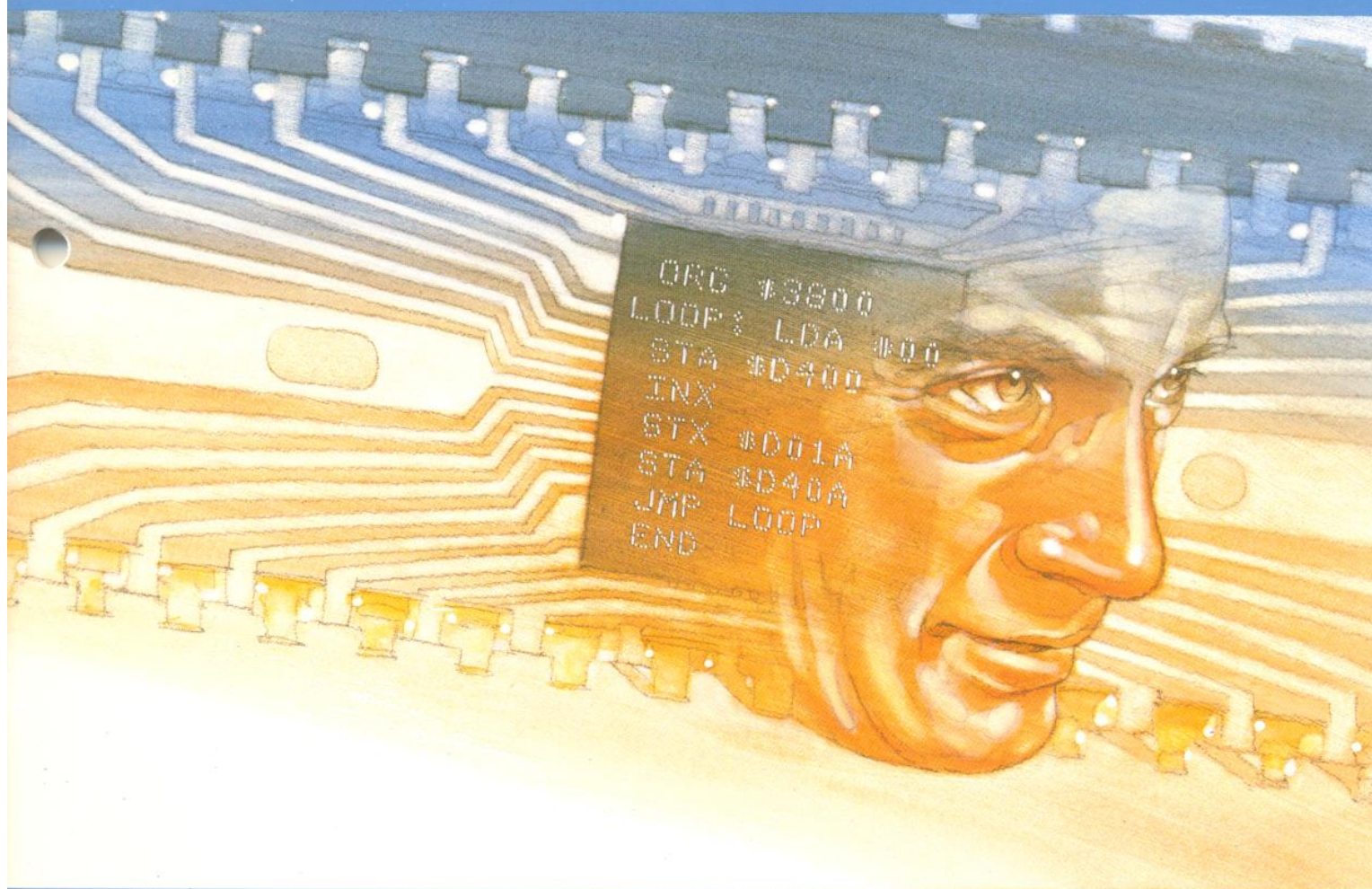
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ATARI® 800™

ATARI PROGRAM-TEXT EDITOR™



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Use With
ATARI® 800™
HOME COMPUTER

SYSTEM REQUIREMENTS

The ATARI® **Program-Text Editor™** (Model No. CX8121) requires:

- **ATARI 810™ Disk Drive**
- ATARI Blank Diskette (CX8100)

For information on your disk drive, refer to the *ATARI 810 Disk Drive Operators Manual*. Check the drive code setting to make certain that you have a disk drive designated as Drive 1. Because the Disk Operating System (DOS) II programs are included on the diskette containing the Program-Text Editor, you can easily load the editor software by inserting your diskette in Drive 1. Otherwise, you must have a copy of the DOS II Master Diskette, Model No. CX8101, inserted into Drive 1.

You must have at least 24K RAM in your ATARI Home Computer to operate the disk drive and the editor software. Although the software requires 24K memory, a total memory capacity of 32K is highly recommended and will result in increased program efficiency. For instructions on inserting additional **ATARI RAM Memory Modules™** into the **ATARI 800™ Computer**, refer to the *ATARI 800 Operators Manual*.

SETUP PROCEDURES

1. Verify that all power switches (console **and** disk drive) are turned to OFF.
2. Check that the computer console is properly connected to the television set and a standard wall outlet.
3. Place the disk drive at least 12 inches away from your television set and plug it into a standard wall outlet.
4. Connect the disk drive to either the computer console or another ATARI peripheral. Plug one end of the I/O Data Cord into the jack labeled I/O CONNECTORS on the back of the disk drive. Plug the other end into either the jack labeled PERIPHERAL on the computer console or one of the I/O CONNECTOR ports of another ATARI peripheral. If you connect your disk drive to another ATARI peripheral, verify that there is an I/O Data Cord plugged into the computer console.

TURNING ON THE SYSTEM

When you are ready to use the computer, proceed as follows:

1. Turn on the television set. Tune to Channel 2 or Channel 3, whichever has a weaker signal in your area. Make certain that the 2-CHAN.-3 switch on the computer console corresponds to your channel selection.

-
2. Turn on the disk drive. Notice that the BUSY and PWR ON light indicators are activated. Wait until the motor of the disk drive stops its activity and the BUSY light goes out before continuing to the next step.
 3. Insert the diskette containing the Program-Text Editor into the disk drive designated as Drive 1.

Note: DO NOT TOUCH THE EXPOSED PORTION OF THE DISKETTE.

4. Turn the computer console power switch to ON. This will activate the disk drive's loading procedure.

Note: *OPTIONAL.* To increase the RAM buffer size on a 48K system, before turning on your computer, remove any language cartridge that might be installed.

Take note of the following conditions to determine if you have successfully completed the power-on procedure. If you have a language cartridge inserted into the computer console, the screen displays the prompt applicable to that particular language. For example, the ATARI BASIC language prompt is the READY message; the ASSEMBLER EDITOR language prompt is the EDIT message. Otherwise, the DOS Menu should appear immediately upon the screen.

TURNING OFF THE SYSTEM

Warning: NEVER turn off the disk drive with a diskette in it. You may damage the information contained on the diskette and lose the ability to load your program.

When you are ready to end your editing session:

1. Use the exit command appropriate for your editing session.
2. Wait for the DOS II Menu display or the filename prompt to appear on the screen.
3. Remove the diskette from the disk drive and return it to the protective sleeve that was provided with the software.
4. You may turn off the television set, the computer, or the disk drive in any order.

OPERATIONAL PROCEDURES FOR THE EDITOR

You must load the editor through the DOS Menu. If the DOS Menu is not already displayed on your screen, type **DOS** and press **RETURN**. Refer to Figure 1. (The *DOS II Reference Manual* contains complete instructions for using the DOS II Menu options.)

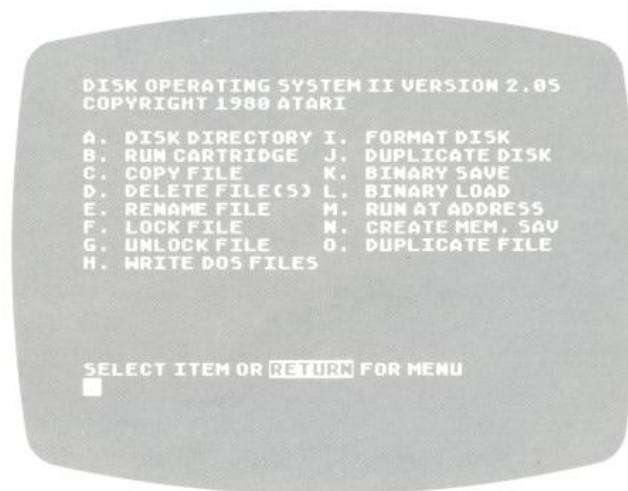


Figure 1 DOS II Menu

Because the editor program is included on a diskette that has been factory write-protected for software safety, you must prepare a diskette for your text files. For identification purposes, we refer to this diskette as a “data” diskette. With the DOS Menu displayed on the screen, remove the diskette containing the Program-Text Editor software. Refer to the *DOS II Reference Manual*. Format a blank diskette, then write new DOS files to it. Remove this diskette and reinsert the editor program diskette.

Select the L-BINARY LOAD command. Answer the prompt, LOAD FROM WHAT FILE, with the name of the Program-Text Editor software, **MEDIT**. The program will automatically run after being loaded. Refer to Figure 2. Insert your data diskette into the disk drive at this time.

Caution: You may **not** change your data diskette once the editing session is started. Because the editor has built-in memory checks and free space allocation computations, a memory map of the diskette inserted at the time the editor performs its check is always retained. Therefore, even though the editor’s workspace resides in RAM, the block-write command can result in an overwrite situation on any but the original diskette.

Note: Because the editor performs a free IOCB (Input/Output Control Block) check, you may receive the error message EDITOR CANNOT RUN - NO FREE IOCBs. PRESS **START** to return to DOS. Refer to the *ATARI Operating System Manual* (part number CO16555) for complete information on IOCBs and to the error messages on the back cover for an explanation of this condition.

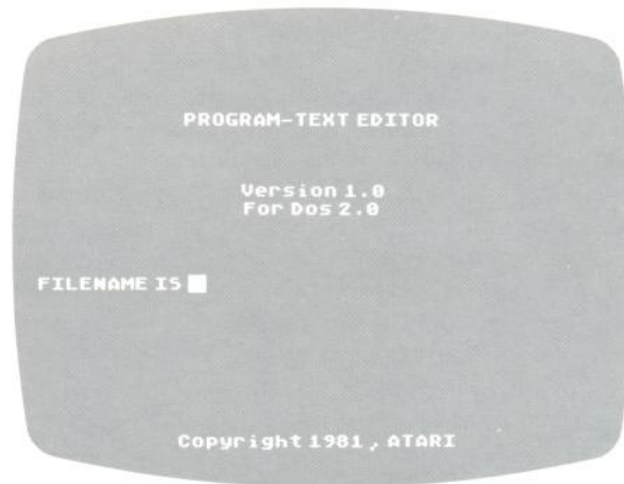


Figure 2 Filename Prompt

Your Program-Text Editor is now ready to bring the file that you wish to edit into its workspace. At this point, there are several options available:

- Press the **BREAK** key to end the edit session and return control to DOS.
- Enter the filename of the program that you wish to edit.
- Create a new file under the editor by naming a file that does not exist. The editor will automatically create an empty file using the specified name.

The correct syntax for an acceptable filename is in the form:

Dn:filename.extension,optional parameters separated by commas.

Example: D4:MYFILE.MAC,3,.ASM,D

The drive number *n* designation corresponds to the disk drive that contains your source program and must be between the numeric characters of one and eight. You may use a filename of from one to eight characters, either alpha characters A through Z or numeric characters 0 through 9.

Note: For a filename specification, an alpha character must be in the first character position. This rule does not apply to filename extensions.

Your optional extension may be from one to three characters long, using either alpha or numeric characters.

Remember the following specifications when answering the filename prompt.

- If no device is specified, the editor automatically assumes the use of the disk drive designated as Drive 1.
- Lowercase file specifications automatically convert to the correct uppercase syntax.
- If the file, its associated backup file, or its temporary file is locked (see the "Theory of Operation" section for further explanation), the editor displays the error message FILE LOCKED and reissues the filename prompt. Unlock any of these files through use of the DOS Menu. Refer to the *ATARI DOS II Reference Manual*.

Optional parameters may be entered in any order after the file specification:

,n OVERRIDE DESTINATION DRIVE. Unless otherwise specified, the default destination drive is the one on which the source file is located. You may move the destination file from the default drive by using this parameter. The value **n** is a numeric digit corresponding to the number of the destination disk drive.

Example: MYFILE,2

When you have more than one disk drive, use this optional parameter to edit large files or when there is not enough free space on the source diskette to allow you to save the edited file.

,D DELETE BACKUP FILE FLAG. If a backup file exists, this parameter tells the editor to erase it before beginning the editing session. Use of this parameter allocates free space at the cost of backup file protection.

Example: MYFILE,D

Note: If the source and destination drive are not the same, the editor automatically deletes a file with the same name on the destination drive.

,.ext OVERRIDE CUSTOMIZING FILE. Use of this parameter causes the editor to use the customizing file associated with the designated extension file. Unless this parameter is assigned, the editor defaults to use of the extension associated with the file specification being edited.

Example: MYFILE,.PAS
MYFILE,.ASM
MYFILE,.BAS

Following are additional examples of valid filename prompt responses.

```
MYFILE
MYFILE.PAS
D3:MYFILE
D3:MYFILE,2
MYFILE.PAS,D,4
D2:MYFILE,.PAS,D,3
MYFILE,.ASM
d2:myfile,.pas,d,3
D4:MYFILE.BAS,3,.PAS,D
```

After receiving the filename specification, your Program-Text Editor checks the free space on the destination diskette and makes a comparison with the size of the file to edit. A minimum growth factor, considering the expansion of file storage capacity requirements because of additions or modifications, of **g** units is ascertained. (See the “Customizing the Editor” section.) If there is not enough room on the diskette for the edit file and the growth factor, the editor displays a warning message. You may choose to ignore the warning and continue with the editing session. Or you may abort the edit, exit from the editor, and return to the DOS Menu. If the editor determines that there is enough room on the diskette for the edit file and growth factor, the edit session begins.

Caution: If you ignore the warning message, be sure that you have as much free space as the size of your existing file plus room for any additions you will make during the editing session. If your calculations are not correct and you run out of free space on the diskette, you may lose all work completed in the current editing session.

Note: A minimum growth factor of **g** units is determined from the customizing file. If default factors are used, the minimum growth factor is 100 sectors of free space.

THEORY OF OPERATION

For efficiency and optimum protection, the Program-Text Editor uses a common **two-file** editing method. During the editing session, the original file remains intact while all modifications are made to a copy of the file. Therefore, this procedure allows for:

- Automatic backup copies of files to be edited
- Modification of the original file **only** after the editing session is terminated with a normal exit from the editor
- Use of sequential file access

A procedural outline of the two-file method is:

- Text is copied from the file to be edited into a memory buffer.
- When the buffer becomes full, data transfers to a **temporary** file.

Normal exit (Figure 3) from the editor causes the following sequence:

- The .BAK file is deleted.
- The edited file is renamed as the new .BAK file.
- The temporary file is renamed as the edited file.

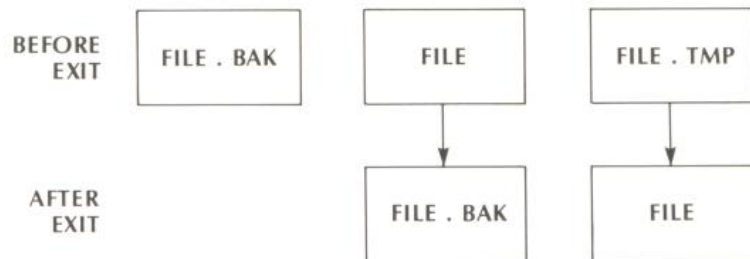


Figure 3 Normal Exit From the Editor

An abort exit (Figure 4) from the editor causes the following sequence:

- The temporary file is deleted.
- The original edited file and the .BAK file retain their integrity.

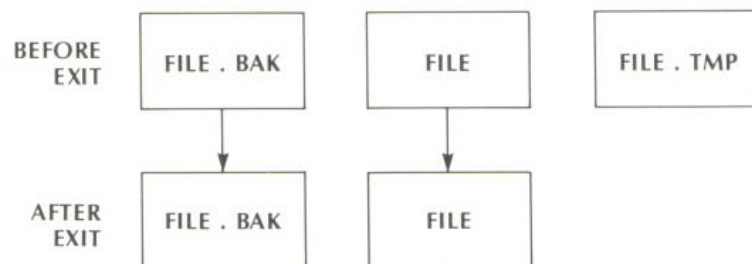


Figure 4 Abort Exit From the Editor

Your Program-Text Editor uses two modes of operation: immediate and command. Immediate mode operation is keyboard interactive. Command mode operation defers to a later time execution. All three windows and both operation modes are discussed at length in subsequent sections of this manual.

The Program-Text Editor is defined as a **source file editor**. A source file is a disk file consisting of ATASCII characters terminated by ATASCII EOLs (End-of-Line). Therefore, the editor functions with files containing the source code written for ATARI Computer programming languages. A line length default value of 114 columns can be changed to a maximum length of 200 columns by using the customizing file feature (see section titled "Customizing the Editor").

Two types of tabs are allowed: (1) regular tabulation as provided by the operating system in which blanks are substituted between tab stops or (2) expanding tabs. Expanding tabs only take one character in the file but are displayed as many columns of blanks. Set the type of tab by using the customizing file.

LINE OF TEXT-35 CHARACTERS
LINE OF TEXT
LINE OF TEXT

5 character displacement = 5 bytes of memory
using default value of 5, inserting blanks like the operating system

LINE OF TEXT-35 CHARACTERS
▶....LINE OF TEXT
▶....LINE OF TEXT

5 character displacement = 1 byte of memory
using expanding tabs

Figure 5 Illustration of Expanding Tabs

If you attempt to edit a file that does not meet source file definitions and customizing column limits, the editor truncates the lines in the file to conform to the set line length limits. Given this situation, the editor generates the LINE TOO LONG error message while reading the file either during initial entry to the editor or as an input command.

STARTING THE EDIT SESSION

Answer the filename prompt. For the purposes of demonstration, enter the filename **PRACTICE**. Refer to Figure 6.

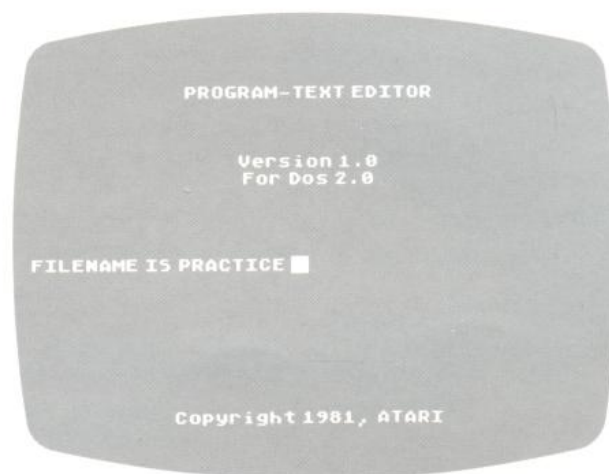


Figure 6 Answering the Filename Prompt

Notice the three windows displayed on the screen:

TEXT WINDOW	Appears at the top of the screen and consists of 20 lines.
ERROR WINDOW	Appears in inverse video and consists of a single line.
COMMAND WINDOW	Appears at the bottom of the screen and consists of three lines.

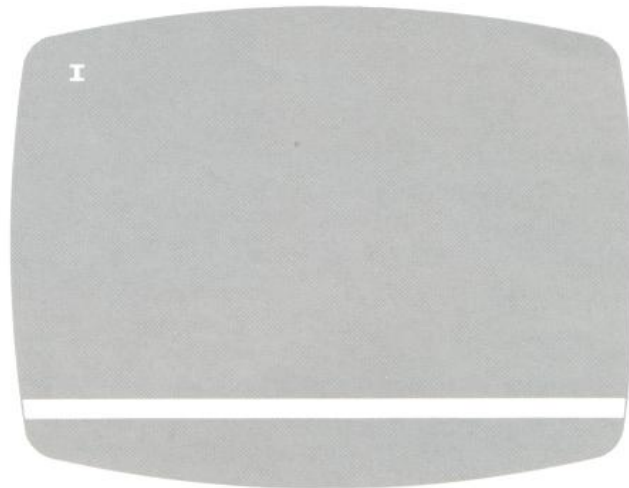


Figure 7 Windows

FAMILIARITY WITH THE KEYBOARD

A summary of the immediate keystroke commands appears at the end of this section.



From the keyboard shown above, locate the following specific keys: **CTRL**, **SHIFT**, **DELETE BACK S**, **CLEAR**. Note that there are keys indicating directional arrows as well as arithmetic operators. Some keys serve a dual purpose, for example, the **DELETE BACK S**. As the operation of the **SHIFT** key on the computer keyboard is the same as the shift key of a typewriter, its use will select the function that appears on the top of the key.

Enter the following text onto your screen:

AND HERE WE SEE THE INVISIBLE BOY RETURN
IN HIS LOVELY INVISIBLE HOUSE, RETURN
FEEDING A PIECE OF INVISIBLE CHEESE RETURN
TO HIS LITTLE INVISIBLE MOUSE. RETURN

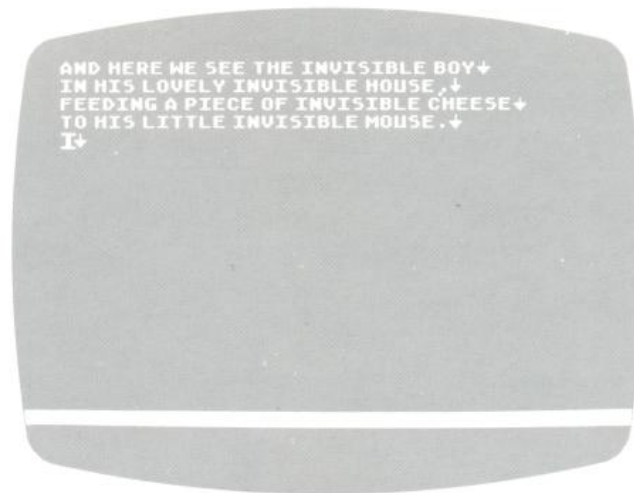


Figure 8 Example of Entered Text

After entering the lines, notice the following: every time you press the **RETURN** key, an ↓ appears on the screen. This figure indicates the carriage return action. Also, pay particular attention to the movement of the cursor. During execution of the keystroke entry, the cursor position indicates character placement by appearing immediately in front of the next entry. After any keystroke, the text window is updated to reflect the current state of the file, and the cursor moves accordingly. Look again at the above screen diagram and note the cursor positioning.

Using the table below, manipulate the cursor within your displayed text.

Keystroke	Explanation
CTRL ←	Moves cursor left
CTRL →	Moves cursor right
CTRL ↓	Moves cursor down one physical line
CTRL ↑	Moves cursor up one physical line
CTRL 2	Moves cursor to beginning of logical line
CTRL 3	Moves cursor to end of logical line

After you feel thoroughly acquainted with the movement produced by striking these keys, follow the procedure outlined below:

Position the cursor on the "A" of the first word in the first line of your text. Use the **CTRL** ← keystroke. Now use the **CTRL** ↑ keystroke. Note that both of these operations result in the warning message **CURSOR AT END**. The same error message will be displayed if you use a **CTRL** → if the cursor is in the far right position at the end of text.

Note: When the cursor moves up and down a slight glitter of the screen may occur. Also, on occasion, you may notice the appearance of an additional line below the command window. These are normal operating conditions.

Notice that these cursor-movement keystrokes position the cursor but do not affect the entered text. Within the immediate mode operation, there are essentially two types of keystrokes: those that directly relate to cursor positioning and those that execute a change to the text itself. You must position the cursor at a precise point using the above key combinations. Refer to the table below for those keystrokes that will immediately edit entered text.

Keystroke	Explanation
SHIFT INSERT	Inserts a blank line above the current logical line
DELETE BACK S	Deletes character left of cursor
CTRL DELETE BACK S	Deletes character right of cursor
SHIFT DELETE BACK S	Deletes the logical line occupied by cursor
Regular keys	Insert character into text

Within the framework of this software and as a matter of convention, this manual introduces the terms **logical line** and **physical line**. A logical line contains those characters entered between carriage returns. A physical line encompasses those characters contained in a straight line from the extreme left side to the extreme right side position of your television screen. A logical line can be one or more physical lines.

Return to your screen. You must use your cursor control keys to move your cursor during an edit session. Position the cursor so that it is over the "v" in the word "invisible." Use the **DELETE** **BACK S** key twice. (**Do not** press **RETURN**. Pressing the **RETURN** key at any time will introduce a carriage return figure, ↓ into your text.)

Take note of several unique conditions that might arise from operation of the **DELETE** **BACK S** and **CTRL** **DELETE** **BACK S** keys.

If the cursor is to the right of a carriage return, use either the **DELETE** **BACK S** key or the **CTRL** ← key to reposition the cursor. However, when the cursor is to the immediate right of a carriage return, use of the **DELETE** **BACK S** key deletes the carriage return itself. Similarly, if the cursor is to the left of a carriage return, use of the **CTRL** **DELETE** **BACK S** key repositions the cursor exactly as use of the **CTRL** → key. However, when the cursor is to the immediate left of a carriage return, use of the **CTRL** **DELETE** **BACK S** key removes the carriage return itself. Concatenation follows the carriage return deletion. If the maximum line length is exceeded, the editor:

- Restores the deleted carriage return
- Aborts the command line
- Displays the error message LINE TOO LONG
- Returns to immediate mode operation

Other specific conditions that result when the cursor is positioned:

Within an expanding tab	Use of either keystroke deletes the entire tab.
At the beginning of the buffer	Use of the DELETE BACK S key results in no operation and generates the error CURSOR AT END.
Above the text window	Use of the DELETE BACK S key causes an automatic scroll that pulls down the previous line.
At the end of the buffer	Use of the CTRL DELETE BACK S key results in no operation and generates the error CURSOR AT END.

Note: Attempted deletion of the last carriage return in the buffer is illegal and results in the CURSOR AT END error message. Use a delete line operation to successfully remove this last carriage return.

Follow the same procedure to acquaint yourself with the use of the other keystrokes outlined in the table. Use cursor control keystrokes to position the cursor. Select the appropriate key to accomplish the desired change. Use cursor control keystrokes to remove the cursor from the logical line.

On the ATARI Computer keyboard, locate the **ESC** key. Use this key in conjunction with control graphics keys to print specific graphics characters. Refer to Figure 9 for keystroke combinations to produce a chosen graphics display.

Press the **ESC** key
and then press:



to get



Press the **ESC** key
and then press the
CTRL key simultaneously
with:



to get



Press the **ESC** key
and then press the
SHIFT key simultaneously
with:



to get



Figure 9 Escape Sequence Characters

If the cursor is within an expanding tab or to the right of a carriage return when a character is inserted into text, the editor automatically repositions the tab or carriage return to the right of the cursor.

Additional cursor movement keystrokes:

Keystroke	Explanation
CTRL 8	Displays previous screen
CTRL 9	Displays next screen

Use the keystrokes above to respectively display either 20 physical lines above or below the text window. Additional reserved keystrokes include:

Keystroke	Explanation
CLEAR SET TAB	Tabs to next tab stop
CTRL RETURN	Returns and auto-indents to same level
CTRL CLR SET TAB	Toggles visible-tab mode
SHIFT CLR SET TAB	Toggles visible-carriage return mode

Use the **CLR SET TAB** key to position the cursor. Space tabs insert a selected number of blanks between tab stops, and the cursor positions itself accordingly. Expanding tabs, however, insert a character into the text that indicates the tab function. By using the customizing file, you can display the expanding tab character as either blanks or a right triangle followed by periods. Set your default choice within the parameters of the customizing file. If you have chosen the expanding tab option, use the **CTRL CLR SET TAB** immediate mode keystroke command to display the alternate character choice.

Carriage returns can be displayed as blanks or down-arrows. Default choice is set within the parameters of the customizing file. Use the **SHIFT CLR SET TAB** immediate mode keystroke to display the alternate character choice.

Auto-indentation allows you to reposition the cursor to return to an automatic tab stop on the next logical line. Press the **CTRL** and **RETURN** keys simultaneously. The indentation of the logical line containing the cursor determines the position of the automatic tab.

Keystroke

Command

CTRL **CLEAR**
START
SELECT
OPTION
BREAK

Erases the error window
Executes command window
Selects the alternate command line
Changes mode
Aborts command being executed

Error messages displayed within the error window are cleared in three ways:

- Pressing the **CTRL** **CLEAR** keys will clear the error.
- If a syntax error occurs, the window clears when the command is corrected.
- After four seconds of elapsed time, the error window automatically clears with any keystroke entry.

Use the **OPTION** key to change operation modes. In immediate mode operation, use of **OPTION** enters command mode. Switching these operation modes automatically clears the current command window. To avoid this erasure, use the **SHIFT** **OPTION** combination keystroke. The current command line remains intact, and the cursor positions itself at the end of the command line.

Within the command mode, all keystrokes enter text into the command window. All immediate and reserved keystrokes, with the exception of **DELETE BACK S**, can still be executed. Use of the **DELETE BACK S** key deletes the last character typed into the command window. Pressing **OPTION** twice while in command mode deletes the entire command line.

During execution of the command window, the editor is in command mode. Notice that the cursor remains in the command window while the command is being executed. After successful completion of the command execution, the cursor disappears from the command window and the editor returns to immediate mode operation. Use the **SELECT** key to rotate displays of the command line and any alternate entry. Touch the **BREAK** key during execution of the command line to discontinue processing. As soon as the current command execution is completed, a BREAK KEY ABORT message appears in the error window, and the editor returns to immediate mode operation. Touching **BREAK** at any other time has no effect.

In command mode, the use of **OPTION** returns control to immediate mode. The command line remains in the command window for later execution. Use the **START** key to execute commands within the command window. A NOT COMPLETE error message results when a command contains a syntax error. The editor remains in command mode so that correction can be made. Executing a blank command or an empty display window returns control to immediate mode.

COMMAND MODE OPERATION

The command window accepts and displays all keystroke entries made in command mode operation. With the exception of the **DELETE BACK S** key, all immediate reserved keystrokes function identically within either operation mode. The command window is three physical lines long and allows a single command line that is made up of one or more commands. You may enter spaces between commands for better readability, and use either upper- or lowercase. Within the command window, a carriage return is displayed as the inverse **E** escape sequence character. A mini-interpreter checks each keystroke for valid syntax. The following syntax error messages may be displayed:

- UNRECOGNIZED COMMAND
- DELIMITER ERROR
- NUMBER TOO BIG

If a syntax error occurs, the editor ignores all keystrokes until you delete the offending character from the command window. Manipulation of the command window is as follows:

- **OPTION** key returns the editor to immediate mode operation.
- **OPTION** key pressed twice erases the entire command window.
- **DELETE BACK S** key deletes the last character entered into the command window.
- **START** key executes the command line if the syntax is correct and complete.
- **SELECT** key swaps the command line displayed in the command window with an alternate command line.

After execution of the command line, the editor returns to immediate mode operation. The command line is not erased and may be reexecuted by pressing **START**.

EXITING THE EDITOR

Depending upon your desired end result, choose one of the following options to exit from the editor:

Command	Explanation
EXIT	Use this command to exit from the editor and return to DOS. All changes made during the edit session are retained.
EXIT2	Use this command to exit from and restart the editor. In effect, this command duplicates the action of EXIT followed by the DOS "L" (load) command, and you will receive the editor sign-on filename prompt.
ABORT	Use this command to exit from the editor without incorporating any changes made during the edit session and return control to DOS.
ABORT2	Use this command to exit without incorporating any changes made during the edit session and restart the editor. In effect, this command duplicates the action of ABORT and DOS "L" (load) commands. You will receive the editor sign-on filename prompt.
REOPEN	Use this command to exit from the editor and automatically reenter the same file. In effect, this command duplicates the action of EXIT2 and answering the filename prompt with the specification of the file you are editing. See "Specialized Commands" within this section for specific details.

Note: The editor accepts the exiting commands in the form EXIT n and ABORT n as valid syntax. However, at execution time, the error message NUMBER TOO BIG is generated if n is greater than 2.

CURSOR MOVEMENT COMMANDS

You may manipulate the cursor through command mode operation. This method lets you quickly move the cursor to where you want it. To use the following table effectively, you must be familiar with two terms: **buffer** and **file**. In this particular software application, text is copied from the file to be edited into a memory buffer where modification is achieved. When the memory buffer becomes full, it is written to a temporary file. This process is repeated continuously until all text has been copied from the edited file into a temporary file. As you can determine, the contents of the edited file and the memory buffer can differ.

Note: Take care in planning your editing session. You cannot easily edit the portion of the file that has been written out of the buffer. Make your modifications from the beginning to the end of the file. To edit a part of the file that has already been written out of the buffer, use the REOPEN command (see "Specialized Commands" contained within this section) or reenter the editor. Both of these methods require lengthy disk access.

Command	Explanation
CL n	Moves cursor left n characters
CR n	Moves cursor right n characters
CU n	Moves cursor up n logical lines
CD n	Moves cursor down n logical lines
CBB	Moves cursor to beginning of buffer
CEB	Moves cursor to end of buffer
CBF	Moves cursor to beginning of file
CEF	Moves cursor to end of file
CBL	Moves cursor to beginning of the logical line
CEL	Moves cursor to end of the logical line
CC n	Moves cursor to column n (range 1-200)

Note: The notation n signifies an optional numeric argument, which usually acts as a repeat counter, with a range of 1-65535. With the exception of margin values, if n is omitted, the editor assumes a value of 1.


The error message CURSOR AT END is generated each time you attempt to position the cursor:

- Left, before the beginning of the buffer
- Right, past the end of the buffer
- Up, before the beginning of the buffer
- Down, past the end of the buffer

Note: Each time the editor generates this error message, it aborts the command line and enters immediate mode operation.

Use the cursor control movements to position the cursor at strategic locations to implement the more sophisticated commands available in the editor.

SEARCH COMMANDS

In the following commands, delimiters must be used to separate the string from the search command notation. You may either use the slash mark, /, or a set of quotation marks as delimiter characters. As an example, the SB/-/n command explained below can also be entered as SB"-'"n. You can use "wild cards" as a substitution for characters in a search string. The editor recognizes the inverse video question mark (?) as a wild card that will match any character while searching. (To display any inverse video characters from the ATARI 800 keyboard, use the  key.)

Command	Explanation
SB/-/n	Search for n th occurrence of string in buffer
SF/-/n	Search for n th occurrence of string in file
SRB/-/n	Search and replace n times in buffer
SRF/-/n	Search and replace n times in file
SRVB/-/n	Search and replace with verify n times in buffer
SRVF/-/n	Search and replace with verify n times in file

Note: The notation **n** signifies an optional numeric argument, which usually acts as a repeat counter, with a range of 1-65535. With the exception of margin values, if **n** is omitted, the editor assumes a value of 1.

In general, all string searches begin after the current cursor location. In successful file and buffer searches, the cursor is positioned after the **n**th occurrence of the string. The logical line containing the cursor is displayed as the first line of the text window.

In unsuccessful buffer searches, the editor:

- Retains the cursor in its original position
- Generates a SEARCH FAILED error message
- Aborts the command line
- Returns to immediate mode operation

In unsuccessful file searches, the editor repeatedly writes out the current buffer and reads a new buffer. If the end-of-file is reached before finding the **n**th occurrence of the string, the search fails. Then, the editor:

- Retains the cursor in its original position **if** the last line in the file was already in the buffer before the search began **or**
- Positions the cursor to the beginning of the last buffer read **if** new lines were introduced from the file to the buffer area
- Follows the same procedure outlined above for unsuccessful buffer searches

In general, the **search and replace** commands, perform a search for the first string and replace it with the designated second string for the specified *n* times. The replacement string may be null or have a different amount of characters than the search string. Care should be taken to avoid the following conditions resulting in error messages. As with all error conditions, the editor aborts the command line and returns to immediate mode operation.

LINE TOO LONG

Could result if the insertion of a large replacement string into a text line exceeds the maximum line length.

Result of Operation: Only the first part of the replacement string would be inserted into the text.

LINE TOO LONG

Could result if the search string contains carriage returns. When a carriage return is deleted and the lines are concatenated, the resulting new line could exceed the maximum line length.

Result of Operation: The cursor is located to the right of a partial search string and that logical line is displayed as the first line of the text window.

CURSOR AT END

Could result if the search string terminates with a carriage return and is found on the last line of the buffer. Because the editor does not allow the last carriage return in the buffer to be deleted (except with a delete-line command), this search results in the given error message.

Result of Operation: The editor will find the string but abort the command line, resulting in no replacement.

In unsuccessful buffer searches, the editor:

- Retains the cursor in its original position if no replacement has been made **or**
- Positions the cursor after the last successful replacement **and**
 - generates a SEARCH FAILED error message
 - aborts the command line
 - returns to immediate mode operation

In unsuccessful file searches, the editor repeatedly writes out the current buffer and reads in a new one. If the end-of-file is found before the *n*th occurrence of the search string, the command fails. Then, the editor follows the same procedure as outlined above for unsuccessful buffer searches.

Search and replace with verify commands for buffer and file use the same procedure as those respective commands without verification. Additionally:

- Before each replacement, the editor moves the cursor after the found search string and displays that logical line as the first line of the text window.
 - A prompt question appears in the error window
- R** Signifies replacement of the search string
S Signals a “skip” of this occurrence
Q Terminates or prematurely “quits” the search and replace command.

You may type your response in upper- or lowercase letters. If the response is valid, the editor clears the error window and completes the operation. If the response is invalid, your typed character is displayed; the cursor appears in the error window with a question mark.

BLOCK COMMANDS

You can manipulate a section of text lines by placing them within a defined **block**. To do this, you must precede and follow the designated text with a **block marker** that flags the attention of the editor and signals the beginning and end of the block. In the case of having more than two markers, the block is defined to be the group of text between the first encountered set of markers within the buffer.

Note: Do not use a line within your file that matches the block marker text designation.

Block markers are:

- A special text line displayed as follows

******BLOCK MARKER**** ↓**

that must be the **Only** text on the line itself

- Converted to a regular text line in the file by adding, deleting, or changing characters within the marker
- Automatically deleted from any text written out of the buffer

Although block commands offer timely execution of lengthy procedures, consider the limitations imposed upon their function by the system, itself. For example, error conditions can result if you attempt to move blocked text from the top of memory through insufficient available RAM. Also, exercise caution when you assign a filename specification within the parameters of a block-read or block-write operation so that you do not attempt to read or write to an already open file. Remember that the .BAK and .TMP file extensions are reserved for internal use by the editor. Also, if you wish to specify a drive number within a block-read or block-write operation, use the drive number **Dn** designation within your filename string.

Command		Explanation
MS	Marker Set	Marker Set Inserts a block-marker text line Before the logical line containing the cursor
MC	Marker Clear	Marker Clear Removes all block-marker text lines and repositions the cursor to the beginning of the buffer

After setting the block markers, use the following commands to perform your intended operation.

Command		Explanation
BC	Block Copy	Copies the marked text before the line on which the cursor is positioned. The block markers are not copied with the text.
BM	Block Move	Moves a marked block of text before the logical line containing the cursor. The block markers are also moved.
BD	Block Delete	Deletes a marked block of text. The block markers are also deleted.
BP	Block Print	Prints the marked block on the system printer (P:). Expanding tabs and carriage returns are displayed as blanks.
BW/-/	Block Write	Writes the marked block to a disk file named within the delimiters. The block markers are not written to the file.
BR/-/	Block Read	Reads the disk file named within the delimiters and inserts that block before the logical line containing the cursor. Automatic paging will occur to read in the entire file if memory becomes full.

In general, the use of these commands:

- Positions the cursor at the beginning of the current line.
- Scrolls the screen until the cursor is on the first line of the text window.

Error messages that could be generated from an attempt of the above commands are:

MEMORY FULL	Results if there is not enough free memory to hold the entire block on a move or copy command.
-------------	--

Procedure for recovery from this condition is to:

- Use a BW/-/ command
- Position the cursor at the desired location for the block operation
- Use a BR/-/ command

An alternate recovery method is to:

- Use the REOPEN command
- Reposition the cursor at the desired location for the block operation
- Repeat the block command

I/O ERROR *nnn*

May result during a print or write command. A standard ATARI operating system error number is given to aid you in isolating the problem.

In a print operation, the editor:

- Aborts the command line
- Returns to immediate mode operation.

In a write operation, the editor: closes the file.

INSERTING AND DELETING COMMANDS

Command

Explanation

IT/-/*n*

Inserts text string at the cursor location *n* times. If the cursor is past the last line in the buffer, the editor inserts a carriage return to the right of the cursor before inserting the text.

DB*n*

Deletes *n* characters before the cursor.

DA*n*

Deletes *n* characters after the cursor.

DF*n*

Deletes every character between the beginning of the logical line and the current cursor location. When the cursor position is immediately past a carriage return, the entire logical line is deleted except for the carriage return, itself. After this occurrence, the cursor moves to the beginning of this null line.

DL <i>n</i>	Deletes the logical line containing the cursor. After deletion the cursor moves before the first character of the next logical line.
RL	Inserts the text stored in the "recover-line" buffer in front of the line containing the cursor. Use this command to recover from accidental deletion of a line or to achieve a simple one-line move. You can insert text into the recover-line buffer by using a command or an immediate keystroke to delete a logical line.

Note: The notation ***n*** signifies an optional numeric argument, which usually acts as a repeat counter, with a range of 1-65535. With the exception of margin values, if ***n*** is omitted, the editor assumes a value of 1.

Error messages that could be generated from an attempt to use the above commands are:

MEMORY FULL	Results if too little free memory exists to allow for complete input of the string argument. Result of Operation: <ul style="list-style-type: none"> • Inserts either none, or only a part, of the string • Aborts the command line • Returns to immediate mode operation
LINE TOO LONG	Results from a deletion command if the editor deletes a carriage return and attempts to concatenate lines that will exceed the current line length limits. Also, this error condition results from text string insertion that causes maximum line length limits to be exceeded.
CURSOR AT END	Results from a deletion command if the cursor is at the beginning of the buffer when the editor attempts a deletion of characters before the cursor or if the cursor is at the end of the buffer when the editor attempts a deletion of characters after the cursor.

Note: To delete the last carriage return in the buffer, use the delete-line command.

SPECIALIZED COMMANDS

LMn and **RMn**: Left and Right Margin Set Commands. If your television set needs adjustment to avoid cutting columns off of the display, change the left and right margins respectively by using these commands. Both margins are set a designated number of spaces dependent upon the value of **n**. If you omit the designation for **n**, the editor assumes a value of 1 for the left margin and a value of 40 for the right margin. The rule for setting the margin values is that the left margin must be greater than or equal to 1, but less than the value of the right margin. The right margin must be less than or equal to 40, but greater than the value of the left margin.

If you attempt a designation for **n** that is not in conformance with the margin rule, the editor generates the error message MARGIN VALUE ERROR, aborts the command line, and returns to immediate mode operation. This error condition also occurs if a new margin value causes existing command lines to exceed margin boundaries. Set automatic default values for both margins by using the customizing file.

CTSn: Convert Tabs to Spaces Command. Use this command to convert expanding tabs into spaces for a specified **n** of logical lines. If you omit the designation for **n**, the editor assumes a value of 1. Error conditions can occur in two instances:

MEMORY FULL

This error is generated when the editor runs out of free memory during the conversion. A partially converted line may appear above the line that is being executed at the time of the error condition.

CURSOR AT END

This error is generated when the editor runs out of lines to convert in the buffer.

Error conditions cause the editor to abort the command line and return to immediate mode operation.

REOPEN: Reopen Editor With Same File. Use the REOPEN command to exit normally from the editor. The editor automatically reenters the same file, retains the original command line, and positions the cursor to the beginning of the file. Minimum growth factor determinations are made by the editor. The editor displays a warning message if the recalculated disk free space shows a limitation. You can choose to leave the editor or ignore the warning and continue with your editing session. When you reenter, the editor ignores all commands past the REOPEN on the current command line and empties both command line entries.

Use this command as a safety factor and backup procedure. Consistent and frequent implementation of the REOPEN command assures you the retention of your most current work in the event of an unforeseeable occurrence such as a power failure. Fifteen-minute interval "saves" are a common data processing practice.

Note: If you are using more than one disk drive, the editor switches source and destination drives each time you execute the REOPEN command.

PLn: Print *n* Lines on the System Printer. Use this command to print a specified number of lines on the system printer (P:). If *n* is not assigned, the editor assumes a value of 1. If you assign a value to *n* that is larger than the number of lines currently residing in the buffer, the editor automatically writes out the buffer and reads in a new one. If the editor encounters an end-of-file before the assigned number of *n* lines has been printed, the CURSOR AT END error message results. The editor aborts the command line and returns to immediate mode operation.

Printing starts from the logical line containing the cursor. Before printing the lines, all carriage returns and tab fields are changed to blanks.

Cursor positioning remains stationary unless the buffer is written out. The cursor moves to the beginning of any newly read buffer.

WL-/n: Write *n* Lines to Disk File. Use this command to write a specified number of lines to the disk file designated within the delimiters. If *n* is not assigned, the editor assumes a value of 1. If you assign a value to *n* that is larger than the number of lines currently residing in the buffer, the editor automatically writes out the buffer and reads in a new one. If the editor encounters an end-of-file before the assigned number of *n* lines has been written, the CURSOR AT END error message results. The editor aborts the command line and returns to immediate mode operation.

Writing starts from the logical line containing the cursor. Cursor positioning remains stationary unless the buffer is written out. The cursor moves to the beginning of any newly read buffer.

Caution: Remember the editor reserves .BAK and .TMP extender designations. Do not attempt a write or read operation to an already open file.

LARGE FILE COMMANDS

You can edit a file that is too large to fit into available free RAM space by using two specialized commands formulated specifically for this purpose.

IH inputs half the available RAM from the file
OC outputs text up to the current position of the cursor

When the editor receives the IH command, its immediate response is to calculate available memory and input approximately half of that amount from the file into the buffer. After receiving the OC command, the editor outputs text from the beginning of the buffer up to the logical line containing the cursor. Thereafter, that logical line becomes the first line in the buffer. With combined use of these two commands, you can obtain free memory to successfully edit files larger than will fit into current memory. Error or warning conditions that can occur include:

INPUT EOF	The editor reaches the end of the specified input file.
I/O ERROR <i>nnn</i>	A fatal disk or printer error occurs.
LINE TOO LONG	The editor encounters a line that exceeds the maximum line length set by the customizing file.

CANNOT-PREVIOUS
DISK I/O ERROR

The editor cannot perform an intended function because of a previous error condition.

TABLE 1 — IMMEDIATE MODE RESERVED KEYSTROKES

CTRL ←	Move cursor left (skip across expanding tabs)
CTRL →	Move cursor right (skip across expanding tabs)
CTRL ↓	Move cursor down one physical line
CTRL ↑	Move cursor up one physical line
CTRL 2	Move cursor to beginning of logical line
CTRL 3	Move cursor to end of logical line
CTRL 8	Display previous screen of characters
CTRL 9	Display next screen of characters
regular keys	Insert character into text
SHIFT INSERT	Prepare to insert new line(s)
TAB	Tab to next tab stop
CTRL RETURN	Return with auto indent to same level
DELETE BACK S	Delete character left of cursor
CTRL DELETE BACK S	Delete character right of cursor
SHIFT DELETE BACK S	Delete logical line containing cursor
CTRL TAB	Toggle visible-tab mode (if expanding tab option selected)
SHIFT TAB	Toggle visible-carriage return mode
SHIFT CLEAR	Clear error window
START	Execute command window
SELECT	Select alternate command line
OPTION	Change mode
BREAK	Abort command being executed

TABLE 2 — COMMAND MODE INSTRUCTIONS

EXIT	Exit normally from edit - return to DOS
EXIT2	Exit normally from edit - restart editor
ABORT	Exit without saving changes - return to DOS
ABORT2	Exit without saving changes - restart editor
SB/-/ <i>n</i>	Search for <i>n</i> th occurrence of string in buffer
SF/-/ <i>n</i>	Search for <i>n</i> th occurrence of string in file
SRB/-/ <i>n</i>	Search and replace <i>n</i> times in buffer
SRF/-/ <i>n</i>	Search and replace <i>n</i> times in file
SRVB/-/ <i>n</i>	Search and replace with verify <i>n</i> times in buffer
SRVF/-/ <i>n</i>	Search and replace with verify <i>n</i> times in file
MS	Marker set
MC	Marker clear
BC	Block copy
BM	Block move
BD	Block delete
BP	Block print
BW/-/	Block write to disk file
BR/-/	Block read from disk file
CL <i>n</i>	Move cursor left <i>n</i> characters
CR <i>n</i>	Move cursor right <i>n</i> characters
CU <i>n</i>	Move cursor up <i>n</i> logical lines
CD <i>n</i>	Move cursor down <i>n</i> logical lines
CBB	Move cursor to beginning of buffer
CEB	Move cursor to end of buffer
CBF	Move cursor to beginning of file
CEF	Move cursor to end of file
CBL	Move cursor to beginning of logical line
CEL	Move cursor to end of logical line
CC <i>n</i>	Move cursor to column <i>n</i>
IT/-/ <i>n</i>	Input string <i>n</i> times at cursor position
DB <i>n</i>	Delete <i>n</i> characters before cursor
DA <i>n</i>	Delete <i>n</i> characters after cursor
DF	Delete first part of logical line
DR	Delete remainder of logical line
DL <i>n</i>	Delete <i>n</i> logical lines
RL	Recover last deleted line
IH	Input half of available RAM from file
OC	Output text to file up to line containing cursor

REOPEN	Reopen editor with same file
PL n	Print n lines on system printer
WL $/-/n$	Write n lines to disk file
CT Sn	Convert expanding tabs to spaces for n lines
LM n	Set left margin to width n
RM n	Set right margin to width n

Note: n is an optional numeric argument, which usually acts as a repeat counter, with a range of 1-65535. With the exception of margin values, if n is omitted, the editor assumes a value of 1.

Note: $/-/$ is a required character string delimited by either a pair of slashes or a pair of quotes. $/-/-/$ is a pair of required strings delimited by either a triplet of slashes or a triplet of quotes.

CUSTOMIZING THE EDITOR

You can use the editor to full advantage by establishing specific parameters to handle distinct file extensions. For example, you may wish to turn off the auto-indentation feature on all file extensions except for languages similar to PASCAL. Maximum line lengths for .ASM files are different than, for instance, .BAS and should be altered from the default value. By setting a customizing screen color you can visually determine the nature of your editing file.

Customizing file alterations use the BASIC programming language. You must have an ATARI BASIC language cartridge inserted into the left slot of your computer console. Refer to the *ATARI 800 Operators Manual* for instruction in installing a cartridge.

To load the customizing file:

1. Place the diskette containing the editor program into your disk drive.
2. Turn on the computer. Wait for the READY message prompt with the cursor to appear on the screen.
3. Type **RUN "D:MEDITCM.BAS"** and press **RETURN**.
4. Remove the program diskette and insert your data diskette.

The Customizing File Menu that appears will allow you to select the area in which you wish to change the default values. Most of the selections are self-documented. You can reference the instructions included in the software program or you can type **N** in response to the **WOULD YOU LIKE INSTRUCTIONS? (Y/N)** query and use this manual.



Figure 10 Extension Group Prompt

Refer to Figure 11. By answering the WHAT EXTENSION GROUP query, you establish the filename specification extension that you wish to customize. Enter the **[?]** to return to the instructions for use of the file.

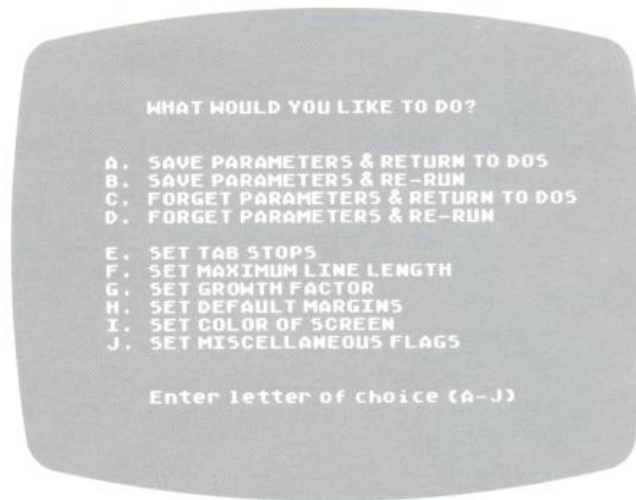


Figure 11 Customizing File Menu

A-D—Parameters

The Customizing File Menu appears as soon as you have answered the extension group prompt. Depending upon your choice of parameters, all changes that you enter into the customizing file will be retained as new values for your selected group. Use the first four fields of the menu, A-D, to establish the changes or to disregard them. Selection of **A** or **C** returns control to DOS for easy access into the editor. Selection of **B** or **D** reruns the customizing file.

E—Set Tab Stops

Selection **E** allows you to set your tab stop values. As the software instructions indicate, tab stop values cannot be changed during an editing session. The screen displays default and current tab stop values. A (Menu, Set, Clear) Select Item prompt appears on the screen.

- M** Reruns the Customizing File Menu
- S** Brings **(2-199) What column to set** onto the screen. Choose the column tab stop by pressing the number combination followed by **[RETURN]**. All current tab stop values will be redisplayed. Note the inclusion of your new value.
- C** Brings **(2-199 or *) What column to clear** onto the screen. Choose the column tab stop by pressing the number combination followed by **[RETURN]**. All current tab stop values will be redisplayed. Note the exclusion of your new value.

Press the **""** key to clear all tab stop values. Wait for the Select-Item prompt to appear. Use the Set command to enter new values.

F—Set Maximum Line Length

Maximum line length defaults to 114 characters or 3 physical lines in conformance with the ATARI Computer's built-in operating system screen editor. The editor allows from 2 to 200 characters per logical line. Enter your chosen value and press **RETURN**. Control automatically returns to the Customizing File Menu.

G—Set Minimum Growth

Use this command to determine your space allocation before receiving an I/O ERROR 162 (disk full) error message. You can ignore the minimum growth check warning and proceed with your editing session. However, be mindful of its usefulness as a warning device. Enter your chosen value and press **RETURN**. Control automatically returns to the Customizing File Menu.

H—Set Default Margins

If display columns are being cut off at the sides of your television screen, you can change the left and right margins.

I—Set Color of Screen

Using the customizing file, you can alter three variables that precisely determine the color display. The first variable, indicated as COLOR, controls the background color selection. Refer to the following table for numbers corresponding to the color of your choice.

TABLE 3—THE ATARI COLORS AND NUMBERS

BACKGROUND COLORS	CORRESPONDING NUMBERS
GRAY	0
LIGHT ORANGE (GOLD)	1
ORANGE	2
RED-ORANGE	3
PINK	4
PURPLE	5
PURPLE-BLUE	6
AZURE BLUE	7
SKY BLUE	8
LIGHT BLUE	9
TURQUOISE	10
GREEN-BLUE	11
GREEN	12
YELLOW-GREEN	13
ORANGE-GREEN	14
LIGHT ORANGE	15

Note: Colors will vary with type and adjustment of television or monitor used.

The second variable, B-lum, controls the luminance of the background color on the screen. The third variable, C-lum, controls the character luminance. Luminance is changed on every **even** number: 0, 2, 4, 6, 8, 10, 12, and 14. Follow certain rules when assigning luminance numbers to ensure a useable combination. To obtain the best clarity and avoid the occurrence of a blank screen:

- Do not equate the luminance values for the two variables, B-lum and C-lum.
- The two luminance values must be greater or less than each other by a factor of 8.

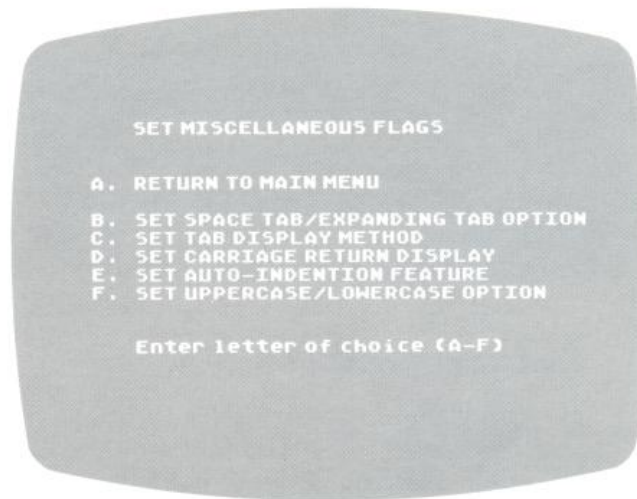


Figure 12 Customizing File Submenu J

J—Set Miscellaneous Flags

A—Return to Main Menu

Return to the main menu after choosing your new values. You may then make a selection to retain or disregard the parameters you have selected.

B—Set Type of Tab

Note: Not all ATARI software recognizes expanding tabs.

Space tabs insert a selected number of blanks between tab stops, and the cursor positions accordingly. Expanding tabs, however, insert a character into the text that indicates the tab function.

C—Set Tab Display Method

Expanding tabs can be conventionally displayed as spaces or usefully displayed as right triangles followed by periods. The value entered into this parameter can be displaced by an immediate mode keystroke.

D—Set Carriage Return Display

A carriage return can either be displayed as a space or a down arrow. The value entered into this parameter can be displaced by an immediate mode keystroke.

E—Auto-Indention Feature

Auto-indention allows you to reposition the cursor to an automatic tab stop on the next logical line. To activate auto-indention, you press the **CTRL** and **RETURN** keys simultaneously. Use the customizing file to disengage this feature.

F—Set Shifting Caselock

After you answer the filename prompt and begin the edit of your specified file, this option comes into effect. Set a shift-lock for uppercase designation or a no-lock for upper- and lowercase. The parameter value entered may be displaced by using the **CAPS LOWR** key during an editing session.

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In California (800) 672-1430
Continental U.S. (800) 538-8737

or write to: Atari, Inc.
Customer Service/Field Support
1340 Bordeaux Drive
Sunnyvale, CA 94086

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EDITOR MESSAGES

Warnings

USING DEFAULTS	No customizing file was found that matched the extension of the filename, so the editor uses its built-in defaults.
NEW FILE	The file named to be edited does not exist; therefore, the editor creates a new file using the specified name given at the prompt.
INPUT EOF	The end of file has been reached on the input file.
CANNOT-PREVIOUS DISK I/O ERROR CURSOR AT END	Refer to a previous execution for cause of error. Use of EXIT, IH, or OC commands may be restricted. Occurs whenever the cursor tries to move past either end of the text buffer.

Prompt Messages

VERIFY(REPLACE, SKIP,QUIT)?	Displays in the error window before each replacement while executing a search-and-replace-with-verify command.
--------------------------------	--

Error Messages

MARGIN VALUE ERROR	Occurs when a designation for n is not in conformance with the margin rule.
LINE TOO LONG	Occurs whenever the addition of text to the current line causes it to exceed the maximum line length set by the customizing file.
MEMORY FULL	Means that there is not enough free RAM in the buffer to carry out the operation.
ILLEGAL DEV:FILE.EXT	Tells you that the last filename prompt was incorrectly answered.
DELIMITER ERROR	Tells you that the command being entered into the command window requires a slash (/) or double quotation mark (") for proper syntax.
SEARCH FAILED	Occurs when a search command was executed and the search string could not be found.
NOT COMPLETE	Occurs when you try to execute the command window when an incomplete command line exists there.
UNRECOGNIZED COMMAND	Occurs when you type an invalid character into the command window.
BREAK KEY ABORT	Acknowledges that you have pressed the BREAK key during execution of the command window.
I/O ERROR nnn	Tells you that a fatal disk or printer error has occurred. nnn is an error number generated by the operating system. Refer to the <i>ATARI Disk Operating System II Reference Manual</i> .
NUMBER TOO BIG	Tells you that the argument n given in the command window is too large for the command specified or the current line length limit.
CANNOT FIND MARKED BLOCK	Means that the editor could not find a marked block of text while executing a BC, BD, BM, BP, BW/-/, or BR/-/ command.
CANNOT FIND FILE	Means that the editor could not find the file requested in a BR/-/ command.
EDITOR IS CONFUSED	Occurs when internal editing pointers have been damaged. Try immediate mode keystrokes CTRL 2 and CTRL ← until you no longer receive this error message. (If this error should occur, it would be helpful to us if you could find a repeatable sequence of events that reproduces it and report to ATARI Customer Service.)
FILE LOCKED	Means that the file you requested to edit is locked or the associated .BAK or .TMP file is locked.
EDITOR CANNOT RUN-NO FREE IOCBs	Occurs if you have attempted to use any other DOS but 2.0S; or if you have called the editor directly, and at least three available IOCBs do not exist.

Note: **n** is an optional numeric argument, which usually acts as a repeat counter, with a range of 1-65535. With the exception of margin values, if **n** is omitted, the editor assumes a value of 1.



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A Warner Communications Company

CO60029 REV. 1.

ATARI® MACRO ASSEMBLER REFERENCE CARD

PSEUDO-OP QUICK REFERENCE

iglab	ASSERT	<exp>	;Check assembly condition
LABEL:	DB	<exp>,<exp>	;Define bytes
LABEL:	DB	'ABCDE','f',\$0D	;Define long strings
LABEL:	DC	'ABCDE'	;DB with 80h added onto the last byte
LABEL:	DS	<exp>	;Define space
LABEL:	DW	<exp>,<exp>	;Define words
LABEL:	DW	'Xu',1234,'y'	;Define 1- or 2-character strings
LABEL:	ECHO	<exp>	;Duplicate code <exp> times
iglab	EJECT		;Page eject
iglab	ELSE		;Part of conditional assembly
LABEL:	END	[exp]	;End of assembly
iglab	ENDIF		;Terminate range of IF
iglab	ENDM		;Terminate MACRO or ECHO
iglab	EPROC		;Terminates local symbol range
LABEL:	EQU	<exp>	;Define LABEL equals <exp>
iglab	ERR		;Force error flag
iglab	IF	<exp>	;Begin conditional assembly
LABEL:	INCLUDE	<filespec>	;Include another source file
iglab	LINK	<filespec>	;Include another source file at the end of this source file
iglab	LIST	<opt>	; <opt> = list control option
iglab	LIST	*	;Pop list control stack
LABEL:	LOC	<exp>	;Set location counter
NAME:	MACRO	<parms>	;Begin macro definition
LABEL:	ORG	<exp>	;Set origin counter
LABEL:	PROC		;Begin local symbol range
LABEL:	REAL6	<exp>	;6-byte real constant conversion
LABEL:	SET	<exp>	;Reset LABEL to <exp>
iglab	SPACE	<exp1>,<exp2>	;Space <exp1> lines if <exp2> lines left on this page
iglab	SUBTTL	'text'	;Set listing subtitle
iglab	TITLE	'text'	;Set listing title
iglab	USE	<name>	;Use block declaration

LABEL: VFD <exp>\<exp> ;Variable field definition

LABEL: = <exp> ;Synonym for EQU

<exp> = required expression

[exp] = optional expression

<filespec> = <device>:<filename>.<extension>

iglab = ignored label

'text' = strings

ERROR CODES

A = Address error. Instruction specified does not support the addressing mode specified.

D = Duplicate label error. The last one defined is used.

E = Expression error. An expression on the source line in the address field is unrecognizable.

F = Bad nesting of control statements. Bad nesting of IF/ELSE/ENDIF statements. When this occurs on the END line, means an IF was not terminated.

I = Instruction field not recognized. Three NOP bytes are generated.

L = Label field not recognized. Three NOP bytes are generated.

M = MACRO statement error. Improper macro definition.

N = Error in number: digit exceeds radix, value exceeds 16 bits, and so forth.

O = Stack table overflow occurred in evaluating expression; user should simplify expression. Too many LINK files. Too many PROCs. Too many USE blocks.

P = Programmer forced error. See ASSERT and ERR pseudo-ops.

R = Expression in variable field not computable.

S = Syntax error in statement. Too many or too few address subfields.

U = Reference to an undefined symbol.

V = Expression overflow. resultant value is truncated.

W = Not within VFD field width (1 <= width <= 16).

Y = Misplaced instruction, extraneous ENDM. When this occurs on the END line, means a MACRO or ECHO was not terminated.

ATARI® PROGRAM-TEXT EDITOR™ REFERENCE CARD

TABLE OF COMMAND MODE INSTRUCTIONS

EXIT	Exit normally from edit - return to DOS
EXIT2	Exit normally from edit - restart editor
ABORT	Exit without saving changes - return to DOS
ABORT2	Exit without saving changes - restart editor
SB/-/n	Search for <i>n</i> th occurrence of string in buffer
SF/-/n	Search for <i>n</i> th occurrence of string in file
SRB/-/n	Search and replace <i>n</i> times in buffer
SRE/-/n	Search and replace <i>n</i> times in file
SRVB/-/n	Search and replace with verify <i>n</i> times in buffer
SRVF/-/n	Search and replace with verify <i>n</i> times in file
MS	Marker set
MC	Marker clear
BC	Block copy
BM	Block move
BD	Block delete
BP	Block print
BW/-/	Block write to disk file
BR/-/	Block read from disk file
CLn	Move cursor left <i>n</i> characters
CRn	Move cursor right <i>n</i> characters
CUn	Move cursor up <i>n</i> logical lines
CDn	Move cursor down <i>n</i> logical lines
CBB	Move cursor to beginning of buffer
CEB	Move cursor to end of buffer
CBF	Move cursor to beginning of file
CEF	Move cursor to end of file
CBL	Move cursor to beginning of logical line
CEL	Move cursor to end of logical line
CCn	Move cursor to column <i>n</i>
IT/-/n	Input string <i>n</i> times at cursor position
DBn	Delete <i>n</i> characters before cursor
DAn	Delete <i>n</i> characters after cursor
DF	Delete first part of logical line
DR	Delete remainder of logical line
DLn	Delete <i>n</i> logical lines
RL	Recover last deleted line
IH	Input half of available RAM from file
OC	Output text to file up to line containing cursor
REOPEN	Reopen editor with same file
PLn	Print <i>n</i> lines on system printer
WL/-/n	Write <i>n</i> lines to disk file
CTSn	Convert expanding tabs to spaces for <i>n</i> lines
LMn	Set left margin to width <i>n</i>
RMn	Set right margin to width <i>n</i>

EDITOR MESSAGES

USING DEFAULTS	No customizing file was found that matched the extension of the filename, so the editor uses its built-in defaults.
NEW FILE	The file named to be edited does not exist; therefore, the editor creates a new file using the name specified at the prompt.
INPUT EOF	The end of file has been reached on the input file.
CANNOT-PREVIOUS DISK I/O ERROR	Refer to a previous execution for cause of error. Use of EXIT, IH, or OC commands may be restricted.
CURSOR AT END	Occurs whenever the cursor tries to move past either end of the text buffer.
VERIFY(REPLACE, SKIP,QUIT)?	Displays in the error window before each replacement while executing a search-and-replace-with-verify command.
MARGIN VALUE ERROR	A designation for <i>n</i> is not in conformance with the margin rule.
LINE TOO LONG	The addition of text to the current line causes it to exceed the maximum line length set by the customizing file.
MEMORY FULL	There is not enough free RAM in the buffer to carry out the operation.
ILLEGAL DEV:FILE.EXT	The last filename prompt was incorrectly answered.
DELIMITER ERROR	The command being entered into the command window requires a slash (/) or double quotation (""') for proper syntax.
SEARCH FAILED	A search command was executed and the search string could not be found.
NOT COMPLETE	Occurs when you try to execute the command window when an incomplete command line exists there.
UNRECOGNIZED COMMAND	Occurs when you type an invalid character into the command window.
BREAK KEY ABORT	Acknowledges that you have pressed the BREAK key during execution of the command window.
I/O ERROR nnn	A fatal disk or printer error has occurred.
NUMBER TOO BIG	The argument <i>n</i> given in the command window is too large for the command specified or the current line length limit.
CANNOT FIND MARKED BLOCK	The editor could not find a marked block of text while executing a BC, BD, BM, BP, BW/-/, or BA/-/ command.
CANNOT FIND FILE	The editor could not find the file requested in a BR/-/ command.
EDITOR IS CONFUSED	Internal editing pointers have been damaged. Try immediate mode keystrokes, CTRL 2 and CTRL ←, until you no longer receive this error message.
FILE LOCKED	The file you requested to edit is locked or the associated .BAK or .TMP file is locked.
EDITOR CANNOT RUN-NO FREE IOCB'S	Occurs if you have attempted to use any other DOS but 2.05; or the editor was called directly, and at least three available IOCBs do not exist.

Note: *n* is an optional numeric argument, which usually acts as a repeat counter, with a range of 1 to 65535. With the exception of margin values, if *n* is omitted, the editor assumes a value of 1. /-/ is a required character string delimited by either a pair of slashes or a pair of quotes. /-/ is a pair of required strings delimited by either a triplet of slashes or a triplet of quotes.