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INTRODUCTION

THE FORTH LANGUAGE WAS INVENTED IN 1970 BY CHARLES MOORE. IT IS UNIQUE AMONG HIGH LEVEL LANGUAGES IN THAT THE WHOLE KERNEL INCLUDING COMPILER, EDITOR AND ASSEMBLER ONLY OCCUPIES ABOUT 8K BYTES. THE LANGUAGE PACKAGE SUPPLIED HERE IS FIG-FORTH WITH EXTENSIONS FOR DISC, CASSETTE AND THE CRU FACILITY OF THE POWERTRAN CORTEX COMPUTER.

THIS MANUAL SHOULD NOT BE REGARDED AS A TUTORIAL ON THE FORTH LANGUAGE, IT IS A DESCRIPTION OF THE "WORDS" AND FACILITIES OFFERED IN THE CORTEX FIG-FORTH EPROM SET SUPPLIED BY LOMBARD SYSTEMS. FOR THE USER NEW TO THE FORTH LANGUAGE WE RECOMMEND THE PURCHASE OF THE EXCELLENT BOOK BY LEO BRODIE "STARTING FORTH." SEE APPENDIX C.

FORTH TYPICALLY RUNS FIVE TO TEN TIMES FASTER THAN THE EQUIVALENT BASIC. IT IS INHERENTLY STRUCTURED AND ENCOURAGES TOP DOWN PROGRAM DESIGN. THE USER BUILDS HIS PROGRAM FROM PREVIOUSLY DEFINED "WORDS" USING THESE WORDS TO CREATE OTHER "WORDS" UNTIL THE WHOLE APPLICATION IS PERFORMED BY THE EXECUTION OF ONE "WORD."

INSTALLATION

CORTEX FIG-FORTH IS SUPPLIED IN TWO 2564 EPROMS. THESE REPLACE THE FIRST TWO BASIC EPROMS.

CAREFULLY REMOVE THE FORTH EPROMS FROM THEIR PACKING. IT IS A GOOD IDEA TO TOUCH AN EARTHED OBJECT BEFORE HANDLING THE EPROMS AS THEY CAN BE DAMAGED BY STATIC CHARGE.

REMOVE THE COVER FROM YOUR CORTEX AND LOCATE THE BASIC EPROMS (SOCKETS IC45, IC46, AND IC47 IN THE ELECTRONICS TODAY INTERNATIONAL ARTICLE). REMOVE THE FIRST TWO EPROMS IC47 AND IC46. PLUG THE EPROM MARKED >0000 INTO SOCKET IC47, AND THE >2000 EPROM INTO SOCKET IC46. CORTEX-FORTH OCCUPIES MEMORY IN PROM FROM >0000 TO >3FFF (THE "->" SIGN MEANS HEX). THE THIRD BASIC EPROM MAY BE LEFT IN OR REMOVED AS YOU DESIRE, EITHER WAY WILL MAKE NO DIFFERENCE TO THE EXECUTION OF THE FORTH SYSTEM.

REPLACE THE COVERS AND POWER ON THE CORTEX. THE SYSTEM SHOULD REPLY WITH THE SIGN ON BANNER CORTEX-FIG FORTH REL 1.0XX, WHERE XX ARE THE RELEASE LETTERS. IF THIS FAILS TO OCCUR, GO BACK AND RE-CHECK YOUR WORK TO MAKE SURE NONE OF THE PINS OF THE EPROMS ARE BENT OVER OR OUTSIDE THE SOCKETS. HAPPY FORTH COMPUTING!
CORTEX FIG - FORTH MEMORY MAP

TEXT BUFFER

VDP DISC AND I/O ROUTINES

USER "WORD" BUFFER

LIMIT

DISC BUFFERS

FIRST

USE

DICTIONARY

UP

USER VARIABLES

BOOT-UP LITERALS

UP

RETURN STACK

I/O ROUTINES

0 + ORIGIN

TERMINAL BUFFER

STACK

STACK

RETURN

SP

>0000

>0300

>2000

>617E

>89A6

>F000

>D000

>6120

>6080

>6120

>0300

>0000

TIB

IN

R0

RP

S0

PREV

FIRST

LIMIT

>6080
CORTEX FIG - FORTH GLOSSARY

THIS SECTION CONTAINS ALL OF THE STANDARD DEFINITIONS IN CORTEX FORTH. THE FIRST LINE OF EACH ENTRY SHOWS A SYMBOLIC REPRESENTATION OF THE PROCEDURE’S ACTION ON THE PARAMETER STACK. THE SYMBOLS ARE IN ORDER OF THEIR POSITION ON THE PARAMETER STACK, THE THREE DASHES REPRESENT THE PROCEDURE’S EXECUTION POINT; ANY PARAMETERS LEFT ON THE STACK AFTER EXECUTION ARE LISTED TO THE RIGHT OF THE THREE DASHES. THE TOP OF THE STACK IS RIGHT MOST IN ORDER. THIS HAS BECOME STANDARD NOTATION FOR FORTH "WORD" ACTIONS.

THE SYMBOLS ARE AS FOLLOWS:

ADDR   MEMORY ADDRESS
B       8 BIT BYTE (HI 8 BITS ZERO)
C       7 BIT ASCII CHARACTER (HI 9 BITS ZERO)
D       32 BIT SIGNED DOUBLE INTEGER, MOST SIGNIFICANT PORTION WITH SIGN ON TOP OF THE STACK.
F       BOOLEAN FLAG, 0 = FALSE, NON-ZERO = TRUE
FF      BOOLEAN FALSE FLAG = 0
N       16 BIT SIGNED INTEGER NUMBER
U       16 BIT UNSIGNED INTEGER
TF      BOOLEAN TRUE FLAG = NON-ZERO

THE CAPITAL LETTERS ON THE RIGHT SHOW DEFINITION CHARACTERISTICS;

C       MAY ONLY BE USED WITHIN A COLON DEFINITION. A DIGIT INDICATES THE NUMBER OF MEMORY ADDRESSES USED, IF MORE THAN ONE.
E       INTENDED FOR EXECUTION ONLY.
L0      LEVEL ZERO DEFINITION OF FORTH-78
L1      LEVEL ONE DEFINITION OF FORTH-78
P       HAS PRECEDENCE BIT SET, WILL EXECUTE EVEN WHEN COMPILING.
U       USER VARIABLE

UNLESS OTHERWISE NOTED, ALL REFERENCES TO NUMBERS ARE FOR 16 BIT SIGNED INTEGERS. FOR 32 BIT SIGNED DOUBLE NUMBERS, THE MOST SIGNIFICANT PART (WITH THE SIGN) IS ON TOP. ALL ARITHMETIC IS IMPLICITLY 16 BIT SIGNED INTEGER MATH, WITH ERROR AND UNDER-FLOW INDICATION UNSPECIFIED.
! N ADDR --- L0
STORE 16 BITS OF N AT ADDRESS, PRONOUNCED "STORE".

! CSP
SAVE THE STACK POSITION IN CSP. USED AS PART OF COMPILER SECURITY.

# D1 --- D2 L0
GENERATE FROM A DOUBLE NUMBER D1, THE NEXT ASCII CHARACTER WHICH IS PLACED IN AN OUTPUT STRING. RESULT D2 IS THE QUOTIENT AFTER DIVISION BY BASE, AND IS MAINTAINED FOR FURTHER PROCESSING. USED BETWEEN <# AND #>. SEE ‘#S’.

#> D --- ADDR COUNT L0
TERMINATE NUMERIC OUTPUT CONVERSION BY DROPPING D, LEAVING THE TEXT ADDRESS AND CHARACTER COUNT SUITABLE FOR TYPE.

#S D1 --- D2 L0
GENERATE ASCII TEXT IN THE OUTPUT BUFFER, BY THE USE OF #> UNTIL A DOUBLE NUMBER RESULTS. USED BETWEEN <# AND #>.

' --- ADDR P, L0
USED IN THE FORM:
' NNNN
LEAVES THE PARAMETER FIELD ADDRESS OF DICTIONARY WORD NNNN. AS A COMPILER DIRECTIVE, EXECUTES IN A COLON DEFINITION TO COMPILE THE ADDRESS OF A LITERAL. IF THE WORD IS NOT FOUND AFTER A SEARCH OF CONTEXT AND CURRENT, AN APPROPRIATE ERROR MESSAGE IS GIVEN, PRONOUNCED "TICK."

( --- ADDR P, L0
USED IN THE FORM:
( CCCC)
IGNORE A COMMENT THAT WILL BE DELIMITED BY A RIGHT PARENTHESIS ON THE SAME LINE, MAY OCCUR DURING EXECUTION OR IN A COLON DEFINITION. A BLANK AFTER THE LEADING PARENTHESIS IS REQUIRED.

( " ) C+
THE RUN TIME PROCEDURE, COMPiled BY ‘.”’ WHICH transmits the FOLLOWING in LINE text to the SELECTED OUTPUT device. SEE ‘.”’

( ;CODE) C
THE RUN TIME PROCEDURE, COMPiled by ‘;CODE’ THAT rewrites the CODE FIELD OF THE MOST RECENTLY DEFINED WORD TO POINT TO THE FOLLOWING MACHINE CODE SEQUENCE. SEE ‘;CODE’.

(+LOOP) N --- C2
THE RUN TIME PROCEDURE COMPiled by ‘+LOOP’, WHICH INCREMENTS THE LOOP INDEX BY N AND TESTS FOR LOOP COMPLETION. SEE ‘+LOOP’.
(ABORT)
EXECUTES AFTER AN ERROR WHEN WARNING IS -1. THIS WORD NORMALLY EXECUTES
ABORT, BUT MAY BE ALTERED (WITH CARE) TO A USER'S ALTERNATIVE PROCEDURE.

(DO)
THE RUN TIME PROCEDURE COMPILED BY 'DO' WHICH MOVES THE LOOP CONTROL
PARAMETERS TO THE RETURN STACK. SEE 'DO'.

(FIND)
ADDR1 ADDR2 --- PFA B TF (OK)
ADDR1 ADDR2 --- FF (BAD)
SEARCHES THE DICTIONARY STARTING AT THE NAME FIELD ADDRESS ADDR2,
MATCHING TO THE TEXT AT ADDR1. RETURNS PARAMETER FIELD ADDRESS. LENGTH
BYTE OF NAME FIELD AND BOOLEAN TRUE FOR A GOOD MATCH. IF NO MATCH IS
FOUND, ONLY A BOOLEAN FALSE FLAG IS LEFT.

(LINE)
N1 N2 --- ADDR COUNT
CONVERT THE LINE NUMBER N1 AND THE SCREEN N2 TO THE DISC BUFFER ADDRESS
CONTAINING THE DATA. A COUNT OF 64 INDICATES THE FULL LINE TEXT LENGTH.

(LOOP)
THE RUN TIME PROCEDURE COMPILED BY 'LOOP' WHICH INCREMENTS THE LOOP INDEX
AND TESTS FOR LOOP COMPLETION. SEE 'LOOP'.

(NUMBER)
D1 ADDR1 --- D2 ADDR2
CONVERT THE ASCII TEXT BEGINNING AT ADDR1+1 WITH REGARD TO BASE. THE NEW
VALUE IS ACCUMULATED INTO DOUBLE NUMBER D1, BEING LEFT AS D2. ADDR2 IS THE
ADDRESS OF THE FIRST UNCONVERTABLE DIGIT. USED BY NUMBER.

*     N1 N2 --- PROD
LEAVE THE SIGNED PRODUCT OF TWO SIGNED NUMBERS

*/    N1 N2 N3 --- N4
LEAVE THE RATIO N4 = N1*N2/N3 WHERE ALL ARE SIGNED NUMBERS. RETENTION OF
AN INTERMEDIATE 31 BIT PRODUCT PERMITS GREATER ACCURACY THAN WOULD BE
AVAILABLE WITH THE SEQUENCE N1 N2 * N3 /

*/MOD  N1 N2 N3 --- N4 N5
LEAVE THE QUOTIENT N5 AND REMAINDER N4 OF THE OPERATION N1*N2/N3 A 31 BIT
INTERMEDIATE PRODUCT IS USED AS FOR */.

+     N1 N2 --- SUM
LEAVE THE SUM OF N1+N2.

+!    N1 ADDR ---
ADD N TO THE VALUE AT THE ADDRESS. PRONOUNCED "PLUS-STORE".

+-    N1 N2 --- N3
APPLY THE SIGN OF N2 TO N1, WHICH IS LEFT AS N3.
+BUF
ADDR1 --- ADDR2   F
ADVANCE THE DISC BUFFER ADDRESS ADDR1 TO THE ADDRESS OF THE NEXT BUFFER ADDR2. BOOLEAN F IS FALSE WHEN ADDR2 IS THE BUFFER PRESENTLY POINTED TO BY VARIABLE PREV.

+LOOP
N1 --- (RUN)
ADDR  N2 --- (COMPILE)
P, C2, L0
USED IN A COLON DEFINITION IN THE FORM:
DO . . . N1 +LOOP
AT RUN TIME, +LOOP SELECTIVELY CONTROLS BRANCHING BACK TO THE CORRESPONDING DO BASED ON N1, THE LOOP INDEX AND THE LOOP LIMIT. THE SIGNED INCREMENT N1 IS ADDED TO THE INDEX AND THE TOTAL COMPARED TO THE LIMIT. THE BRANCH BACK TO DO OCCURS UNTIL THE NEW INDEX IS EQUAL TO OR GREATER THAN THE LIMIT (N1>0), OR UNTIL THE NEW INDEX IS EQUAL TO OR LESS THAN THE LIMIT (N1<0). UPON EXITING THE LOOP- THE PARAMETERS ARE DISCARDED AND EXECUTION CONTINUES AHEAD.

+ORIGIN
N --- ADDR
LEAVE THE MEMORY ADDRESS RELATIVE BY N TO THE ORIGIN PARAMETER AREA. N IS THE MINIMUM ADDRESS UNIT, EITHER BYTE OR WORD. THIS DEFINITION IS USED TO ACCESS OR MODIFY THE BOOT-UP PARAMETERS AT THE ORIGIN AREA.

,  N --- L0
STORE N IN THE NEXT AVAILABLE DICTIONARY MEMORY CELL, ADVANCING THE DICTIONARY POINTER (COMMA)

- N1 N2 --- DIFF L0
LEAVE THE DIFFERENCE OF N1-N2.

--> P, L0
CONTINUE INTERPRETATION WITH THE NEXT DISC SCREEN. (PRONOUNCED NEXT-SCREEN)

-DUP
N1 --- N1   (IF ZERO)
N1 --- N1 N1   (NON ZERO) L0
REPRODUCE N1 ONLY IF IT IS NON-ZERO. THIS IS USUALLY USED TO COPY A VALUE JUST BEFORE IF, TO ELIMINATE THE NEED FOR AN ELSE PART TO DROP IT.

-FIND --- PFA B TF   (FOUND)
--- FF   (NOT FOUND)
ACCEPTS THE NEXT WORD (DELIMINATED BY BLANKS) IN THE INPUT STREAM TO HERE, AND SEARCHES THE CONTEXT AND THEN CURRENT VOCABULARIES FOR A MATCHING ENTRY. IF FOUND, THE DICTIONARY ENTRY’S PARAMETER FIELD ADDRESS, ITS LENGTH BYTE, AND A BOOLEAN TRUE IS LEFT. OTHERWISE ONLY A BOOLEAN FALSE IS LEFT.

-TRAILING
ADDR  N1 --- ADDR  N2
ADJUSTS THE CHARACTER COUNT N1 OF A TEXT STRING’S BEGINNING ADDRESS TO SUPPRESS THE OUTPUT OF TRAILING BLANKS. I. E., THE CHARACTERS AT ADDR+N1 TO ADDR+N2 ARE BLANKS.
PRINT A NUMBER FROM A SIGNED 16 BIT TWO’S COMPLEMENT VALUE, CONVERTED ACCORDING TO THE NUMERIC BASE. A TRAILING BLANK FOLLOWS . PRONOUNCED "DOT".

"." USED IN THE FORM: "." CCCC" COMPILES AN IN-LINE STRING CCCC (DELIMITED BY THE TRAILING "), WITH AN EXECUTION PROCEDURE TO TRANSMIT THE TEXT TO THE SELECTED OUTPUT DEVICE. IF EXECUTED OUTSIDE A DEFINITION, ‘."" WILL IMMEDIATELY PRINT THE TEXT UNTIL THE FINAL ‘"".

PRINT ON THE TERMINAL DEVICE A LINE OF TEXT FROM THE DISC BY ITS LINE AND SCREEN NUMBER. TRAILING BLANKS ARE SUPPRESSED.

PRINT THE NUMBER N1 RIGHT ALIGNED IN A FIELD WHOSE WIDTH IS N2. NO FOLLOWING BLANK IS PRINTED.

LEAVE THE SIGNED QUOTIENT OF N1/N2.

LEAVE THE REMAINDER AND SIGNED QUOTIENT OF N1/N2. THE REMAINDER HAS THE SIGN OF THE DIVIDEND.

THESE SMALL NUMBERS ARE USED SO OFTEN THAT IT IS ATTRACTIVE TO DEFINE THEM BY NAME IN THE DICTIONARY AS CONSTANTS.

LEAVE A TRUE FLAG IF THE NUMBER IS LESS THAN ZERO (NEGATIVE), OTHERWISE LEAVE A FALSE FLAG.

LEAVE A TRUE FLAG IF THE NUMBER IS EQUAL TO ZERO, OTHERWISE LEAVE A FALSE FLAG.

THE RUN-TIME PROCEDURE TO CONDITIONALLY BRANCH. IF F IS FALSE (ZERO), THE FOLLOWING IN-LINE PARAMETER IS ADDED TO THE INTERPRETIVE POINTER TO BRANCH AHEAD OR BACK. COMPILED BY IF, UNTIL, AND WHILE.

INCREMENT N1 BY 1

LEAVE N1 INCREMENTED BY 2.
: P, E, L0

USED IN THE FORM CALLED A COLON DEFINITION:

: CCCC . . . ;

CREATES A DICTIONARY ENTRY DEFINING CCCC AS EQUIVALENT TO THE FOLLOWING
SEQUENCE OF FORTH WORD DEFINITIONS '...' UNTIL THE NEXT ';' OR '; CODE'. THE
COMPILING PROCESS IS DONE BY THE TEXT INTERPRETER AS LONG AS STATE IS NON-
ZERO. OTHER DETAILS ARE THAT THE CONTEXT VOCABULARY IS SET TO THE CURRENT
VOCABULARY AND THAT WORDS WITH THE PRECEDENCE BIT SET (P) ARE EXECUTED
RATHER THAN BEING COMPILED.

; P, C, L0

TERMINATE A COLON-DEFINITION AND STOP FURTHER COMPILATION. COMPILES THE
RUN-TIME '; S'.

; CODE P, C, L0

USED IN THE FORM:

: CCCC . . . ;CODE

ASSEMBLY MNEMONICS

STOP COMPILATION AND TERMINATE A NEW REFINING WORD CCCC BY COMPILING
(;CODE). SET THE CONTEXT VOCABULARY TO ASSEMBLER, ASSEMBLING TO MACHINE
CODE THE FOLLOWING MNEMONICS. WHEN CCCC LATER EXECUTES IN THE FORM:

CCC NNNN

THE WORD NNNN WILL BE CREATED WITH ITS EXECUTION PROCEDURE GIVEN BY THE
MACHINE CODE FOLLOWING CCCC. THAT IS, WHEN NNNN IS EXECUTED, IT DOES SO BY
JUMPING TO THE CODE AFTER NNNN, AN EXISTING DEFINING WORD MUST EXIST IN
CCC PRIOR TO ‘;CODE’.

; S P, L0

STOP INTERPRETATION OF A SCREEN. ‘;S’ IS ALSO THE RUN-TIME WORD COMPILED AT
THE END OF A COLON-DEFINITION WHICH RETURNS EXECUTION TO THE CALLING
PROCEDURE.

< L0

LEAVE A TRUE FLAG IF N1 IS LESS THAN N2; OTHERWISE LEAVE A FALSE FLAG.

<# L0

SETUP FOR PICTURED NUMERIC OUTPUT FORMATING USING THE WORDS:

<# # #S SIGN #>

THE CONVERSION IS DONE ON A DOUBLE NUMBER PRODUCING TEXT AT PAD.

<BUILDS C, L0

USED WITHIN A COLON-DEFINITION:

: CCCC <BUILDS . . .

DOES> . . . ;

EACH TIME CCCC IS EXECUTED, <BUILDS DEFINES A NEW WORD WITH A HIGH LEVEL
EXECUTION PROCEDURE. EXECUTING CCCC IN THE FORM:

CCC NNNN

USES ‘<BUILDS’ TO CREATE A DICTIONARY ENTRY FOR NNNN WITH A CALL TO THE
‘DOES>’ PART FOR NNNN. WHEN NNNN IS LATER EXECUTED, IT HAS THE ADDRESS OF
ITS PARAMETER AREA ON THE STACK AND EXECUTES THE WORDS AFTER DOES> IN
CCCC. ‘<BLUILDS’ AND ‘DOES>‘ ALLOW RUN-TIME PROCEEDURES TO BE WRITTEN IN
HIGH LEVEL RATHER THAN ASSEMBLER CODE (AS REQUIRED BY ‘;CODE’).

= N1 N2 --- F L0
LEAVE A TRUE FLAG IF N1=N2, OTHERWISE LEAVE A FALSE FLAG.

> N1 N2 --- F L0
LEAVE A TRUE FLAG IF N1 IS GREATER THAN N2; OTHERWISE LEAVE A FALSE FLAG.

>R N --- C, L0
REMOVE A NUMBER FROM THE COMPUTATION STACK AND PLACE AS THE MOST
ACCESSABLE ON THE RETURN STACK. USE SHOULD BE BALANCED WITH R> IN THE SAME
DEFINITION.

? ADDR --- L0
PRINT THE VALUE CONTAINED AT THE ADDRESS IN FREE FORMAT ACCORDING TO THE
CURRENT BASE.

?COMP
ISSUE AN ERROR MESSAGE IF NOT COMPILING.

?CSP
ISSUE AN ERROR MESSAGE IF STACK POSITION DIFFERS FROM VALUE SAVED IN CSP.

?ERROR F N ---
ISSUE AN ERROR MESSAGE NUMBER N, IF THE BOOLEAN FLAG IS TRUE.

?EXEC
ISSUE AN ERROR MESSAGE IF NOT EXECUTING.

?LOADING
ISSUE AN ERROR MESSAGE IF NOT LOADING.

?PAIRS N1 N2 ---
ISSUE AN ERROR MESSAGE IF N1 DOES NOT EQUAL N2. THE MESSAGE INDICATES THAT
COMPiled CONDITIONALS DO NOT MATCH.

?STACK
ISSUE AN ERROR MESSAGE IF THE STACK IS OUT OF BOUNDS.

?TERMINAL --- F
PERFORM A TEST OF THE TERMINAL KEYBOARD FOR ACTUATION OF ANY KEY
EXCEPTING THE ‘CR’ KEY. A TRUE FLAG INDICATES ACTUATION.
@ ADDR --- N L0
LEAVE THE 16 BIT CONTENTS OF ADDRESS.

ABORT L0
CLEAR THE STACKS AND ENTER THE EXECUTION STATE. RETURN CONTROL TO THE OPERATORS TERMINAL, PRINTING SIGN ON MESSAGE.

ABS N --- L1 L0
LEAVE THE ABSOLUTE VALUE OF N AS U.

AGAIN ADDR N --- (COMPILED) P, C2, L0
USED IN A COLON-DEFINITION IN THE FORM:
BEGIN . . . AGAIN
AT RUN-TIME, AGAIN FORCES EXECUTION TO RETURN TO CORRESPONDING BEGIN. THERE IS NO EFFECT ON THE STACK. EXECUTION CANNOT LEAVE THIS LOOP (UNLESS R> DROP IS EXECUTED ONE LEVEL BELOW). AT COMPILE TIME, AGAIN COMPILES BRANCH WITH AN OFFSET FROM HERE TO ADDR. N IS USED FOR COMPILE TIME ERROR CHECKING.

ALLOC N --- L0
ADD THE SIGNED NUMBER TO THE DICTIONARY POINTER DP. MAY BE USED TO RESERVE DICTIONARY SPACE OR RE-ORIGIN MEMORY. N IS A BYTE VALUE.

AND N1 N2 --- N3 L0
LEAVE THE BITWISE LOGICAL AND OF N1 AND N2 AS N3.

B/BUF --- N
THIS CONSTANT LEAVES THE NUMBER OF BYTES PER DISC BUFFER, THE BYTE COUNT READ FROM DISC BY BLOCK.

B/SCR --- N
THIS CONSTANT LEAVES THE NUMBER OF BLOCKS PER EDITING SCREEN. BY CONVENTION AN EDITING SCREEN IS ORGANIZED AS 1024 BYTES ORGANIZED AS 16 LINES OF 64 CHARACTERS EACH.

BACK ADDR ---
CALCULATE THE BACKWARD BRANCH OFFSET FROM HERE TO ADDR AND COMPILE INTO THE NEXT AVAILABLE DICTIONARY MEMORY ADDRESS.

BASE --- ADDR U, L0
A USER VARIABLE CONTAINING THE CURRENT NUMBER BASE USED FOR INPUT AND OUTPUT CONVERSION.

BEGIN --- ADDR N (COMPILING) P,L0
OCCURS IN A COLON-DEFINITION IN THE FORM:
BEGIN . . . UNTIL
BEGIN . . . AGAIN
BEGIN . . . WHILE . . . REPEAT
AT RUN-TIME, 'BEGIN' MARKS THE START OF A SEQUENCE THAT MAY BE REPETITIVELY EXECUTED. IT SERVES AS A RETURN POINT FROM THE CORRESPONDING 'UNTIL', 'AGAIN' OR 'REPEAT'. WHEN EXECUTING 'UNTIL', A RETURN TO 'BEGIN' WILL OCCUR IF THE TOP OF THE STACK IS FALSE, FOR 'AGAIN' AND 'REPEAT' A RETURN TO 'BEGIN' ALWAYS OCCURS. AT COMPILE TIME 'BEGIN' LEAVES ITS RETURN ADDRESS AND N FOR COMPILER ERROR CHECKING.

BL --- C
A CONSTANT THAT LEAVES THE ASCII VALUE FOR "BLANK".

BLANKS ADDR COUNT ---
FILL AN AREA OF MEMORY BEGINING AT ADDR WITH BLANKS.

BLK --- ADDR U, L0
A USER VARIABLE CONTAINING THE BLOCK NUMBER BEING INTERPRETED. IF ZERO, INPUT IS BEING TAKEN FROM THE TERMINAL INPUT BUFFER.

BLOCK N --- ADDR L0
LEAVE THE MEMORY ADDRESS OF THE BLOCK BUFFER CONTAINING BLOCK N. IF THE BLOCK IS NOT ALREADY IN MEMORY, IT IS TRANSFERRED FROM DISC TO WHICH EVER BUFFER WAS LEAST RECENTLY WRITTEN. IF THE BLOCK OCCUPYING THAT BUFFER HAS BEEN MARKED AS UPDATED, IT IS RE-WRITTEN TO DISC BEFORE BLOCK N IS READ INTO THE BUFFER. SEE ALSO BUFFER, R/W UPDATE FLUSH.

BRANCH C2, L0
THE RUN-TIME PROCEDURE TO UNCONDITIONALY BRANCH. AN IN-LINE OFFSET IS ADDED TO THE INTERPRETIVE POINTER IP TO BRANCH AHEAD OR BACK. BRANCH IS COMPILLED BY ELSE, AGAIN, REPEAT.

BUFFER N --- ADDR
OBTAIN THE NEXT MEMORY BUFFER, ASSIGNING IT TO BLOCK N. IF THE CONTENTS OF THE BUFFER IS MARKED AS UPDATED, IT IS WRITTEN TO THE DISC. THE BLOCK IS NOT READ FROM THE DISC. THE ADDRESS LEFT IS THE FIRST CELL WITHIN THE BUFFER FOR DATA STORAGE.

C! B ADDR ---
STORE 3 BITS AT ADDRESS.

C, B ---
STORE 8 BITS OF B INTO THE NEXT AVAILABLE DICTIONARY BYTE, ADVANCING THE DICTIONARY POINTER. MUST BE USED WITH CAUTION TO PREVENT COMPILATION OCCURRING ON AN ODD ADDRESS BOUNDARY.

C@ ADDR --- B
LEAVE THE 8 BIT CONTENTS OF MEMORY ADDRESS.
CFA PFA --- CFA
CONVERT THE PARAMETER FIELD ADDRESS OF A DEFINITION TO ITS CODE FIELD
ADDRESS.

CMOVE FROM TO COUNT ---
MOVE THE SPECIFIED QUANTITY OF BYTES BEGINNING AT ADDRESS FROM TO ADDRESS
TO. THE CONTENTS OF ADDRESS FROM IS MOVED FIRST PROCEEDING TOWARD HIGH
MEMORY.

COLD
THE COLD START PROCEDURE TO ADJUST THE DICTIONARY POINTER TO THE MINIMUM
STANDARD AND RESTART VIA ABORT. MAY BE CALLED FROM THE TERMINAL TO
REMOVE APPLICATION PROGRAMS AND RESTART.

COMPILE
WHEN THE WORD CONTAINING COMPILE EXECUTES, THE EXECUTION ADDRESS OF THE
WORD FOLLOWING COMPILE IS COPIED (COMPILED) INTO THE DICTIONARY. THIS
ALLOWS SPECIFIC COMPILATION SITUATIONS TO BE HANDLED IN ADDITION TO SIMPLY
COMPILING AN EXECUTION ADDRESS (WHICH THE INTERPRETER ALREADY DOES).

CONSTANT N ---
A DEFINING WORD USED IN THE FORM:
    N CONSTANT CCCC
TO CREATE A WORD CCCC, WITH ITS PARAMETER FIELD CONTAINING N. WHEN CCCC IS
LATER EXECUTED, IT WILL PUSH THE VALUE OF N TO THE STACK.

CONTEXT --- ADDR
A USER VARIABLE CONTAINING A POINTER TO THE VOCABULARY WITHIN WHICH
DICTIONARY SEARCHES WILL BEGIN FIRST.

COUNT ADDR1 --- ADDR2
LEAVE THE BYTE ADDRESS ADDR2 AND BYTE COUNT N OF A MESSAGE TEXT BEGINNING
AT ADDRESS ADDR1. IT IS PRESUMED THAT THE FIRST BYTE AT ADDR1 CONTAINS THE
TEXT BYTE COUNT AND THE ACTUAL TEXT STARTS WITH THE SECOND BYTE. TYPICALLY
COUNT IS FOLLOWED BY TYPE.

CR
TRANSMIT A CARRIAGE RETURN AND LINE FEED TO THE SELECTED OUTPUT DEVICE.

CREATE
A DEFINING WORD USE IN THE FORM:
    CREATE   CCCC
BY SUCH WORDS AS CODE AND CONSTANT TO CREATE A DICTIONARY HEADER FOR A
FORTH DEFINITION. THE CODE FIELD CONTAINS THE ADDRESS OF THE WORDS
PARAMETER FIELD. THE NEW WORD IS CREATED IN THE CURRENT VOCABULARY. ALSO
USED FOR IN-LINE ASSEMBLER CODE.
CSP --- ADDR
A USER VARIABLE TEMPORARILY STORING THE STACK POINTER POSITION, FOR
COMPILEDATION ERROR CHECKING.

D+ D1 D2 --- DSUM
LEAVE THE DOUBLE NUMBER SUM OF TWO DOUBLE NUMBERS.

D+- D1 N --- D2
APPLY THE SIGN OF N TO THE DOUBLE NUMBER D1, LEAVING IT AS D2.

D. D --- L1
PRINT A SIGNED DOUBLE NUMBER FROM A 32 BIT TWO'S COMPLEMENT VALUE. THE
HIGH ORDER 16 BITS ARE MOST ACCESSIBLE ON THE STACK. CONVERSION IS
PERFORMED ACCORDING TO THE CURRENT BASE. A BLANK Follows. PRONOUNCED
“D-DOT”.

D. R D N ---
PRINT A SIGNED DOUBLE NUMBER D RIGHT ALIGNED IN A FIELD N CHARACTERS WIDE.

DABS D --- UD
LEAVE THE ABSOLUTE VALUE UD OF A DOUBLE NUMBER.

DECIMAL L0
SET THE NUMERIC CONVERSION BASE FOR DECIMAL INPUT-OUTPUT.

DEFINITIONS L1
USED IN THE FORM:
CCCCCC DEFINITIONS
SET THE CURRENT VOCABULARY TO THE CONTEXT VOCABULARY. IN THE EXAMPLE,
EXECUTING VOCABULARY NAME CCCC MADE IT THE CONTEXT VOCABULARY AND
EXECUTING DEFINITIONS MADE BOTH SPECIFY VOCABULARY CCCC.

DIGIT C N1 --- N2 TF (OK)
C N1 --- FF (BAD)
CONVERTS THE ASCII CHARACTER C (USING BASE N1) TO ITS BINARY EQUIVALENT N2,
ACCOMPANIED BY A TRUE FLAG. IF THE CONVERSION IS INVALID LEAVES ONLY A FALSE
FLAG.

DLIST
LIST THE NAMES OF THE DICTIONARY ENTRIES IN THE CONTEXT VOCABULARY.

DLITERAL D --- D (EXECUTING)
D --- (COMPILING) P
IF COMPILING, COMPILE A STACK DOUBLE NUMBER INTO A LITERAL. LATER EXECUTION
OF THE DEFINITION CONTAINING THE LITERAL WILL PUSH IT TO THE STACK. IF
EXECUTING, THE NUMBER WILL REMAIN ON THE STACK.
DMINUS D1 --- D2
CONVERT D1 TO ITS DOUBLE NUMBER TWO'S COMPLEMENT.

DO N1 N2 --- (EXECUTE)
ADDR N --- (COMPILE) P, C2, L0
OCCURS IN A COLON DEFINITION IN THE FORM:
DO . . . LOOP
DO . . . +LOOP

DOES> --- ADDR L0
A WORD WHICH DEFINES THE RUN-TIME ACTION WITHIN A HIGH LEVEL DEFINING WORD. DOES> ALTERS THE CODE FIELD AND FIRST PARAMETER OF THE NEW WORD TO EXECUTE THE SEQUENCE OF COMPILED WORD ADDRESSES FOLLOWING DOES>. USED IN COMBINATION WITH <BUILDS. WHEN THE DOES> PART EXECUTES, IT BEGINS WITH THE ADDRESS OF THE FIRST PARAMETER OF THE NEW WORD ON THE STACK. THIS ALLOWS INTERPRETATION USING THIS AREA OR ITS CONTENTS. TYPICAL USES INCLUDE THE FORTH ASSEMBLER, MULTI-DIMENTIONSIONAL ARRAYS, AND COMPILER GENERATION.

DP --- ADDR U, L
A USER VARIABLE, THE DICTIONARY POINTER, WHICH CONTAINS THE ADDRESS OF THE NEXT FREE MEMORY ABOVE THE DICTIONARY. THE VALUE MAY BE READ BY HERE AND ALTERED BY ALLOT.

DPL --- ADDR U, L0
A USER VARIABLE CONTAINING THE NUMBER OF DIGITS TO THE RIGHT OF THE DECIMAL ON DOUBLE INTEGER INPUT. IT MAY ALSO BE USED TO HOLD OUTPUT COLUMN LOCATION OF A DECIMAL POINT, IN USER GENERATED FORMATING. THE DEFAULT VALUE ON SINGLE NUMBER INPUT IS -1.

DR0 SELECT DISC DRIVE BY PRESETTING OFFSET. THE CONTENTS OF OFFSET IS ADDED TO THE BLOCK NUMBER IN BLOCK TO ALLOW FOR THIS SELECTION. OFFSET IS SUPRESSED FOR ERROR TEXT SO THAT IT MAY ALWAYS ORIGINATE FROM DRIVE 0.
DROP          N ---                       L0
DROP THE NUMBER FROM THE STACK.

DUMP          ADDR N ---                L0
PRINT THE CONTENTS OF N MEMORY LOCATIONS BEGINNING AT ADDR. DUE TO
OUTPUT FORMATING CURRENT BASE MUST BE HEX. ANY KEY EXCEPT CR TO PAUSE, ESC
TO EXIT.

DUP           N --- N N                L0
DUPLICATE THE VALUE ON THE STACK.

ELSE          ADDR1 N1 --- ADDR2 N2
(COMPILED)
OCCURS WITHIN A COLON DEFINITION IN THE FORM:
IF . . .    ELSE   . . .    ENDIF
AT RUN-TIME, ELSE EXECUTES AFTER THE TRUE PART FOLLOWING IF. ELSE FORCES
EXECUTION TO SKIP OVER THE FOLLOWING FALSE PART AND RESUME EXECUTION
AFTER THE ENDIF. IT HAS NO STACK EFFECT. AT COMPILE-TIME ELSE EMPLACES
BRANCH RESERVING A BRANCH OFFSET, LEAVES THE ADDRESS ADDR2 AND N2 FOR
ERROR TESTING. ELSE ALSO RESOLVES THE PENDING FOWARD BRANCH FROM IF BY
CALCULATING THE OFFSET FROM ADDR1 TO HERE AND STORING AT ADDR1.

EMIT          C ---                      L0
TRANSMIT ASCII CHARACTER C TO THE SELECTED OUTPUT DEVICE. OUT IS
INCREMENTED FOR EACH CHARACTER OUTPUT.

EMPTY-BUFFERS                            L0
MARK ALL BLOCK-BUFFERS AS EMPTY, NOT NECESSARILY AFFECTING THE CONTENTS.
UPDATED BLOCKS ARE NOT WRITTEN TO THE DISC. THIS IS ALSO AN INITIALIZATION
PROCEDURE BEFORE FIRST USE OF THE DISC.

ENCLOSE      ADDR1  C ---
ADDR1  N1  N2  N3
THE TEXT SCANNING PRIMITIVE USED BY WORD. FROM THE TEXT ADDRESS ADDR1
AND AN ASCII DELIMITING CHARACTER C, IS DETERMINED THE BYTE OFFSET TO THE
FIRST NON-DELIMITER CHARACTER N1, THE OFFSET TO THE FIRST DELIMITER AFTER THE
TEXT N2, AND THE OFFSET TO THE FIRST CHARACTER NOT INCLUDED. THIS PROCEDURE
WILL NOT PROCESS PAST AN ASCII "NULL", TREATING IT AS AN UNCONDITIONAL
DELIMITER.

END                                        P, C2, L0
THIS IS AN "ALIAS" OR DUPLICATE DEFINITION FOR UNTIL.

ENDIF         ADDR  N --- (COMPILE)       P, C0, L0
OCCURS IN A COLON-DEFINITION IN THE FORM:
IF . . .    ENDIF
IF . . . ELSE . . . ENDIF
AT RUN-TIME, ENDFIF SERVES ONLY AS THE DESTINATION OF A FORWARD BRANCH FROM IF OR ELSE. IT MARKS THE CONCLUSION OF THE CONDITIONAL STRUCTURE. THEN IS ANOTHER NAME FOR ENDFIF. BOTH NAMES ARE SUPPORTED IN CORTEX FIG-FORTH. SEE ALSO IF AND ELSE. AT COMPILE-TIME, ENDFIF COMPUTES THE FORWARD BRANCH OFFSET FROM ADDR TO HERE AND STORES IT AT ADDR. N IS USED FOR ERROR TESTS.

ERASE ADDR N --- CLEAR A REGION OF MEMORY TO ZERO FROM ADDR OVER N ADDRESSES.

ERROR LINE --- IN BLK EXECUTE ERROR NOTIFICATION AND RESTART OF SYSTEM. WARNING IS FIRST EXAMINED. IF 1, THE TEXT OF LINE N, RELATIVE TO SCREEN 4 OF DRIVE 0 IS PRINTED. THIS LINE NUMBER MAY BE POSITIVE OR NEGATIVE, AND BEYOND JUST SCREEN 4. IF WARNING=0, N IS JUST PRINTED AS A MESSAGE NUMBER (NON-DISC INSTALLATION). IF WARNING IS -1, THE DEFINITION (ABORT) IS EXECUTED, WHICH EXECUTES THE SYSTEM ABORT. THE USER MAY CAUTIOUSLY MODIFY THIS EXECUTION BY ALTERING (ABORT). CORTEX FIG-FORTH SAVES THE CONTENTS OF IN AND BLK TO ASSIST IN DETERMINING THE LOCATION OF THE ERROR. FINAL ACTION IS EXECUTION OF QUIT.

EXECUTE ADDR --- EXECUTE THE DEFINITION WHOSE CODE FIELD ADDRESS IS ON THE STACK. THE CODE FIELD ADDRESS IS ALSO CALLED THE COMPILATION ADDRESS.

EXPECT ADDR COUNT --- L0 TRANSFER CHARACTERS FROM THE TERMINAL TO ADDRESS, UNTIL A "RETURN" OR THE COUNT OF CHARACTERS HAVE BEEN RECEIVED. ONE OR MORE NULLS ARE ADDED TO THE END OF THE TEXT.

FENCE --- ADDR U A USER VARIABLE CONTAINING AN ADDRESS BELOW WHICH FORGETT ING IS TRAPPED. TO FORGET BELOW THIS POINT THE USER MUST ALTER THE CONTENTS OF FENCE.

FILL ADDR QUAN B --- FILL MEMORY AT THE ADDRESS WITH THE SPECIFIED QUANTITY OF BYTES B.

FIRST --- N A CONSTANT THAT LEAVES THE ADDRESS OF THE FIRST (LOWEST) BLOCK BUFFER.

FLD --- ADDR U A USER VARIABLE FOR CONTROL OF NUMBER OUTPUT FIELD WIDTH. PRESENTLY UN-USED IN CORTEX FIG-FORTH.

FORGET E, L0 EXECUTING IN THE FORM:
FORGET CCCC
DELETES DEFINITION NAMED CCCC FROM THE DICTIONARY WITH ALL ENTRIES PHYSICALLY FOLLOWING IT. IN CORTEX FIG-FORTH AN ERROR MESSAGE WILL OCCUR IF THE CURRENT AND CONTEXT VOCABULARIES ARE NOT CURRENTLY THE SAME.
THE NAME OF THE PRIMARY VOCABULARY. EXECUTION MAKES FORTH THE CONTEXT VOCABULARY. UNTIL ADDITIONAL USER VOCABULARIES ARE DEFINED, NEW USER DEFINITIONS BECOME A PART OF FORTH. FORTH IS IMMEDIATE, SO IT WILL EXECUTE DURING THE CREATION OF A COLON-DEFINITION, TO SELECT THIS VOCABULARY AT COMPILE TIME.

LEAVE THE ADDRESS OF THE NEXT AVAILABLE DICTIONARY LOCATION.

SET THE NUMERIC CONVERSION BASE TO SIXTEEN (HEXADECIMAL).

A USER VARIABLE THAT HOLDS THE ADDRESS OF THE LATEST CHARACTER OF TEXT DURING NUMERIC OUTPUT CONVERSION.

USED BETWEEN ‘<#’ AND ‘#>’ TO INSERT AN ASCII CHARACTER INTO A PICTURED NUMERIC OUTPUT STRING, E. G., 2E HOLD WILL PLACE A DECIMAL POINT.

USED WITHIN A DO-LOOP TO COPY THE LOOP INDEX TO THE STACK; SEE R.

PRINT A DEFINITION’S NAME FROM ITS NAME FIELD ADDRESS.

OCCURS IN A COLON-DEFINITION IN THE FORM:

IF (TP) . . . ENDIF
IF (TP) . . . ELSE (FP) . . . ENDIF

AT RUN-TIME, IF SELECTS EXECUTION BASED ON A BOOLEAN FLAG. IF F IS TRUE (NON-ZERO), EXECUTION CONTINUES AHEAD THRU THE TRUE PART. IF F IS FALSE (ZERO), EXECUTION SKIPS TO JUST AFTER ELSE TO EXECUTE THE FALSE PART. AFTER EITHER PART, EXECUTION RESUMES AFTER ENDIF. ELSE AND ITS FALSE PART ARE OPTIONAL; IF MISSING FALSE EXECUTION SKIPS TO JUST AFTER ENDIF. AT COMPILE-TIME IF COMPILES 0BRANCH AND RESERVES SPACE FOR AN OFFSET AT ADDR. ADDR AND N ARE USED LATER FOR RESOLUTION OF THE OFFSET AND ERROR TESTING.
IMMEDIATE
MARK THE MOST RECENTLY MADE DEFINITION SO THAT WHEN ENCOUNTERED AT
COMPILE TIME, IT WILL BE EXECUTED RATHER THAN BEING COMPILED. I. E., THE
PRECEDENCE BIT IN ITS HEADER IS SET. THIS METHOD ALLOWS DEFINITIONS TO
HANDLE UNUSUAL CompILING SITUATIONS, RATHER THAN BUILD THEM IN TO THE
FUNDAMENTAL COMPILER. THE USER MAY FORCE COMPIlATION OF AN IMMEDIATE
DEFINITION BY PRECEEDING IT WITH [COMPILE].

IN --- ADDR L0
A USER VARIABLE CONTAINING THE BYTE OFFSET WITHIN THE CURRENT INPUT TEXT
BUFFER (TERMINAL OR DISC) FROM WHICH THE NEXT TEXT WILL BE ACCEPTED. WORD
USES AND MOVES THE VALUE OF IN.

INDEX FROM TO ---
PRINT THE FIRST LINE OF EACH SCREEN OVER THE RANGE FROM, TO. THIS IS USED TO
VIEW THE COMMENT LINES OF AN AREA OF TEXT ON DISC SCREENS.

INTERPRET
THE OUTER TEXT INTERPRETER WHICH SEQUENTIALLY EXECUTES OR COMPIlES TEXT
FROM THE INPUT STREAM (TERMINAL OR DISC) DEPENDING ON STATE. IF THE WORD
NAME CANNOT BE FOUND AFTER A SEARCH OF CONTEXT AND THEN CURRENT IT IS
CONVERTED TO A NUMBER ACCORDING TO THE CURRENT BASE. THAT ALSO FAILING,
AN ERROR MESSAGE ECHOING THE NAME WITH A "?" WILL BE GIVEN. TEXT INPUT WILL
BE TAKEN ACCORDING TO THE CONVENTION FOR WORD. IF A DECIMAL POINT IS
FOUND AS PART OF A NUMBER, A DOUBLE NUMBER VALUE WILL BE LEFT. THE
DECIMAL POINT HAS NO OTHER PURPOSE THAN TO FORCE THIS ACTION. SEE NUMBER.

KEY --- C L0
LEAVE THE ASCII VALUE OF THE NEXT TERMINAL KEY STRUCK.

LATEST --- ADDR
LEAVE THE NAME FIELD ADDRESS OF THE TOP MOST WORD IN THE CURRENT
VOCABULARY.

LEAVE C, L0
FORCE TERMINATION OF A DO-LOOP AT THE NEXT OPPORTUNITY BY SETTING THE LOOP
LIMIT EQUAL TO THE CURRENT VALUE OF THE INDEX. THE INDEX ITSELF REMAINS
UNCHANGED, AND EXECUTION PROCEEDS NORMALLY UNTIL LOOP OR +LOOP IS
ENCOUNTERED.

LFA --- LFA
CONVERT THE PARAMETER FIELD ADDRESS OF A DICTIONARY DEFINITION TO ITS LINK
FIELD ADDRESS.

LIMIT --- N
A CONSTANT LEAVING THE ADDRESS JUST ABOVE THE HIGHEST MEMORY AVAILABLE
FOR A DISC BUFFER. USUALLY THIS IS THE HIGHEST SYSTEM MEMORY.
LIST  N ---                      L0
DISPLAY THE ASCII TEXT OF SCREEN N ON THE SELECTED OUTPUT DEVICE. SCR
CONTAINS THE SCREEN NUMBER DURING AND AFTER THIS PROCESS.

LIT           --- N                      C2, L0
WITHIN A COLON-DEFINITION, LIT IS AUTOMATICALLY COMPILED BEFORE EACH 16 BIT
LITERAL NUMBER ENCOUNTERED IN THE INPUT TEXT. LATER EXECUTION OF LIT
CAUSES THE CONTENTS OF THE NEXT DICTIONARY ADDRESS TO BE PUSHED TO THE
STACK.

LITERAL       N --- (COMPILING)         P, C2, L0
IF COMPILING, THEN COMPILE THE STACK VALUE N AS A 16 BIT LITERAL. THIS
DEFINITION IS IMMEDIATE SO THAT IT WILL EXECUTE DURING A COLON-DEFINITION.
THE INTENDED USE IS:

: XXX   [CALCULATE] LITERAL;
COMPILATION IS SUSPENDED FOR THE COMPILE TIME CALCULATION OF A VALUE.
COMPILATION IS RESUMED AND LITERAL COMPiles THIS VALUE.

LOAD          N ---                     L0
BEGIN INTERPRETATION OF SCREEN N. LOADING WILL TERMINATE AT THE END OF THE
SCREEN OR AT ';' S'. SEE ';' S' AND '-->'.

LOOP           ADDR  N --- (COMPILING)  P,C2,L0
OCCURS IN A COLON-DEFINITION IN THE FORM:

DO . . .   LOOP
AT RUN-TIME, LOOP SELECTIVELY CONTROLS BRANCHING BACK TO THE
CORRESPONDING DO BASED ON THE LOOP INDEX AND LIMIT. THE LOOP INDEX IS
INCREMENTED BY ONE AND COMPARED TO THE LIMIT. THE BRANCH BACK TO DO
OCCURS UNTIL THE INDEX EQUALS OR EXCEEDS THE LIMIT; AT THAT TIME, THE
PARAMETERS ARE DISCARDED AND EXECUTION CONTINUES AHEAD. AT COMPILE-TIME,
LOOP COMPILES (LOOP) AND USES ADDR TO CALCULATE AN OFFSET TO DO. N IS USED
FOR ERROR TESTING.

M*             N1  N2 --- D
A MIXED MAGNITUDE MATH OPERATION WHICH LEAVES THE DOUBLE NUMBER SIGNED
PRODUCT OF TWO SIGNED NUMBERS.

M/             D  N1 --- N2  N3
A MIXED MAGNITUDE MATH OPERATOR WHICH LEAVES THE SIGNED REMAINDER N2
AND SIGNED QUOTIENT N3, FROM A DOUBLE NUMBER DIVIDEND AND DIVISOR N1. THE
REMAINDER TAKES ITS SIGN FROM THE DIVIDEND.

M/MOD         UD1  U2 --- U3  UD4
AN UNSIGNED MIXED MAGNITUDE MATH OPERATION WHICH LEAVES A DOUBLE
QUOTIENT UD4 AND REMAINDER U3, FROM A DOUBLE DIVIDEND UD1 AND SINGLE
DIVISOR U2.

MAX            N1  N2 --- MAX          L0
LEAVE THE GREATER OF TWO NUMBERS.
MESSAGE N ---
PRINT ON THE SELECTED OUTPUT DEVICE THE TEXT OF LINE N RELATIVE TO SCREEN 4
OF DRIVE 0. N MAY BE POSITIVE OR NEGATIVE. MESSAGE MAY BE USED TO PRINT
INCIDENTAL TEXT SUCH AS REPORT HEADERS. IF WARNING IS ZERO, THE MESSAGE WILL
SIMPLY BE PRINTED AS A NUMBER. (DISC UN-AVAILABLE).

MIN N1 N2 --- MIN L0
LEAVE THE SMALLER OF TWO NUMBERS.

MINUS N1 --- N2 L0
LEAVE THE TWO'S COMPLEMENT OF A NUMBER.

MOD N1 N2 --- MOD L0
LEAVE THE REMAINDER OF N1/N2, WITH THE SAME SIGN AS N1.

MOVE ADDR1 ADDR2 N ---
MOVE THE CONTENTS OF N MEMORY CELLS (16 BIT CONTENTS) BEGINNING AT ADDR1
INTO N CELLS BEGINNING AT ADDR 2. THE CONTENTS OF ADDR1 IS MOVED FIRST.

NFA PFA --- NFA
CONVERT THE PARAMETER FIELD ADDRESS OF A DEFINITION TO ITS NAME FIELD
ADDRESS.

NUMBER ADDR --- D
CONVERT A CHARACTER STRING LEFT AT ADDR WITH A PRECEEDING COUNT, TO A
SIGNED DOUBLE NUMBER, USING THE CURRENT NUMERIC BASE. IF A DECIMAL POINT
IS ENCOUNTERED IN THE TEXT, ITS POSITION WILL BE GIVEN IN DPL, BUT NO OTHER
EFFECT OCCURS. IF NUMERIC CONVERSION IS NOT POSSIBLE, AN ERROR MESSAGE WILL
BE GIVEN.

OFFSET --- ADDR U
A USER VARIABLE WHICH MAY CONTAIN A BLOCK OFFSET TO DISC DRIVES. THE
CONTENTS OF OFFSET IS ADDED TO THE STACK NUMBER BY BLOCK. MESSAGES BY
MESSAGE ARE INDEPENDANT OF OFFSET. SEE ‘BLOCK’, ‘DR0’, ‘DR1’, ‘MESSAGE’.

OR N1 N2 --- OR L0
LEAVE THE BIT-WISE LOGICAL OR OF TWO 16 BIT VALUES.

OUT --- ADDR U
A USER VARIABLE THAT CONTAINS A VALUE INCREMENTED BY EMIT. THE USER MAY
ALTER AND EXAMINE OUT TO CONTROL DISPLAY FORMATING.

OVER N1 N2 --- N1 N2 N1 L0
COPY THE SECOND STACK VALUE, PLACING IT AS THE NEW TOP.

PAD --- ADDR L0
LEAVE THE ADDRESS OF THE TEXT OUTPUT BUFFER, WHICH IS A FIXED OFFSET ABOVE
HERE.
PFA
NFA --- PFA
CONVERT THE NAME FIELD ADDRESS OF A COMPILED DEFINITION TO ITS PARAMETER
FIELD ADDRESS.

PREV
--- ADDR
A VARIABLE CONTAINING THE ADDRESS OF THE DISC BUFFER MOST RECENTLY
REFERENCED. THE UPDATE COMMAND MARKS THIS BUFFER TO BE LATER WRITTEN TO
DISC.

QUERY
INPUT 80 CHARACTERS OF TEXT (OR UNTIL A "RETURN") FROM THE OPERATOR'S
TERMINAL. TEXT IS POSITIONED AT THE ADDRESS CONTAINED IN 'TIB' WITH 'IN' SET TO
ZERO.

QUIT
L1
CLEAR THE RETURN STACK, STOP COMPILATION, AND RETURN CONTROL TO THE
OPERATOR'S TERMINAL. NO MESSAGE IS GIVEN.

R
--- N
COPY THE TOP OF THE RETURN STACK TO THE COMPUTATION STACK.

R#
--- ADDR U
A USER VARIABLE WHICH MAY CONTAIN THE LOCATION OF AN EDITING CURSOR, OR
OTHER FILE RELATED FUNCTIONS. (PART OF THE FORTH EDITOR)

R/W
ADDR BLK F ---
THE STANDARD CORTEX FIG-FORTH DISC READ-WRITE LINKAGE. ADDR SPECIFIES THE
SOURCE OR DESTINATION BLOCK BUFFER, BLK IS THE SEQUENTIAL NUMBER OF THE
REFERENCED BLOCK; AND F IS A FLAG FOR F=0 WRITE AND F=1 READ. R/W
DETERMINES THE LOCATION ON MASS STORAGE, PERFORMS THE READ-WRITE AND
ANY ERROR CHECKING.

R>
--- N L0
REMOVE THE TOP VALUE FROM THE RETURN STACK AND LEAVE IT ON THE
COMPUTATION STACK. SEE ‘->R’ AND ‘R’.

R0
--- ADDR U
A USER VARIABLE CONTAINING THE INITIAL LOCATION OF THE RETURN STACK.
PRONOUNCED "R-ZERO". SEE ‘RP!’

REPEAT
ADDR N --- (COMPILING) P,C2
USED WITHIN A COLON DEFINITION IN THE FORM:
BEGIN . . . WHILE . . . REPEAT
AT RUN-TIME, REPEAT FORCES AN UNCONDITIONAL BRANCH BACK TO JUST AFTER THE
CORRESPONDING BEGIN. AT COMPIL-TIME, REPEAT COMPILES BRANCH AND THE
OFFSET FROM HERE TO ADDR. N IS USED FOR ERROR TESTING.
ROT N1 N2 N3 --- N2 N3 N1 L0
ROTATE THE TOP THREE VALUES ON THE STACK, BRINGING THE THIRD TO THE TOP.

RP!
INITIALIZE THE RETURN STACK POINTER FROM USER VARIABLE R0.

S->D N --- D
SIGN EXTEND A SINGLE NUMBER TO FORM A DOUBLE NUMBER.

S0 --- ADDR U
A USER VARIABLE THAT CONTAINS THE INITIAL VALUE FOR THE STACK POINTER.
PRONOUNCED “S-ZERO”. SEE ‘SP!’

SCR --- ADDR U
A USER VARIABLE CONTAINING THE SCREEN NUMBER MOST RECENTLY REFERENCED BY LIST.

SIGN N D --- D L0
STORES AN ASCII “-” SIGN JUST BEFORE A CONVERTED NUMERIC OUTPUT STRING IN THE TEXT OUTPUT BUFFER WHEN N IS NEGATIVE. N IS DISCARDED, BUT DOUBLE NUMBER D IS MAINTAINED. MUST BE USED BETWEEN ‘<#’ AND ‘#>’.

SMUDGE
USED DURING WORD DEFINITION TO TOGGLE THE "SMUDGE BIT" IN A DEFINITION’S NAME FIELD. THIS PREVENTS AN UN-COMPLETED DEFINITION FROM BEING FOUND DURING DICTIONARY SEARCHES, UNTIL COMPILING IS COMPLETED WITHOUT ERROR.

SP!
INITIALIZE THE STACK POINTER FROM S0. WILL ALMOST CERTAINLY CAUSE A SYSTEM CRASH IF CALLED FROM THE KEYBOARD.

SP@ --- ADDR
RETURN THE ADDRESS OF THE STACK POSITION TO THE TOP OF THE STACK, AS IT WAS BEFORE SP@ WAS EXECUTED.

SPACE L0
TRANSMIT AN ASCII BLANK TO THE OUTPUT DEVICE.

SPACES N --- L0
TRANSMIT N ASCII BLANKS TO THE OUTPUT DEVICE.

STATE --- ADDR L0, U

SWAP N1 N2 --- N2 N1 L0
EXCHANGE THE TOP TWO VALUES ON THE STACK.
TASK
A NO-OPERATION WORD WHICH CAN MARK THE BOUNDARY BETWEEN APPLICATIONS.
BY FORGETTING TASK AND RE-COMPILING, AN APPLICATION CAN BE DISCARDED IN ITS
ENTIRETY.

THEN
P, C0, L0
AN ALIAS FOR ENDF.

TIB --- ADDR  U
A USER VARIABLE CONTAINING THE ADDRESS OF THE TERMINAL INPUT BUFFER.

TOGGLE ADDR B ---
COMPLEMENT THE CONTENTS OF ADDR BY THE BIT PATTERN B.

TRAVERSE ADDR1 N --- ADDR2
MOVE ACROSS THE NAME FIELD OF A CORTEX FIG-FORTH VARIABLE LENGTH NAME
FIELD. ADDR1 IS THE ADDRESS OF EITHER THE LENGTH BYTE OR THE LAST LETTER. IF
N=1, THE MOTION IS TOWARD HI MEMORY, IF N=-1, THE MOTION IS TOWARD LOW
MEMORY. THE ADDR2 RESULTING IS THE ADDRESS OF THE OTHER END OF THE NAME.

TRIAD SCR ---
DISPLAY ON THE SELECTED OUTPUT DEVICE THE THREE SCREENS WHICH INCLUDE THAT
NUMBERED SCR, BEGINING WITH A SCREEN EVENLY DIVISIBLE BY THREE. OUTPUT IS
SUITE FOR SOURCE TEXT RECORDS, AND INCLUDES A REFERENCE LINE AT THE
BOTTOM TAKEN FROM LINE 15 OF SCREEN 4.

TYPE ADDR COUNT --- L0
TRANSMIT COUNT CHARACTERS FROM ADDR TO THE SELECTED OUTPUT DEVICE.

U* U1 U2 --- UD
LEAVE THE UNSIGNED DOUBLE NUMBER PRODUCT OF TWO UNSIGNED NUMBERS.

U/ UD U1 --- U2 U3
LEAVE THE UNSIGNED REMAINDER U2 AND UNSIGNED QUOTIENT U3 FROM THE
UNSIGNED DOUBLE DIVIDEND UD AND UNSIGNED DIVISOR U1.

UNTIL F --- (RUN-TIME)
ADD N --- (COMPILE) P,C2,L0
OCCURS WITHIN A COLON-DEFINITION IN THE FORM:
BEGIN . . . UNTIL
AT RUN-TIME, UNTIL CONTROLS THE CONDITIONAL BRANCH BACK TO THE
CORRESPONDING BEGIN. IF F IS FALSE, EXECUTION RETURNS TO JUST AFTER BEGIN; IF
TRUE, EXECUTION CONTINUES AHEAD. AT COMPILE-TIME, UNTIL COMPILES (OBRANCH)
AND AN OFFSET FROM HERE TO ADDR. N IS USED FOR ERROR TESTS.

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UPDATE L0
MARKS THE MOST RECENTLY REFERENCED BLOCK (POINTED TO BY PREV) AS ALTERED.
THE BLOCK WILL SUBSEQUENTLY BE TRANSFERRED AUTOMATICALLY TO DISC SHOULD
ITS BUFFER BE REQUIRED FOR STORAGE OF A DIFFERENT BLOCK.

USE --- ADDR
A VARIABLE CONTAINING THE ADDRESS OF THE BLOCK BUFFER TO USE NEXT, AS THE
LEAST RECENTLY WRITTEN.

USER N --- L0
A DEFINING WORD USED IN THE FORM:
N USER CCCC
WHICH CREATES A USER VARIABLE CCCC. THE PARAMETER FIELD OF CCCC CONTAINS N
AS A FIXED OFFSET RELATIVE TO THE USER- POINTER REGISTER UP FOR THIS USER
VARIABLE. WHEN CCCC IS LATER EXECUTED, IT PLACES THE SUM OF ITS OFFSET AND
THE USER AREA BASE ADDRESS ON THE STACK AS THE STORAGE ADDRESS OF THAT
PARTICULAR VARIABLE.

VARIABLE E, L0
A DEFINING WORD USED IN THE FORM:
N VARIABLE CCCC
WHEN VARIABLE IS EXECUTED, IT CREATES THE DEFINITION CCCC WITH ITS PARAMETER
FIELD INITIALIZED TO N. WHEN CCCC IS LATER EXECUTED, THE ADDRESS OF ITS
PARAMETER FIELD (CONTAINING N) IS LEFT ON THE STACK, SO THAT A FETCH OR STORE
MAY ACCESS THIS LOCATION.

VOC-LINK --- ADDR U
A USER VARIABLE CONTAINING THE ADDRESS OF A FIELD IN THE DEFINITION OF THE
MOST RECENTLY CREATED VOCABULARY. ALL VOCABULARY NAMES ARE LINKED BY
THESE FIELDS TO ALLOW CONTROL FOR FORGET ING THRU MULTIPLE VOCABULARYS.

VOCABULARY E, L
A DEFINING WORD USED IN THE FORM:
VOCABULARY CCCC
TO CREATE A VOCABULARY DEFINITION CCCC. SUBSEQUENT USE OF CCCC WILL MAKE
IT THE CONTEXT VOCABULARY WHICH IS SEARCHED FIRST BY INTERPRET. THE
SEQUENCE "CCCC DEFINITIONS" WILL ALSO MAKE CCCC THE CURRENT VOCABULARY
INTO WHICH NEW DEFINITIONS ARE PLACED. IN CORTEX FIG-FORTH, CCCC WILL BE SO
CHAINED AS TO INCLUDE ALL DEFINITIONS OF THE VOCABULARY IN WHICH CCCC IS
ITSELF DEFINED. ALL VOCABULARYS ULTIMATELY CHAIN TO FORTH. BY CONVENTION
VOCABULARY NAMES ARE TO BE DECLARED IMMEDIATE. SEE VOC-LINK.

VLIST
LIST THE NAMES OF THE DEFINITIONS IN THE CONTEXT VOCABULARY.
WARNING --- ADDR                U
A USER VARIABLE CONTAINING A VALUE CONTROLLING MESSAGES. IF = 1 DISC IS
PRESENT, AND SCREEN 4 OF DRIVE 0 IS THE BASE LOCATION FOR MESSAGES. IF = 0, NO
DISC IS PRESENT AND MESSAGES WILL BE PRESENTED BY NUMBER. IF = -1, EXECUTE
(ABORT) FOR A USER SPECIFIED PROCEDURE. SEE ‘MESSAGE’, ‘ERROR’.

WHILE  F --- (RUN-TIME)
    AD1  N1 --- AD1  N1  AD2   NP, C2
OCCURS IN A COLON-DEFINITION IN THE FORM:
    BEGIN    . . .    WHILE (TP)    . . .    REPEAT
AT RUN-TIME, WHILE SELCTS CONDITIONAL EXECUTION BASED ON BOOLEAN FLAG F.
IF F IS TRUE (NON-ZERO), WHILE CONTINUES EXECUTION OF THE TRUE PART THRU TO
REPEAT, WHICH THEN BRANCHES BACK TO BEGIN. IF F IS FALSE (ZERO), EXECUTION
SKIPS TO JUST AFTER REPEAT, EXITING THE STRUCTURE. AT COMPIL-TIME, WHILE
EMPLACES (OBRANCH) AND LEAVES AD2 OF THE RESERVED OFFSET. THE STACK VALUES
WILL BE RESOLVED BY REPEAT.

WIDTH --- ADDR             U
IN CORTEX FIG-FORTH, A USER VARIABLE CONTAINING THE MAXIMUM NUMBER OF
LETTERS SAVED IN THE COMPILATION OF A DEFINITION’S NAME. IT MUST BE 1 THRU
31, WITH A DEFAULT VALUE OF 31. THE NAME CHARACTER COUNT AND ITS NATURAL
CHARACTERS ARE SAVED, UP TO THE VALUE IN WIDTH. THE VALUE MAY BE CHANGED
AT ANY TIME WITHIN THE ABOVE LIMITS.

WORD        C ---               L0
READ THE NEXT TEXT CHARACTERS FROM THE INPUT STREAM BEING INTERPRETED,
UNTIL A DELIMITER C IS FOUND, STORING THE PACKED CHARACTER STRING BEGINING
AT THE DICTIONARY BUFFER HERE. WORD LEAVES THE CHARACTER COUNT IN THE
FIRST BYTE, THE CHARACTERS, AND ENDS WITH TWO OR MORE BLANKS. LEADING
OCCURANCES OF C ARE IGNORED. IF BLK IS ZERO, TEXT IS TAKEN FROM THE TERMINAL
INPUT BUFFER, OTHERWISE FROM THE DISC BLOCK STORED IN BLK. SEE ‘BLK’, ‘IN’.

XOR        N1  N2 --- XOR              L1
LEAVE THE BITWISE LOGICAL EXCLUSIVE-OR OF TWO VALUES.

[                                           P, L1
USED IN A COLON-DEFINITION IN THE FORM:
    : XXX  [  WORDS  ]  MORE ;
SUSPEND COMPILATION. THE WORDS AFTER ‘[’ ARE EXECUTED, NOT COMPILED. THIS
ALLOWS CALCULATION OR COMPILATION EXECPTIONS BEFORE RESUMING
COMPILATION WITH ‘]’. SEE ‘LITERAL’, ‘]’.

[COMPILE]                                 P, C
USED IN A COLON-DEFINITION IN THE FORM:
    : XXX  [COMPILE]  FORTH ;
[COMPILE] WILL FORCE THE COMPILATION OF AN IMMEDIATE DEFINITION THAT
WOULD OTHERWISE EXECUTE DURING COMPILATION. THE ABOVE EXAMPLE WILL
SELECT THE FORTH VOCABULARY WHEN XXX EXECUTES, RATHER THAN AT COMPILE
TIME.
RESUME COMPILATION, TO THE COMPLETION OF A COLON-DEFINITION. SEE ‘[‘.
EXTENSIONS TO STANDARD WORD SET

THE FOLLOWING WORDS SUPPORT THE TMS 9995'S COMMUNICATIONS-REGISTER UNIT. REFERENCE SHOULD BE MADE TO THE TMS 9995 DATA BOOK FOR FURTHER DETAILS OF THIS I/O INTERFACE.


CRUBASE N ---
SET THE CURRENT CRUBASE TO THE 16 BIT VALUE N.

?CRUBASE --- N
LEAVE THE 16 BIT CONTENTS OF THE CURRENT CRUBASE.

SB N ---
SET THE CRU BIT N TO A ONE, SETS CURRENT CRUBASE TO N \times 2

RB N ---
SET THE CRU BIT N TO A ZERO, SETS CURRENT CRUBASE TO N \times 2

TB N --- F
TEST THE CRU BIT N. IF BIT=0 LEAVE F=0, IF BIT=1 LEAVE F=1. SETS CURRENT CRUBASE TO N \times 2.

TSTBIT N --- F
TESTS THE CRN BIT N, LEAVES A ONE IF BIT EQUALS ONE, OR A ZERO IF BIT EQUALS ZERO. CURRENT CRUBASE IS NOT MODIFIED.

RSTBIT N ---
SETS THE CRU BIT N TO ZERO, CURRENT CRUBASE UN-MODIFIED.

SETBIT N ---
SET THE CRU BIT N TO A ONE, CURRENT CRUBASE IS UN-MODIFIED.

BYTEOUT B ---
OUTPUT THE 8 BIT BYTE (LOW 8 BITS OF TOS) USING THE CURRENT CRUBASE.
(8 BIT PORT WRITE)

WORDOUT N ---
OUTPUT THE 16 BIT SIGNED INTEGER NUMBER USING THE CURRENT CRUBASE.
(16 BIT PORT WRITE)

WORD IN --- N
INPUT A 16 BIT SIGNED INTEGER NUMBER USING THE CURRENT CRUBASE.
(16 BIT PORT READ)
BYTE IN        --- B
  INPUT A 8 BIT BYTE USING THE CURRENT CRU BASE.
  (INPUT IS RIGHT JUSTIFIED ON THE TOS, HIGH 8 BITS ZERO; 8 BIT PORT READ)

THE FOLLOWING WORDS SUPPORT ADDITIONAL FEATURES OF CORTEX FIG-FORTH.
THESE WILL BE EXTENDED WITH FUTURE RELEASES OF CORTEX FORTH.

LU.                      U---
  PRINT THE UNSIGNED 16 BIT INTEGER ON THE CONSOLE DEVICE.

MEMP           ADDR --- ADDR+8
  OUTPUT THE ADDRESS FOLLOWED BY THE CONTENTS OF THE ADDRESS AND THE NEXT 3
  MEMORY LOCATIONS. USED BY DUMP.

DUMP           ADDR N ---
  OUTPUT THE CONTENTS OF THE NEXT N ADDRESSES TO THE CONSOLE DEVICE. OUTPUT
  IS FORMATTED 4 WORDS PER LINE.

SIZE           ---
  OUTPUTS THE CURRENT DICTIONARY AND BLOCK BUFFER SIZE TO THE CONSOLE
  DEVICE.

CLS
  CLEAR THE CONSOLE SCREEN.

C/L
  CONSTANT >40 CHARACTERS PER LINE USED BY THE FORTH EDITOR.

COLOUR        B ---
  SET THE VDP FOREGROUND/BACKGROUND COLOUR. THE LEFT HAND NIBBLE IS THE
  FOREGROUND COLOUR; THE RIGHT HAND, THE BACKGROUND COLOUR.

(8INIT)
  INITIALIZE DRIVE ZERO TO 8INCH, ONE DRIVE, STEP TIME 3MSEC, SETTLING TIME
  15MSEC, HEAD LOAD TIME 35MSEC. RECAL TO TRACK ZERO.

$INIT
  USED BY (8INIT)
SOME SIMPLE FORTH DEFINITIONS

SQUARE A NUMBER

THE FOLLOWING ROUTINE WILL SQUARE A NUMBER ON THE TOP OF THE STACK.

: SQR  DUP * ; (N --- NSQUARED)
    TYPE "." AND FORTH WILL PRINT THE TOP OF STACK VALUE.

STRING OUTPUT

OUTSIDE A DEFINITION: : " HELLO" WILL ECHO THE STRING IMMEDIATELY A CARRIAGE RETURN IS TYPED.
INSIDE A DEFINITION:
    : GREETING . " HELLO I'M A CORTEX COMPUTER" ;
TYPE GREETING AND SEE THE DIFFERENCE.

THE DO LOOP

TYPE IN THE FOLLOWING DEFINITION:

: COUNTER 0 DO I . LOOP ;
NOW TYPE 8 COUNTER, FORTH WILL THEN TYPE 0 1 2 3 4 5 6 7 OK: ON THE SCREEN. TRY OTHER VALUES.
THIS IS AN EXAMPLE OF A DEFINITE LOOP, THE PROCEDURE INSIDE THE DO . . . LOOP WILL EXECUTE N-1 TIMES, WHERE N IS THE STACK VALUE.
MEMP USES A DO LOOP TO OUTPUT THE CONTENTS OF THE FOUR ADDRESS VALUES.

FLASH THE TIME LED

THIS ROUTINE WILL FLASH THE TIME LED SIX TIMES AT APPROXIMATELY 3 SEC INTERVALS, THEN TYPE A SIGN OFF MESSAGE.

: WAIT-3SEC 3 0 DO $WA LOOP ;
: LAMP-ON 0 RB ;
: LAMP-OFF 0 SB ;
: FLASH 6 0 DO WAIT-3SEC LAMP-ON WAIT-3SEC LAMP-OFF LOOP CR "." LIGHTS OUT FOLKS" ;

SUBSTITUTE 6 RB AND 6 SB IN THE LAMP-ON AND LAMP-OFF DEFINITIONS.

ARRAY GENERATION

THE FOLLOWING WORD IS A DEFINING WORD TO CREATE TWO DIMENSION BYTE ARRAYS.
SUBSCRIPTS START AT ONE.

: ARRAY (2D BYTE ARRAY DEFINING WORD )
    <BUILDS DUP C , * ALLOT HERE =CELLS DP!\n    DOES> ROT 1 - OVER C@ * + + ;
TO CREATE A 2D 4 BY 4 ARRAY CALLED ANIMALS, TYPE 4 4 ARRAY ANIMALS TO OBTAIN THE VALUE OF AN ELEMENT, TYPE N N ANIMALS C@. THIS WILL PLACE THE BYTE VALUE ON THE STACK.
CASSETTE SUPPORT

THE FOLLOWING WORDS ALLOW THE USER TO SAVE THE USER "WORD" BUFFER TO CASSETTE TAPE.

DSAVE
SAVE THE CURRENT USER DICTIONARY TO CASSETTE TAPE. DSAVE WILL PROMPT FOR A NAME. THIS CAN BE FROM ONE TO TWELVE CHARACTERS IN LENGTH. THE OUTPUT TO TAPE WILL COMMENCE AS SOON AS THE TWELFTH CHARACTER IS INPUT, OR IF THE NAME IS LESS THAN TWELVE CHARACTERS A CARRIAGE RETURN TERMINATES NAME INPUT. IT IS IMPORTANT TO START THE TAPE BEFORE THE TERMINATOR IS ENTERED. DSAVE SAVES FROM $DS UNTIL HERE.

DREAD
READ A PREVIOUSLY SAVED USER DICTIONARY FROM CASSETTE TAPE DREAD SEARCHES FOR A NAMED FILE ON TAPE. IT WILL READ THE FIRST NAMED FILE FOUND. THE FILE NAME WILL BE OUTPUT AS FOLLOWS:
FOUND 'CCC....' WHERE 'CCC...' IS THE FILE NAME.

INPUT TO FORTH IS ACCEPTED FROM ANY INPUT PORT, CONSEQUENTLY DO NOT HIT ANY KEYS ON THE KEYBOARD OR INPUT FROM THE >80 PORT DURING DREAD. THE FILE LOADED IS CHECKED FOR ERRORS, EITHER OF THE TWO FOLLOWING ERROR CONDITIONS CAN OCCUR DURING TAPE INPUT.

H-ERROR
AN ERROR WAS FOUND IN THE HEADER RECORD, THE DREAD IS ABORTED.

D-ERROR
THE HEADER RECORD WAS RECIEVED CORRECTLY BUT AN ERROR OCCURED IN THE DATA PORTION. IN THIS CASE BAD DATA WILL HAVE BEEN LOADED BUT ONLY AT THE CORRECT ADDRESSES. AGAIN THE DREAD IS ABORTED.

THE FOLLOWING WORDS SUPPORT THE TWO MAIN CASSETTE SAVE AND READ WORDS. THEY MAY BE CALLED DIRECTLY BY THE USER (WITH CAUTION!)

$CS
---
SET THE >180 PORT FOR CASSETTE I/O. (2 STOP, NO PARITY, 8 BITS, 300 BAUD)

$CR
---
RESET THE >180 PORT FOR NORMAL I/O. (7 BITS- EVEN PARITY, 2 STOP BITS, 300 BAUD)

$CO
-B1 ---
OUTPUT THE RIGHT HAND BYTE AT TOS TO THE CASSETTE PORT.
$CI             --- B1
INPUT A BYTE FROM THE CASSETTE PORT TO THE RH BYTE OF THE TOS.

$SS  B2  B1--- B1  B2
BYTE REVERSE THE ORDER OF THE TOS (STACK SWAP)

U<            U1  U2 --- F
RETURN A TRUE, F=1 FLAG IF U1 < OR EQUAL TO U2. OTHERWISE RETURN FALSE F=0.

$DS
A VARIABLE CONTAINING THE VALUE EQUAL TO THE START OF THE USER DICTIONARY.

2DROP         D ---
REMOVE THE TOP DOUBLE PRECISION VALUE FROM THE STACK.

2DUP             D1 --- D1  D1
DUPLICATE THE TOP DOUBLE PRECISION VALUE ON THE STACK.

2SWAP         D2  D1 --- D1  D2
EXCHANGE THE TOP TWO DOUBLE PRECISION VALUES ON THE STACK.

$NA
PROMPT FOR AND GENERATE A NAME HEADER FOR CASSETTE SAVE.

$PT
A VARIABLE CONTAINING A POINTER TO NAME CHARACTER INPUT.

$RN
GET A FILE NAME FROM TAPE AND DISPLAY IT ON THE TERMINAL DEVICE.

$WA
WAIT APPROXIMATELY ONE SECOND.

$CK
A VARIABLE CONTAINING THE TAPE CHECKSUMS.

WWD            B2  B1 ---
OUTPUT THE TWO BYTES AT THE TOS TO THE CASSETTE PORT LOW BYTE FIRST.

$HD            U2  U1 ---
GENERATE A HEADER WITH CHECKSUM FOR THE TWO VALUES ON THE STACK.

$CD            U2  U1 ---
OUTPUT BYTES FROM ADDRESS U1 UPTO AND INCLUDING ADDRESS U2, THEN OUTPUT A CHECKSUM CELL.
RDW            --- B2B1
INPUT TWO BYTES FROM THE CASSETTE PORT, THE FIRST BYTE IS PLACED LOW ORDER ON THE STACK.

$RH            --- U2  U1  F
READ THE TWO HEADER CELLS FROM THE CASSETTE PORT. (WHERE U2= END ADDRESS, U1= START ADDRESS, F=1 IF CHECKSUM IS OK).

$RD            U2  U1 --- F
READ DATA FROM THE CASSETTE PORT, WHERE U1 EQUALS THE START ADDRESS, U2 THE END ADDRESS AND F=1 IF THE CHECKSUM IS OK.

$SP
SAVE PARAMETERS FOR THIS DICTIONARY TO TAPE.

$RP
READ THE PREVIOUS DICTIONARY PARAMETERS FROM TAPE.
DISC SUPPORT

THE CURRENT CORTEX FIG-FORTH REL 1.0 SUPPORTS A SINGLE 8 INCH DISC DRIVE INSTALLED AS DRIVE ZERO. PLEASE ENQUIRE FOR MULTIPLE DRIVE VARIANTS.

THE DISC FORMAT IS IBM 3740, 77 TRACKS PER SIDE/SINGLE SIDED, 26 SECTORS PER TRACK AND 128 BYTES PER SECTOR. BEFORE USING THE DISC, THE CONTROLLER MUST BE INITIALIZED AND THE DRIVE RE-CALIBRATED. THE (8INIT) WORD PERFORMS THIS FUNCTION. WITH AN 8 INCH DRIVE CONNECTED AND CONFIGURED AS DRIVE ZERO, TYPE (8INIT) FOLLOWED BY RETURN, THE DRIVE SHOULD RE-CALIBRATE AND FORTH WILL REPLY "INITIALIZATION COMPLETE".

DISC OPERATION IS NORMALLY CONTROLLED BY THE FORTH OPERATING SYSTEM VIA THE BLOCK AND BUFFER WORDS. FORTH MANAGES ALL DISC ACCESSES AS A VIRTUAL MEMORY SYSTEM ALLOCATING BLOCK BUFFERS AND WRITING UPDATED BUFFERS BACK TO DISC. SEE THE BUFFER, UPDATE AND BLOCK WORDS IN THE GLOSSARY.

A MORE PRIMITIVE FORM OF DISC ACCESS IS AVAILABLE VIA THE R/W WORD. SEE ALSO THE SYSTEM VECTORS SECTION, APPENDIX B.

AN 8 INCH DISC CONTAINING THE FORTH EDITOR, AN ASSEMBLER AND A NUMBER OF UTILITY PROGRAMS IS AVAILABLE FROM LOMBARD SYSTEMS. PLEASE ENQUIRE FOR DETAILS.
## APPENDIX A

### FORTH ERROR MESSAGES

<table>
<thead>
<tr>
<th>ERR MSG #</th>
<th>MESSAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>? (PRONOUNCED “HUH?”)</td>
<td>THE WORD IN QUESTION CANNOT BE FOUND IN THE DICTIONARY.</td>
</tr>
<tr>
<td>1</td>
<td>EMPTY STACK</td>
<td>MORE VALUES HAVE BEEN REMOVED FROM THE PARAMETER STACK THAN WERE ADDED (NOT ENOUGH VALUES ARE ON STACK TO SUPPORT DEFINITION EXECUTION)</td>
</tr>
<tr>
<td>2</td>
<td>DICTIONARY FULL</td>
<td>THE DICTIONARY HAS GROWN INTO THE TERMINAL INPUT BUFFER</td>
</tr>
<tr>
<td>3</td>
<td>INCORRECT ADX MODE</td>
<td>USED BY THE FORTH ASSEMBLER</td>
</tr>
<tr>
<td>4</td>
<td>ISN’T UNIQUE</td>
<td>THE NAME OF THIS DEFINITION ALREADY EXISTS ELSEWHERE IN THE DICTIONARY</td>
</tr>
<tr>
<td>6</td>
<td>DISK RANGE?</td>
<td>A DISC ACCESS TO A PHYSICALLY NON-EXISTANT BLOCK NUMBER WAS REQUESTED (CURRENTLY 249 FOR THIS RELEASE. MAKE SURE YOU ARE NOT IN BASE HEX WHEN YOU THINK THINK YOU ARE IN BASE DECIMAL)</td>
</tr>
<tr>
<td>7</td>
<td>FULL STACK</td>
<td>TOO MANY VALUES HAVE BEEN ADDED TO THE PARAMETER STACK</td>
</tr>
<tr>
<td>8</td>
<td>DISK ERROR</td>
<td>AN I/O ERROR OCCURED WHILE ATTEMPTING TO READ OR WRITE TO VIRTUAL I/O</td>
</tr>
<tr>
<td>17</td>
<td>COMPILATION ONLY</td>
<td>THIS WORD MUST ONLY BE USED WITHIN A COLON DEFINITION</td>
</tr>
<tr>
<td>18</td>
<td>EXECUTION ONLY</td>
<td>THE WORD MUST NOT BE USED WHILE THE SYSTEM IS IN COMPILE MODE</td>
</tr>
<tr>
<td>Condition</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>CONDITIONALS NOT PAIRED THERE IS SOME SORT OF PROBLEM WITH THE PAIRING OF CONDITIONALS WITHIN THE DEFINITION BEING COMPILED (DO WITHOUT LOOP OR BEGIN WITHOUT UNTIL, ETC.)</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>DEFINITION NOT FINISHED THE POSITION OF THE PARAMETER STACK POINTER DIFFERS FROM WHAT IT WAS WHEN THIS DEFINITION BEGAN COMPILING. SOMETHING IS WRONG WITH THE DEFINITION</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>PROTECTED DICTIONARY THE ADDRESS OF THE DEFINITION BEING &quot;FORGOTTEN&quot; IS LESS THAN THE VALUE STORED IN FENCE. CHANGE THE VALUE IN FENCE.</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>USE ONLY WHEN LOADING THIS DEFINITION SHOULD ONLY BE USED WHEN LOADING</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>OFF CURRENT EDIT SCREEN OCCURS WHEN USING CORTEX FORTH EDITOR</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>DECLARE VOCABULARY CONTEXT AND CURRENT ARE NOT AIMING AT THE SAME VOCABULARY WHEN ATTEMPTING TO FORGET</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B  

SYSTEM VECTORS

THESE ARE ASSEMBLY LANGUAGE LEVEL CALL VECTORS, IMPROPER USE MAY CRASH THE FORTH SYSTEM.

INPUT-OUTPUT

XOP 0 IS USED FOR LOW LEVEL O/P, CALLED BY EMIT
XOP 1 IS USED FOR LOW LEVEL I/P

ALL OTHER XOP'S ARE AVAILABLE FOR USER USE AT PRESENT, HOWEVER IT IS RECOMMENDED THAT ANY USER XOP'S ARE ALLOCATED FROM 9 UPWARDS. FURTHER RELEASES OF CORTEX FIG-FORTH MAY COMMIT XOP'S LOW ORDER UPWARDS.

NOTE: ALL INPUT IS INTERRUPT DRIVEN (INT 4)
(">" INDICATES A HEXADECIMAL VALUE)

SYSTEM ADDRESSES

CHAR$ EQU >0080 CONTAINS VALUE OF LAST CHARACTER INPUT.

EVECT EQU >E284 FORTH DISC READ-WRITE ENTRY VECTOR, EXPECTS STACK SET UP AS PER R/W WORD.

TOG 1 EQU >E28A SIDE TOGGLE VALUE 0 FOR STANDARD CORTEX. CONTROLS THE SENSE OF THE SIDE SIGNAL SENT TO THE DISC DRIVE. LOAD WITH >0400 TO CHANGE SIDE SIGNAL POLARITY.

MAXB EQU >E28C MAXIMUM FORTH BLOCK NUMBER ALLOWED BY SYSTEM.

TMX EQU >E28E MAXIMUM TRACK AND MAXIMUM SECTOR VALUES.

PROF EQU >E290 FORTH WRITE PROTECT FLAG, IF SET TO A 1 WILL WRITE PROTECT TRACK IN MD WORD.

MD EQU >E292 MAXIMUM TRACK AND PROTECTED TRACK NUMBER. THE LOW ORDER BYTE CONTAINS 2 TIMES THE VALUE OF THE DESIRED PROTECTED TRACK.
**SYSTEM CALLS**

**INIT** EQU >E294

CALL BY BLWP @INIT
INTERNAL DISK CONTROLLER. THIS ROUTINE DOES NOT
PERFORM A FULL INITIALIZATION OF THE DISK. CONSEQUENTLY
USER CALLS TO THIS ROUTINE ARE NOT RECOMMENDED.

**TXFER** EQU >E2F2

CALL BY BLWP @TXFER
CALLERS WORKSPACE AS FOLLOWS:
R0 = RETURNED STATUS
R1 = NNNN NNNS DDNN NNNN
TRACK #  DRIVE  STARTING
SIDE  SECTOR #
R2 = WKNN NNNN NNNN NNNN
WRITE # OF SECTORS  RESERVED
FLAG  TO TRANSFER  RH BYTE
SEEK ONLY
R3 = DATA TRANSFER ADDRESS

IF THE WRITE BIT IS SET, OPERATION IS A SINGLE/MULTI
SECTOR WRITE. STARTING ADDRESS IN R3. OTHERWISE R3
CONTAINS START ADDRESS OF WHERE READ INFORMATION
IS TO BE PLACED. IF THE SEEK BIT IS SET OPERATION ABORTS
AFTER SEEK.
EXAMPLE:
TO WRITE 8 SECTORS FROM 6000 IN MEMORY TO TRACK 12
STARTING SECTOR 5 SIDE ZERO, DRIVE 0

CLR R0  CLEAR STATUS
LI R1,>2405  TRACK 12, SIDE 0, DRIVE 0,
STARTING SECTOR 5.
LI R2,>8800  WRITE, 8 SECTORS.
LI R3,>6000  TRANSFER ADDRESS >6000.
BLWP @TXFER  EXECUTE COMMAND.
CI R0,>FF00  CHECK STATUS.
JNE ERROR  CALL ERROR IF BAD STATUS.

**RCALIB** EQU >E3BE

CALL BY BLWP @RCALIB
CALLERS WORKSPACE AS FOLLOWS:
R0 = RETURNED STATUS
R1 = ABAB ABAB NNNN DDDD
RATES  DRIVE
D3 D2 D1 DO  RESERVED
THE RATE PAIRS ARE PER DRIVE AS INDICATED, (SEE THE
TMS 9909 DATA MANUAL) THE LH NIBBLE OF THE RH BYTE
IS RESERVED. THE DRIVE VALUE IS ONE BIT PER DRIVE
EXCLUSIVE. E. G., DRIVE 2 = 0100. DRIVE 0 = 0000.
APPENDIX C

BIBLIOGRAPHY

FIG-FORTH INSTALLATION MANUAL
FORTH INTEREST GROUP, PO BOX 1105, SAN CARLOS, CA 94070
THE FIG GLOSSARY SUPPLIED IN THIS MANUAL WAS TAKEN FROM THE ABOVE PUBLIC DOMAIN PUBLICATION.

BAKER & DERICK
FORTH ENCYCLOPEDIA (MVP, 1982)

BRODIE, LEO
STARTING FORTH (PRENTICE-HALL/1981)

HAYDON, G
ALL ABOUT FORTH (MVP, 1983)

HUANG, T
AND SO FORTH (MVP)

KATZAN, H JR.
INVITATION TO FORTH (VAN NOSTRAND)

KNECHT, K
INTRODUCTION TO FORTH (HOWARD SAMS)

LOELIGER, R
THREADED INTERPRETIVE LANGUAGES (MCGRAW HILL, 1981 BYTE BOOKS)

SCANLON, L
FORTH PROGRAMMING (HOWARD SAMS, 1982)

TING, C
SYSTEMS GUIDE TO FIG-FORTH (MVP)

WINFIELD, A
THE COMPLETE FORTH (SIGMA TECHNICAL PRESS, 1983)

MVP
MOUNTAIN VIEW PRESS
PO BOX 4656
MOUNTAIN VIEW, CALIFORNIA 94040 U.S.A.