RAE-1 REFERENCE DATA

(C) 1980 SYM-1 Users' Group
P. O. Box 315, Chico, CA 95927

COLD START ENTRY

To enter RAE type:
.G B000

SYM will respond with:

RAE V1.0
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0200-08FC 0C00-0EFC 0F00
0200 0C00
>

The first four values are the bounds for the text file and the label file. The remaining values are the start of the relocating buffer and the current pointers to the text file and the label file. All values are in hexadecimal. The > is the prompt; RAE is now in the command mode.

Note that RAE initializes itself for a 4K SYM. If you have 8K and wish to reserve the first 4K for object code enter:

SET $1000 $1BFD $1C00 $1EFD $1F00

and after the confirmation message enter CL. The files may be allocated as desired, but should not overlap.

COMMANDS

Only the first two characters of the command and the first character of a parameter are required. Others may be added as for example, PRINT/FIL2 is equivalent to PR. Spaces are required before each parameter. Definitions and abbreviations follow the addressing modes list.

```
ASsemble   List    ln
ASsemble   Nolist  ln
Autonumber step    ln
Autonumber 0
Autonumber
Break
Clear
COpy       ln1  ln3
DElete     ln1
DElete     ln1  ln2
DUplicate  ffn

EDit       ln
EDit       string
Find       string
FORmat     Set  ll
FORmat     Clear
GET        ffn
GET        ffn  ln
GET        ffn  Append
GET        ffn  Set  Pn
HardCopy   Clear
HardCopy   Pase  (if HA S)
Labels
MAnuscript Set
MAnuscript Clear
MOVe       ln1  ln2  ln3
Number     ln   step
OFf        tn
ON         tn
Output     ffn
PASS
PRint      ln
PRint      ln1  ln2
PRint      /
PRint
PRint      ffn
PUt        ffn  ln1  ln2
PUt        X
PUt        ln
PUt        ln1  ln2
SET        ts tf ls lf bs
RUn
USer       (at $0003, return
           with JMP B0AC)
```

PSEUDO OPCODES

```
.BA le    Begin Assembly
.BY le    Byte
.CE       Continue on Errors
.CT       Continue on Tape
.DE le    Define External
.DI le    Define Internal
.IS le    Define Storage
.EC       Macro Expand Clear
.EJ       Eject (if HA S)
.EN       End assembly
.ES       Macro Expand Set
.LC       List Clear
.LS       List Set
.MC le    Move Code
.MD (sl1 sl2 ... sln)  Macro Definition
.ME       Macro End
.OC       Object store Clear
.OS       Object store Set
.RC       Relocate Clear
.RS       Relocate Set
.SE le    Store External
.SI le    Store Internal
IFE le    IF Equals zero
IFN le    IF Non-zero
IFP le    IF Plus
IFM le    IF Minus
***       end control block.
SET sl=le
```

(this pseudo op is used to redefine the value of a symbolic label and is not to be confused with the command Set)

Symbolic labels are mandatory where shown, optional elsewhere, except with .SE. (sl) .SE is equivalent to .SI

ADDRESSING MODES

```
Immediate       #le
                #ac
                #L,le
                #H,le
(H is high, L is low; default is L)
Absolute        le
Zero Page       *le
Accumulator     A
Implied
(Indirect, X)   (le,X)
(Indirect), Y   (le),Y
Zero Page, X    *le,X
Zero Page, Y    *le,Y
Absolute, X     le,X
Absolute, Y     le,Y
Relative        le
Indirect        (le)
Zero Page, Y    *le,Y
```

e 'A' is reserved for Accumulator

DEFINITIONS

ln   Line Number
One or more decimal digits in the range 0-9999. Only the last four digits are accepted

fn   File Number
One or more decimal digits in the range 0-99. Only the last two are accepted

sl   Symbolic Label
Up to 10 (or 11) ASCII characters. The first must be in the range 40-5F, others must be in the range 2E-7E, except not 3E (=)

nl   Numeric Label
One or more decimal digits in the range 0-9999, or, preceded by $, hex, or, preceded by Z, binary digits

le   Label Expression
A symbolic label, or a numeric label, or the sum or difference of two label expressions; all label entry and arithmetic is 16 bits unsigned

ac   ASCII character
Single quote (') followed by one ASCII character

as   ASCII String
ASCII characters enclosed within single quotes (')

tn   Tape Number
0 is write deck, 1 is read deck

ABBREVIATIONS

```
bs   Buffer Start
ls   Label Start
lf   Label Finish
ts   Text Start
tf   Text Finish
ll   Label Length
pn   Page Number
ec   Error Code
```

Other abbreviations will be defined as they occur

COLD START INITIALIZATION

```
Auto        0
MAnuscript  Clear
FORmat      Set  :0
Clear
OFf
OFf
HardCopy    .RA
            .OC
            .LC
            .EC
            .RS
```

COMMAND DEFAULTS

```
Auto        0
MAnuscript  Clear
FORmat      Set  :0
Clear       0
OFf         1
OFf         Clear
HardCopy    $0200
```

If fn is not entered 0 is assumed
If ln is not entered 10 is assumed
If ll is not entered 10 is assumed
If step is not entered 10 is assumed
If pn is not entered 1 is assumed at initialization, otherwise last pn + 1 is assumed
If tn is not entered 0 is assumed
If neither C or S is entered, S is assumed in F0 and MA, C is assumed in HA
If neither L or N is entered N is assumed
In SE previous values assumed unless $ hex, or decimal assumed unless $

ERROR CODES

Error format is !ec AT LINE ln/fn

!ED	Error in command input
!00	Not a zero page address
!01	Branch out of range
!02	Illegal mnemonic
!03	Illegal pseudo opcode
!04	Operand undefined in .BA or .MC
!05	Label missing with .DE or .DI
!06	Duplicate label
!07	Missing .EN in assembly
!08	Undefined or illegal label
!09	Illegal decimal character
!0A	Error in or missing operand
!0B	Unimplemented address mode
!0C	Illegal character in label
!0E	Label file overflow
!0F	Text file overflow
!10	Line renumber overflow
!11	Missing parameter in NU
!14	Cannot relocate; errors, or no AS
!15	Syntax error in ED command
!16	Illegal tape deck number
!17	Tape load checksum error

Macro Error Codes

!20	Attempted expansion before definition
!21	Macro in expand state at .EN
!22	Conditional suppress set at .EN
!23	Macro definition incomplete at .EN
!24	Too many nested macros
!25	Parameter mismatch or illegal characters
!26	Duplicate macro definition
!27	Definition overlaps file boundary
!29	Illegal nested definition
!2A	Non-symbolic label in SET
!2D	.ME without associated .MD
!2E	Overflow in number of macros
!2F	Overflow in file sequence count

If .CE is included in the source code AS will continue on all errors except !04, !07, or !17; error messages will still be printed, and an error count will be given.

CONTROL CODES

The following control codes will print as shown, and perform the specified functions:

^B	go to BASIC
^C	go to SUPERMON, return via .G
^D	delete in ED
^F	find in ED
^O	continue processing after terminal break, suppress further printing
^Ttn	toggle specified tape deck
^X	delete entire line entered
^Y	Jump to location $0000, return is via RTS
^Z	terminate processing after terminal break, return to '>' mode

The following non-printing control codes will perform the specified functions:

^G	SYM "Beep", terminal bell
^H	backspace and delete
^O	continue processing and printing after terminal break
^I	use to enter a null line or for tabulating (8 columns)

^K (VT) and ^L (FF) not implemented
^J (LF), ^M (CR), and ^C (ESC) operative
^@ (NUL) clears screen on KTM-2

Most other control characters will echo with ^ch, but will be ignored

RUBOUT may be used as an alternative to ^H (echo is \)

TAB may be used as an alternative to ^I

EDIT AND FIND COMMANDS

EDit ln   Will find and print line ln. To modify use the following subcommands (this command is always fully interactive):

Fch	Find character ch (if the character appears more than once in the line, repeat until correct position is found, then use either or both of the following)
^H	Delete character(s) (backward delete)
ch	Insert character(s) (forward insert)

(repeat as needed and exit with one of the following)

^D	Delete to end of line
RETURN	Retain rest of line

EDit tSltS2t Xd a ln1 ln2

The parameters have the following significance:

t is a "terminator" to mark the string limits. t may be chosen as any symbol which does not appear in the string

S1 and S2 are the search and replacement strings. X may be used as a 'don't care' character in S1

d is alternate 'don't care' to be used in S1. If X is a valid character in S1, an alternate should be specified with Xd

a is either * or # or space.
  space: print all lines
  #: print no lines
  *: interact before altering

Interact Commands

A	alter field
D	delete entire line
M	move to next field
X	skip line; no alter.
X	exit ED command
^F	enter ED ln mode

ln1 and ln2 are the search limiters
Defaults for ln1 and ln2 are 0 and 9999

FInd tSlt Xd a ln1 ln2

The parameters are as above without interaction or alteration, and a frequency count is printed. Useful for label cross reference file if a is space, or for a character count if a is # and S1 is Z

RECOVERY FROM ACCIDENTAL CLEAR

Through the monitor replace the 00 at the beginning of text file + 2 with the first character of the text (usually a 20).

Enter RAE at warm start with .G B003.
Input to RAE; PR /
Exit RAE with ^C.

Obtain contents of DD and DE with .V DD and place these in D3 and D4 with .D D3

Renter RAE with .G B003 and continue.

MACRO ASSEMBLY

To define a macro, use the form:
  !!NAME .MD (SYMB1 SYMB2 ... SYMBn)

To permit multiple calls of the macro without an !06 error, prefix all symbolic labels with three periods. Symbolic labels may be duplicated in different macros; unless the macros are nested, that is, one calls another.

To call a macro, use the form:
  NAME (EXPR1 EXPR2 ... EXPRn)

SUGGESTIONS FOR USE

*The delimiter between fields is one or more spaces. Lines are entered with RETURN.

*Comments may be added after the last required field in any line following a space.

*Comment lines may be entered by using a semicolon in the symbolic label field.

*The equal sign may be used as a numeric label whose value is the current value of the program counter.

*Except in symbolic labels, and in the ED and FI commands for string matching, upper and lower case letters may be used interchangeably.

*After CO or MO use NU to eliminate the duplicate line numbers.

*Return to RAE after BR or ^C is with .G; return after reset is .G B003.

*To return to the command mode when in AU, enter // RETURN. Entry of A line number will return control to AU.

*To use Hardcopy, enter HA S pn, hit RETURN three times, adjust to top of page. Enter PR or AS L and RETURN. HA P and .EJ will advance to top of next page at each call.

*To find the value of the last line number used, enter PR /.

*If your terminal has only 40 columns restrict the label field width by entering FO S 6.

*Message after AS is:
  error count/.BA adds/.MC adds