CORTEX FIG - FORTH USER MANUAL

REL 1.0

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<u>INTRODUCTION</u>

THE FORTH LANGUAGE WAS INVENTED IN 1970 BY CHARLES MOORE. IT IS UNIQUE AMONG HIGH LEVEL LANGUAGES IN THAT THE WHOLE KERNAL INCLUDING COMPILER, EDITOR AND ASSEMBER 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 LANGAUGE, 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

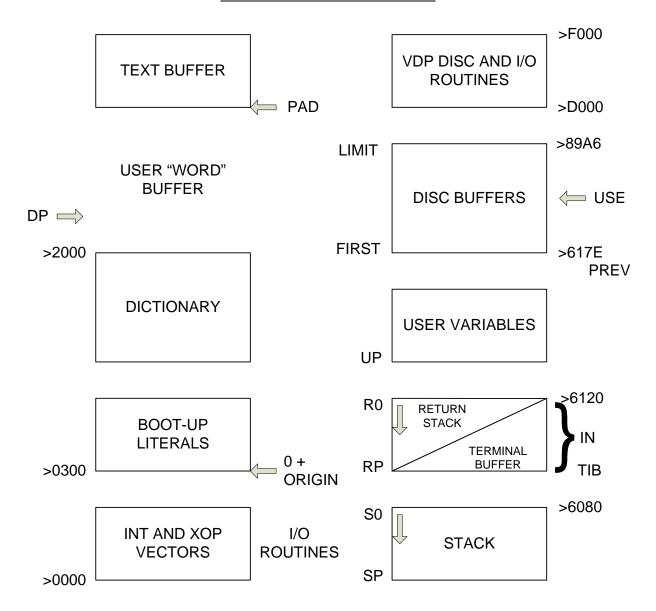
CORTEX FIG-FORTH IS SUPPLIED IN TWO 2564 EPROMS. THESE REPLACE THE FIRST TWO BASIC EPROMS.

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



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
В	8 BIT BYTE (HI 8 BITS ZERO)
С	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;

С	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.
LO	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 ARITHEMETIC IS IMPLICITLY 16 BIT SIGNED INTEGER MATH, WITH ERROR AND UNDER-FLOW INDICATION UNSPECIFIED.

ļ N ADDR ---LO 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 10 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." (P, L0 USED IN THE FORM: (CCCC) IGNORE A COMENT 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. (. ") 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) C2

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 L0
 LEAVE THE SIGNED PRODUCT OF TWO SIGNED NUMBERS
- */ N1 N2 N3 --- N4 L0
 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 L0

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 L0 LEAVE THE SUM OF N1+N2.
- +! N1 ADDR --- L0
 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--- LO

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.

N ---L0 PRINT A NUMBER FROM A SIGNED 16 BIT TWO'S COMPLEMENT VALUE. CONVERTED ACCORDING TO THE NUMERIC BASE. A TRAILING BLANK FOLLOWS. PRONOUNCED "DOT". LO 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 ' "'. .LINE LINE SCR ---PRINT ON THE TERMINAL DEVICE A LINE OF TEXT FROM THE DISC BY ITS LINE AND SCREEN NUMBER. TRAILING BLANKS ARE SUPPRESSED. . R N1 N2 ---PRINT THE NUMBER N1 RIGHT ALIGNED IN A FIELD WHOSE WIDTH IS N2. NO FOLLOWING BLANK IS PRINTED. / N1 N2 --- QUOT LO LEAVE THE SIGNED QUOTIENT OF N1/N2. /MOD N1 N2 --- REM QUOT LO LEAVE THE REMAINDER AND SIGNED QUOTIENT OF N1/N2. THE REMAINDER HAS THE SIGN OF THE DIVIDEND. 0123 --- N THESE SMALL NUMBERS ARE USED SO OFTEN THAT IT IS ATTRACTIVE TO DEFINE THEM BY NAME IN THE DICTIONARY AS CONSTANTS. 0< N --- F LO LEAVE A TRUE FLAG IF THE NUMBER IS LESS THAN ZERO (NEGATIVE), OTHERWISE LEAVE A FALSE FLAG. 0= N --- F L₀ LEAVE A TRUE FLAG IF THE NUMBER IS EQUAL TO ZERO, OTHERWISE LEAVE A FALSE FLAG. OBRANCH F ---C2 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. L1 1+ N1 --- N2

INCREMENT N1 BY 1

N1 --- N2 LEAVE N1 INCREMENTED BY 2.

2+

: P, E, LO

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, LO

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:

CCCC 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 CCCC PRIOR TO ';CODE'.

; S P, LO

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.

< N1 N2 --- F 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:

CCCC 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 LC 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, LO
 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 --- LO
 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 LO

LEAVE THE 16 BIT CONTENTS OF ADDRESS.

ABORT LO

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 --- (COMPILING) 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.

ALLOT N--- LO

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, LO

A USER VARIABLE CONTAINING THE CURRENT NUMBER BASE USED FOR INPUT AND OUTPUT CONVERSION.

BEGIN --- ADDR N (COMPILING) P,LO

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. LO

A USER VARIABLE CONTAINING THE BLOCK NUMBER BEING INTERPRETED. IF ZERO, INPUT IS BEING TAKEN FROM THE TERMINAL INPUT BUFFER.

BLOCK N --- ADDR LO

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 COMPILED 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 OCCUR ING 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 C2

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 --- LO

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 U, L0

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

COUNT ADDR1 --- ADDR2 L0

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 LO

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 U

A USER VARIABLE TEMPORARILY STORING THE STACK POINTER POSITION, FOR COMPILATION 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 ACCESSABLE 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 LO

SET THE NUMERIC CONVERSION BASE FOR DECIMAL INPUT-OUTPUT.

DEFINITIONS L1

USED IN THE FORM:

CCCC 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) F

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

AT RUN TIME, DO BEGINS A SEQUENCE WITH REPETITIVE EXECUTION CONTROLLED BY A LOOP LIMIT N1 AND AN INDEX WITH THE INITIAL VALUE N2. DO REMOVES THESE FROM THE STACK UPON REACHING LOOP THE INDEX IS INCREMENTED BY ONE. UNTIL THE NEW INDEX EQUALS OR EXCEEDS THE LIMIT, EXECUTION LOOPS BACK TO JUST AFTER DO, OTHERWISE THE LOOP PARAMETERS ARE DISCARDED AND EXECUTION CONTINUES AHEAD. BOTH N1 AND N2 ARE DETERMINED AT RUN-TIME AND MAY BE THE RESULT OF OTHER OPERATIONS. WITHIN A LOOP 'I' WILL COPY THE CURRENT VALUE OF THE INDEX TO THE STACK. SEE 'I', 'LOOP', '+LOOP', 'LEAVE', 'J'. WHEN COMPILING WITHIN THE COLON DEFINITION, DO COMPILES (DO), LEAVES THE FOLLOWING ADDRESS ADDR AND N FOR LATER ERROR-CHECKING.

DOES> LO

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 --- LO

DROP THE NUMBER FROM THE STACK.

DUMP ADDR N --- LO

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 LO

DUPLICATE THE VALUE ON THE STACK.

ELSE ADDR1 N1 --- ADDR2 N2

(COMPILING) P, C2, L0

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 --- LO

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

EMPTY-BUFFERS LO

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, CO, LO

OCCURS IN A COLON-DEFINITION IN THE FORM:

IF ... ENDIF

IF ... ELSE ... ENDIF

AT RUN-TIME, ENDIF 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 ENDIF. BOTH NAMES ARE SUPPORTED IN CORTEX FIGFORTH. SEE ALSO IF AND ELSE. AT COMPILE-TIME, ENDIF COMPUTES THE FOWARD 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 --- LO

TRANSFER CHARACTERS FROM THE TERMINAL TO ADDRESS, UNTIL A "RETURN" OR THE COUNT OF CHARACTERS HAVE BEEN RECIEVED. 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 UNUSED IN CORTEX FIG-FORTH.

FORGET E, LO

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.

FORTH P, LO

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.

HERE --- ADDR LO

LEAVE THE ADDRESS OF THE NEXT AVAILABLE DICTIONARY LOCATION.

HEX LO

SET THE NUMERIC CONVERSION BASE TO SIXTEEN (HEXADECIMAL).

HLD --- ADDR LO

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

HOLD C --- LO

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

C, LO

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

ID. ADDR ---

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

IF F --- (RUN-TIME)

--- ADDR N (COM P, C2, L0

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 OBRANCH 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 MILL 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 PRECEDING IT WITH [COMPILE].

IN --- ADDR LO

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 LO

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, LO

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 PFA --- 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 --- LO

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 --- LO

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 LO

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', 'DRO', '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 LO

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

R#

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.

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

U

R/W ADDR BLK F ---

--- ADDR

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'.

RO --- 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 COMPILE-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 RO. N --- D S->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 SO. 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 LO TRANSMIT AN ASCII BLANK TO THE OUTPUT DEVICE. SPACES N ---LO

TRANSMIT N ASCII BLANKS TO THE OUTPUT DEVICE.

STATE --- ADDR LO, U A USER VARIABLE CONTAINING THE COMPILATION STATE. A NON-ZERO VALUE

INDICATES COMPILATION.

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, CO, LO

AN ALIAS FOR ENDIF.

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 ACCROSS 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 SUITABLE FOR SOURCE TEXT RECORDS, AND INCLUDES A REFERENCE LINE AT THE BOTTOM TAKEN FROM LINE 15 OF SCREEN 4.

TYPE ADDR COUNT --- LO

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)

ADDR N --- (COMPILE)

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.

P,C2,L0

UPDATE LO

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 --- LO

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, LO

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 VACABULARY 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

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

U

OCCURS IN A COLON-DEFINITION IN THE FORM:

BEGIN ... WHILE (TP) ... REPEAT

AT RUN-TIME, WHILE SELECTS 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 COMPILE-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 --- LO

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.

] L1 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.

NOTE: THE SB, RB, TB, TSTBIT, RSTBIT, AND SETBIT WORDS AFFECT THE ABSOLUTE BIT NUMBER ON THE TOS. THEY ARE NOT CRU BASE RELATIVE. E.G., 300 TB TESTS PHYSICAL CRU BIT 300. THE ONLY DIFFERENCE BETWEEN THE SB, RB AND TB AND THE TSTBIT, RSTBIT AND SETBIT WORDS IS THAT THE FORMER MODIFY THE CURRENT CRUBASE WHEREAS THE LATER LEAVE THE CRUBASE UN-MODIFIED. AS A CONSEQUENCE OF THIS SB, RB AND TB EXECUTE FASTER.

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 * 2

RB N ---

SET THE CRU BIT N TO A ZERO, SETS CURRENT CRUBASE TO N * 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 * 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 CRUBASE.

(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! 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.

DRFAD

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 MILL 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.

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\$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.

ŚΝΑ

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 APPROXIMATLY 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.

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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	
ERR MSG #	MESSAGE	DESCRIPTION
0	? (PRONOUNCED "HUH?")	THE WORD IN QUESTION CANNOT BE FOUND IN THE DICTIONARY.
1	EMPTY STACK	MORE VALUES HAVE BEEN REMOVED FROM THE PARAMETER STACK THAN WERE ADDED (NOT ENOUGH VALUES ARE ON STACK TO SUPPORT DEFINITION EXECUTION)
2	DICTIONARY FULL	THE DICTIONARY HAS GROWN INTO THE TERMINAL INPUT BUFFER
3	INCORRECT ADX MODE	USED BY THE FORTH ASSEMBLER
4	ISN'T UNIQUE	THE NAME OF THIS DEFINITION ALREADY EXISTS ELSEWHERE IN THE DICTIONARY
6	DISK RANGE?	A DISC ACCESS TO A PHYSICALLY NON-EX ISTANT 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)
7	FULL STACK	TOO MANY VALUES HAVE BEEN ADDED TO THE PARAMETER STACK
8	DISK ERROR	AN I/O ERROR OCCURED WHILE ATTEMPTING TO READ OR WRITE TO VIRTUAL I/O
17	COMPILATION ONLY	THIS WORD MUST ONLY BE USED WITHIN A COLON DEFINITION
18	EXECUTION ONLY	THE WORD MUST NOT BE USED WHILE THE SYSTEM IS IN COMPILE MODE

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19	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.)
20	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
21	PROTECTED DICTIONARY	THE ADDRESS OF THE DEFINITION BEING "FORGOTTEN" IS LESS THAN THE VALUE STORED IN FENCE. CHANGE THE VALUE IN FENCE.
22	USE ONLY WHEN LOADING	THIS DEFINITION SHOULD ONLY BE USED WHEN LOADING
23	OFF CURRENT EDIT SCREEN	OCCURS WHEN USING CORTEX FORTH EDITOR
24	DECLARE VOCABULARY	CONTEXT AND CURRENT ARE NOT AIMING AT THE SAME VOCABULARY WHEN ATTEMPTING TO FORGET

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 0/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

INITIALIZE THE DISC CONTROLLER. THIS ROUTINE DOES NOT PERFORM A FULL INITIALIZATION OF THE DISC. CONSEQUENTLY USER CALLS TO THIS ROUTINE ARE NOT RECOMMENDED.

TXFER EQU >E2F2 CALL BY BLWP ©TXFER

CALLERS WORKSPACE AS FOLLOWS:

RO= 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 RO 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:

RO= RETURNED STATUS

R1= ABAB ABAB NNNN DDDD

RATES DRIVE

D3 D2 D1 D0 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

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