

II DIGITAL RESEARCH

Post Office Box 579, Pacific Grove, California 93950, (408) 373-3403

CP/M ASSEMBLER (ASM)

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ASM 1.0

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; COMMON DATA FOR CP/M ASSEMBLER MODULE
0100    ORG    100H
20F0 =  ENDA   EQU    20F0H ;END OF ASSEMBLER PROGRAM
0035 =  BDOS   EQU    5H ;ENTRY TO DOS, USED TO COMPUTE END MEMORY
0103 310002  LXI    SP,ENDMOD
0103 2A2600  LHLD   BDOS+1
0106 22CD01  SHLD   SYMAX ;COMPUTE END OF MEMORY
0109 C30002  .JMP   ENDMOD
;
; PRINT BUFFER AND PRINT BUFFER POINTER
0378 =  PBMAX  EQU    128 ;MAX PRINT BUFFER
J18C  PBUFF: DS     PBMAX
0134  PBP:   DS     1      ;PRINT BUFFER POINTER
;
; SCANNER PARAMETERS
0105  TOKEN: DS    1      ;CURRENT TOKEN
0156  VALUE: DS    2      ;BINARY VALUE FOR NUMBERS
0128  ACCLEN: DS   1      ;ACCUMULATOR LENGTH
0040 =  ACMAX  EQU    64    ;LENGTH OF ACCUMULATOR
0189  ACCUM: DS   ACMAX ;ACCUMULATOR (MUST FOLLOW ACCLEN)
;
; OPERAND EXPRESSION EVALUATOR PARAMETERS
01C0  EVALUE: DS   2      ;VALUE OF EXPRESSION AFTER EVALUATION
;
; SYMBOL TABLE MODULE PARAMETERS
01CB F020  SYTOP: DW    ENDA ;FIRST LOCATION AVAILABLE FOR SYMBOL TABLE
J1CD  SYMAX: DS   2      ;LAST AVAILABLE LOCATION FOR SYMBOL TABLE
;
; MISCELLANEOUS DATA AREAS
01CF  PASS:  DS    1      ;PASS # 0,1
01D0  FPC:   DS    2      ;FILL ADDRESS FOR NEXT HEX RECORD
01D2  ASPC:  DS    2      ;ASSEMBLER'S PSEUDO PC
01D4 F020  SYBAS: DW    ENDA ;SYMBOL TABLE BASE
01D6  SYADR: DS   2      ;CURRENT SYMBOL BASE
0203 =  ENDMOD EQU    ($ AND 0FF00H)+100H
01D8  END
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; I/O MODULE FOR CP/M ASSEMBLER
0200 0000 -  BOOT
0200 C3E00C
0203 C3A100
0206 C3CA0D
0209 C3340E
020C C3AA0E
020F C3DE0E
0212 C3BC0C
0215 C3000F
0216 C32F0F
021B C34C10
021E C3390F
;
; DATA FOR I/O MODULE
0221 BPC: DS 2      ;BASE PC FOR CURRENT HEX RECORD
0223 DRL: DS 1      ;HEX BUFFER LENGTH
0224 DBUFF: DS 16    ;HEX BUFFER
;
; DISK NAMES
0234 CRISK: DS 1      ;CURRENTLY SELECTED DISK
0236 PDISK: DS 1      ;PRN DISK
0237 HDISK: DS 1      ;HEX DISK
;
; COMMON EQUATES
0078 =  QMAX  EQU    128 ;MAX PRINT SIZE
010C =  QBUFF EQU    10CH ;PRINT BUFFER
0184 =  QBP   EQU    QBUFF+QMAX ;PRINT BUFFER POINTER
;
0185 =  TOKEN EQU    QBP+1 ;CURRENT TOKEN UNDER SCAN
0186 =  VALUE EQU    TOKEN+1 ;VALUE OF NUMBER IN BINARY
0188 =  ACCLEN EQU    VALUE+2 ;ACCUMULATOR LENGTH
0040 =  ACMAX  EQU    64    ;MAX ACCUMULATOR LENGTH
0189 =  ACCUM  EQU    ACCLEN+1
;
01C9 =  EVALUE EQU    ACCUM+ACMAX ;VALUE FROM EXPRESSION ANALYSIS
;
01CB =  SYTOP  EQU    EVALUE+2 ;CURRENT SYMBOL TOP
01CD =  SYMAX  EQU    SYTOP+2 ;MAX ADDRESS+1
;
01CF =  PASS   EQU    SYMAX+2 ;CURRENT PASS NUMBER
01D0 =  FPC    EQU    PASS+1 ;FILL ADDRESS FOR DHEX ROUTINE
01D2 =  ASPC   EQU    FPC+2 ;ASSEMBLER'S PSEUDO PC

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220D = CR EQU 0DH ;CARRIAGE RETURN
003A = LP EQU 0AH ;LINE FEED
001A = EOP EQU 1AH ;END OF FILE MARK
;
;
; DOS ENTRY POINTS
0205 = BOOS EQU 5H ;DOS ENTRY POINT
0301 = READC EQU 1 ;READ CONSOLE DEVICE
0032 = WRITC EQU 2 ;WRITE CONSOLE DEVICE
0033 = REDYC EQU 11 ;CONSOLE CHARACTER READY
0032 = SELECT EQU 14 ;SELECT DISK SPECIFIED BY REGISTER E
020F = OPENF EQU 15 ;OPEN FILE
0010 = CLOSF EQU 16 ;CLOSE FILE
0013 = DELEP EQU 19 ;DELETE FILE
0014 = READP EQU 20 ;READ FILE
0015 = WRITP EQU 21 ;WRITE FILE
0016 = MAKEP EQU 22 ;MAKE A FILE
0019 = CSEL EQU 25 ;RETURN CURRENTLY SELECTED DISK
001A = SETDM EQU 26 ;SET DMA ADDRESS
;
; FILE AND BUFFERING PARAMETERS
0033 = NSB EQU 8 ;NUMBER OF SOURCE BUFFERS
0036 = NPB EQU 6 ;NUMBER OF PRINT BUFFERS
0035 = NHB EQU 6 ;NUMBER OF HEX BUFFERS
;
0400 = SSIZE EQU NSB*128
0302 = PSIZE EQU NPB*128
0300 = KSIZE EQU NHB*128
;
; FILE CONTROL BLOCKS
0238 = SCB: DS 9 ;FILE NAME
0241 41534D DB 'ASM' ;FILE TYPE
0244 = SCBR: DS 1 ;REEL NUMBER (ZEROED IN SETUP)
0245 = DS 19 ;MISC AND DISK MAP
0258 = SCBCR: DS 1 ;CURRENT RECORD (ZEROED IN SETUP)
;
0259 = PCB: DS 9
0262 50524E00 DB 'PRN',0
0266 = DS 19
0279 00 DB 0 ;RECORD TO WRITE NEXT
;
027A = HCB: DS 9
0283 48455800 DS 'HEX',0
0287 = DS 19
029A 00 DB 0
;
; POINTERS AND BUFFERS
029B 0004 SBP: DW SSIZE ;NEXT CHARACTER POSITION TO READ
029D = SBUFF: DS SSIZE

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069D 0000 PBP: DW 0
069F PBUFF: DS PSIZE
;
099F 0000 HBPP: DW 0
09A1 HBUFF: DS HSIZE
005C = FCB EQU SCH ;FILE CONTROL BLOCK ADDRESS
0001 = FNM EQU 1 ;POSITION OF FILE NAME
0009 = FLN EQU 9 ;FILE NAME LENGTH
0080 = BUFF EQU 80H ;INPUT DISK BUFFER ADDRESS
;
SEL: ;SELECT DISK IN REG-A
0CA1 213402 LXI H,CDISK
0CA4 BE CMP M ;SAME?
0CA5 C8 RZ
0CA6 77 MOV M,A ;CHANGE CURRENT DISK
0CA7 5F MOV E,A
0CA8 0E0E MVI C,SELECT
0CAA CD0500 CALL BDOS
0CAD C9 RET
;
SCNP: ;SCAN THE NEXT PARAMETER
0CAE 23 INX H
0CAF 7E MOV A,M
0CB0 FE20 CPI
0CB2 CAB80C JZ SCNPO
0CB5 DE41 SBI 'A' ;NORMALIZE
0CB7 C9 RET
0CB8 3A3402 SCNPO: LDA CDISK
0CB8 C9 RET
;
PCON: ;PRINT MESSAGE AT H,L TO CONSOLE DEVICE
0CBC 7E MOV A,M
0CBD CDDE0E CALL PCHAR
0CC0 7E MOV A,M
0CC1 23 INX H
0CC2 FE0D CPI CR
0CC4 C2BC0C JNZ PCON
0CC7 3E0A MVI A,LF
0CC9 CDDE0E CALL PCHAR
0CCC C9 RET
;
FNAME: ;FILL NAME FROM DEFAULT FILE CONTROL BLOCK
0CCD 115C00 LXI D,FCB
0CD0 0609 MVI B,FLN
0CD2 1A FNAM0: LDAX D ;GET NEXT FILE CHARACTER
0CD3 FE3F CPI ?
0CD5 CABBD JZ FNERR ;FILE NAME ERROR
0CD8 77 MOV M,A ;STORE TO FILE CNTRL BLOCK
0CD9 23 INX H

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0CDA 13 INX D
 0CDB 05 DCR B
 0CDC C2D20C JNZ FNAM0 ;FOR NEXT CHARACTER
 0CDF C9 RET

; INIT: ;SET UP STACK AND FILES, START ASSEMBLER
 0CE0 21A00F LXI H,TITL
 0CE3 CDB00C CALL PCON
 0C26 C33F0D JMP SET0

; OPEN: ;OPEN FILE ADDRESSED BY D,E
 0CE9 0E0F MVI C,OPENP
 0CE8 CD0500 CALL BDOS
 0CEE FEFF CPI 255
 0CF0 C0 RNZ
 ; OPEN ERROR
 0CF1 21B90F LXI H,ERROP
 0CF4 CDB00C CALL PCON
 0CF7 C30000 JMP BOOT

; CLOSE: ;CLOSE FILE ADDRESSED BY D,E
 0CFA 0E10 MVI C,CLOSEP
 0CPF CD0500 CALL BDOS
 0CFF FEFF CPI 255
 0D01 C0 RNZ ;CLOSE OK
 0D02 212910 LXI H,ERRCL
 0D05 CDB00C CALL PCON
 0D08 C30000 JMP BOOT

; DELETE: ;DELETE FILE ADDRESSED BY D,E
 0D03 0E13 MVI C,DELEF
 0D0D C30500 JMP BDOS

; MAKE: ;MAKE FILE ADDRESSED BY D,E
 0D10 0E16 MVI C,MAKEP
 0D12 CD0500 CALL BDOS
 0D15 FEFF CPI 255
 0D17 C0 RNZ
 ; MAKE ERROR
 0D18 21D00F LXI H,ERRMA
 0D1B CDB00C CALL PCON
 0D1E C30000 JMP BOOT

; SELA: LDA ADISK
 ; CALL SEL
 ; RET
 ; NPR: ;RETURN ZERO FLAG IF NO PRINT FILE
 0D28 3A3602 LDA PDISK
 0D28 FE19 CPI 'Z'-'A'

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0D2D C8 RZ
 0D2E FE17 CPI 'X'-'A' ;CONSOLE:
 0D30 C9 RET

; SELP: LDA PDISK
 0D31 3A3602 CALL SEL
 0D34 CDA10C RET
 0D37 C9 ;
 0D38 3A3702 SELH: LDA HDISK
 0D3B CDA10C CALL SEL
 0D3E C9 RET

; SET0: ;SET UP FILES FOR INPUT AND OUTPUT
 0D3F 3A5C00 LDA FCB ;GET FIRST CHARACTER
 0D42 FE20 CPI ;MAY HAVE FORGOTTEN NAME
 0D44 CABBD0 JZ FNERR ;FILE NAME ERROR
 0D47 0E19 MVI C,CSEL ;CURRENT DISK?
 0D49 CD0500 CALL BDOS ;GET IT TO REG
 0D4C 323402 STA CDISK

; SCAN PARAMETERS
 0D4F 216400 LXI H,FCB+FLN-1
 0D52 CDAE0C CALL SCNP
 0D55 323502 STA ADISK
 0D58 CDAE0C CALL SCNP
 0D5B 323702 STA HDISK
 0D5E CDAE0C CALL SCNP
 0D61 323602 STA PDISK

; LXI H,SCB ;ADDRESS SOURCE FILE CONTROL BLOCK
 0D64 213802 0D67 CDDC0C CALL FNAME ;FILE NAME OBTAINED FROM DEFAULT FCB

; CALL NPR ;Z OR X?
 0D6A CD280D 0D6D CA830D JZ NOPR
 0D70 215902 LXI H,PCB ;ADDRESS PRINT FILE CONTROL BLOCK
 0D73 E5 PUSH H ;SAVE A COPY FOR OPEN
 0D74 E5 PUSH H ;SAVE A COPY FOR DELETE
 0D75 CDDC0C CALL FNAME ;FILL PCB
 0D78 CD310D CALL SELP
 0D7B D1 POP D ;FCB ADDRESS
 0D7C CD080D CALL DELETE
 0D7F D1 POP D ;FCB ADDRESS
 0D80 CD100D CALL MAKE

; NOPR: ;TEST FOR HEX FILE
 0D83 3A3702 LDA HDISK
 0D86 FE19 CPI 'Z'-'A'
 0D88 CA9E0D JZ NOHEX
 0D88 217A02 LXI H,HCB
 0D8E E5 PUSH H

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0D8P E5      PUSH H
0D93 CDCD0C CALL FNAME
0D93 CD380D CALL SELH
0D96 D1      POP D
0D97 CD0B0D CALL DELETE
0D9A D1      POP D
0D9B CD100D CALL MAKE
;
; FILES SET UP, CALL ASSEMBLER
0D9E C30011 NOHEX: JMP ENDMOD
;
; SETUP: ;SETUP INPUT FILE FOR SOURCE PROGRAM
0DA1 210004 LXI H,SSIZE
0DA4 229302 SHLD SBP ;CAUSE IMMEDIATE READ
0CA7 AF      XRA A ;ZERO VALUE
0CA8 324402 STA SCBR ;CLEAR REEL NUMBER
0DA8 325802 STA SCBR ;CLEAR CURRENT RECORD
0CAE 322302 STA DBL ;CLEAR HEX BUFFER LENGTH
0DB1 CD210D CALL SELA
0DB4 113802 LXI D,SCB
0DB7 CDE90C CALL OPEN
;
; RET
;
; FNERR: ;FILE NAME ERROR
0DBB 21E30F LXI H,ERRFN
0DC2 CDEC2C CALL PCON
0DC1 C30000 JMP BOOT
;
; GCOMP: ;COMPARE D,E AGAINST H,L
0DC4 7A      MOV A,D
0DC5 BC      CMP H
0DC6 C0      RNZ
0DC7 7B      MOV A,E
0DC8 BD      CMP L
0DC9 C9      RET
;
; GNC: ;GET NEXT CHARACTER FROM SOURCE BUFFER
0DCA C5      PUSH B
0DCB D5      PUSH D
0DCC E5      PUSH H ;ENVIRONMENT SAVED
0DD0 2A9302 LHLD SBP
0DD3 110304 LXI D,SSIZE
0DD3 CDC40D CALL GCOMP
0DD6 C21902 JNZ GNC2
;
; READ ANOTHER BUFFER
0DD9 CD210D CALL SELA
0DDC 210000 LXI H,B

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0DDF 229B02 SHLD SBP ;NUMBER OF SOURCE BUFFERS
0DE2 0608 MVI B,NSB
0DE4 219D02 LXI H,SBUFF
;
GNC0: ;READ 128 BYTES
0DE7 C5      PUSH B ;SAVE COUNT
0DE8 E5      PUSH H ;SAVE BUFFER ADDRESS
0DE9 0E14      MVI C,READF
0DEB 113802 LXI D,SCB
0DEE CD0500 CALL BDOS ;PERFORM THE READ
0DF1 E1      POP H ;RESTORE BUFFER ADDRESS
0DF2 C1      POP B ;RESTORE BUFFER COUNT
0DF3 B7      ORA A ;SET FLAGS
0DF4 0E80      MVI C,128
0DF6 C20D0E JNZ GNC1
;
; NORMAL READ OCCURRED
0DF9 118000 LXI D,BUFF ;SOURCE BUFFER ADDRESS
0DFC 0E80 MVI C,128
0DFA 1A      MOV0: LDAX D ;GET CHARACTER
0DFE 77      MOV M,A ;STORE CHARACTER
0E00 13      INX D
0E01 23      INX H
0E02 0D      DCR C
0E03 C2FE0D JNZ MOV0
;
; BUFFER LOADED, TRY NEXT BUFFER
0E06 05      DCR B
0E07 C2E70D JNZ GNC0
0E0A C3190E JMP GNC2
;
; GNC1: ;EOF OR ERROR
0E0D FE03      CPI 3 ;ALLOW 0,1,2
0E0F D22B0E JNC FRERR ;FILE READ ERROR
0E12 361A      GNCE: MVI M,EOF ;STORE AND END OF FILE CHARACTER
0E14 23      INX H
0E15 0D      DCR C
0E16 C2120E JNZ GNCE ;FILL CURRENT BUFFER WITH EOF'S
;
; GNC2: ;GET CHARACTER TO ACCUMULATOR AND RETURN
0E19 119D02 LXI D,SBUFF
0E1C 2A9B02 LHLD SBP
0E1F E5      PUSH H ;SAVE CURRENT SBP
0E20 23      INX H ;READY FOR NEXT READ
0E21 229B02 SHLD SBP
0E24 E1      POP H ;RESTORE PREVIOUS SBP
0E25 19      DAD D ;ABSOLUTE ADDRESS OF CHARACTER
0E26 7E      MOV A,M ;GET IT
0E27 E1      POP H
0E28 D1      POP D
0E29 C1      POP B
0E2A C9      RET

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; FRERR: LXI H,ERRFR
0E28 21FA0P CALL PCON ;PRINT READ ERROR MESSAGE
0E2E CD8C0C JMP BOOT

; PNC: ;SAME AT PNCF, BUT ENVIRONMENT IS SAVED FIRST
0E31 C38000
0E34 C5 PUSH B
; CHECK FOR CONSOLE OUTPUT / NO OUTPUT
MOV B,A ;SAVE CHARACTER
LDA PDISK ;Z OR X?
CPI 'Z'-'A' ;Z NO OUTPUT
JZ PNRET

0E35 47 CPI 'X'-'A'
0E36 3A3602 MOV A,B ;RECOVER CHAR FOR CON OUT
0E39 FE19 JNZ PNOG
0E3B CA510E CALL PCHAR
JMP PNRET

0E3E PE17 ; NOT X OR Z, SO PRINT IT
0E40 78 PNGO: PUSH D
0E41 C24A0E PUSH H
0E42 E1 CALL PNCF
0E44 CDDE0E POP H
0E47 C3510E CALL PCHAR
JMP PNRET

0E4A D5 PNRET: POP B
0E4B E5 RET
0E4C CD530E
0E4F E1
0E50 D1
0E51 C1
0E52 C9

; PNCF: ;PRINT NEXT CHARACTER
0E53 2A9D06 LHLD PBP
0E55 EB XCHG
0E57 219P06 LXI H,PBUFF
0E5A 19 DAD D
0E5B 77 MOV M,A ;CHARACTER STORED AT PBP IN PBUFF
0E5C EB XCHG ;PBP TO H,L
0E5D 23 INX H ;POINT TO NEXT CHARACTER
0E5E 229D06 SHLD PBP ;REPLACE IT
0E61 EB XCHG
0E62 210003 LXI H,PSIZE
0E65 CDC40D CALL GCOMP ;AT END OF BUFFER?
0E68 C8 RNZ ;RETURN IF NOT

; OVERFLOW, WRITE BUFFER
0E69 CD310D CALL SELP
0E6C 210000 LXI H,0
0E6F 229D06 SHLD PBP
0E72 219F06 LXI H,PBUFF
0E75 115902 LXI D,PCB ;D,E ADDRESS FILE CONTROL BLOCK
0E78 0606 MVI B,NPB ;NUMBER OF BUFFERS TO B
; (DROP THROUGH TO WBUFF)

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; WBUFF: ;WRITE BUFFERS STARTING AT H,L FOR B BUFFERS
0E7A 7E CHECK FOR EOF'S
0E7B FE1A MOV A,M
0E7D C8 CPI EOF
RZ ;DON'T DO THE WRITE

; PUSH B ;SAVE NUMBER OF BUFFERS
0E7E C5 PUSH D ;SAVE FCB ADDRESS
0E7F D5 MVI C,128 ;READY FOR MOVE
0E80 0E80 LXI D,BUF
0E82 118000

; WBUFO: ;MOVE TO BUFFER
0E85 7E MOV A,M ;GET CHARACTER
0E86 12 STAX D ;PUT CHARACTER
0E87 23 INX H
0E88 13 INX D
0E89 0D DCR C
0E8A C2850E JNZ WBUFO

; WRITE BUFFER
0E8D D1 POP D ;RECOVER FCB ADDRESS
0E8E D5 PUSH D ;SAVE IT AGAIN FOR LATER
0E8F E5 PUSH H ;SAVE BUFFER ADDRESS
0E90 0E15 MVI C,WRITE ;DOS WRITE FUNCTION
0E92 CD0500 CALL BDOS
0E95 E1 POP H ;RECOVER BUFFER ADDRESS
0E96 D1 POP D ;RECOVER FCB ADDRESS
0E97 C1 POP B ;RECOVER BUFFER COUNT
0E98 B7 ORA A ;SET ERROR RETURN FLAGS
0E99 C2A10E JNZ FWERR

; WRITE OK
0E9C 05 DCR B
0E9D C8 RZ ;RETURN IF NO MORE BUFFERS TO WRITE
0E9E C37A0E JMP WBUFF

; FWERR: ;ERROR IN WRITE
0EA1 211110 LXI H,ERRPW
0EA4 CD8C0C CALL PCON ;ERROR MESSAGE OUT
0EA7 C3770F JMP EORC ;TO CLOSE AND REBOOT

; PNB: ;PUT NEXT HEX BYTE
0EAA C5 PUSH B
0EAB D5 PUSH D
0EAC E5 PUSH H
0EAD CDB40E CALL PNBF
0EB0 E1 POP H
0EB1 D1 POP D
0EB2 C1 POP B

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02B3 C9      RET
; PNBF: ;PUT NEXT BYTE
; (SIMILAR TO THE PNCF SUBROUTINE)
0E34 2A9F09    LHLD HBP
0E37 E8        XCHG
0E33 21A109    LXI H,HBUFF
0E2B 19        DAD D
0E3C 77        MOV M,A ;CHARACTER STORED AT HBP IN HBUFF
0E3D EB        XCHG
0E3E 23        INX H ;HBP INCREMENTED
0E3F 229F09    SHLD HBP
0E2C EB        XCHG ;BACK TO D,E
0E23 210003    LXI H,HSIZE
0E26 CDC48D    CALL GCOMP ;EQUAL?
0E29 C8        RNZ
; OVERFLOW, WRITE BUFFERS
0ECA CD380D    CALL SELH
0ECD 210000    LXI H,D
0EDE 229F09    SHLD HBP
0ED3 21A109    LXI H,HBUFF
0ED6 117A02    LXI D,HCB ;FILE CONTROL BLOCK FOR HEX FILE
0ED9 0636      MVI B,NHB
0EDB C37A0E    JMP WBUFF ;WRITE BUFFERS
; PCHAR: ;PRINT CHARACTER IN REGISTER A
0EDE C5        PUSH B
0EDF D5        PUSH D
0EE0 E5        PUSH H
0EE1 0E02      MVI C,WRITC
0EE3 5P        MOV E,A
0EE4 CD0500    CALL BDOS
0EE7 E1        POP H
0EE8 D1        POP D
0EE9 C1        POP B
0EEA C9        RET
; WOCHAR: ;WRITE CHARACTER IN REG-A WITH REFLECT AT CONSOLE IF ERROR
0EEB 4F        MOV C,A ;SAVE THE CHAR
0EEC CD340E    CALL PNC ;PRINT CHAR
0EEF 3A8C01    LDA QBUFF
0EF2 FE20      CPI
0EF4 C8        RZ
; ERROR IN LINE
0EF5 3A3602    LDA PDISK
0EF3 FE17      CPI 'X'-'A'
0EFA C8        RZ ;ALREADY PRINTED IF 'X'-'A'
0EF8 79        MOV A,C ;RECOVER CHARACTER

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0EFC CDDE0E    CALL PCHAR ;PRINT IT
0EFF C9        RET
; WOBUFF: ;WRITE THE OUTPUT BUFFER TO THE PRINT FILE
0F00 3A8401    LDA QBP ;GET CHARACTER COUNT
0F03 210C01    LXI H,QBUFF ;BASE OF BUFFER
0F06 B7        WOB0: ORA A ;ZERO COUNT?
0F07 CA150F    JZ WOBE
; NOT END, SAVE COUNT AND GET CHARACTER
0F0A 47        MOV B,A ;SAVE COUNT
0F0B 7E        MOV A,M
0F0C CDEB0E    CALL WOCHAR ;WRITE CHARACTER
0F0F 23        INX H ;ADDRESS NEXT CHARACTER OF BUFFER
0F10 78        MOV A,B ;GET COUNT
0F11 3D        DCR A
0F12 C3060F    JMP WOB0
; WOBE: ;END OF PRINT - ZERO QBP
0F15 328401    STA QBP
; FOLLOW BY CR LF
0F18 3E0D      MVI A,CR
0F1A CDEB0E    CALL WOCHAR
0F1D 3E0A      MVI A,LF
0F1F CDEB0E    CALL NOCHAR
0F22 210C01    LXI H,QBUFF
0F25 3E78      MVI A,QBMAX ;READY TO BLANK OUT
0F27 3620      WOB2: MVI M,
0F29 23        INX H
0F2A 3D        DCR A
0F2B C2270F    JNZ WOB2
0F2E C9        RET
; PERR: ;FILL QBUFF ERROR MESSAGE POSITION
0F2F 47        MOV B,A ;SAVE CHARACTER
0F30 210C01    LXI H,QBUFF
0F33 7E        MOV A,M
0F34 FE20      CPI
0F36 C0        RNZ ;DON'T CHANGE IT IF ALREADY SET
0F37 70        MOV M,B ;STORE ERROR CHARACTER
0F38 C9        RET
; EOR: ;END OF ASSEMBLER
0F39 CD280D    CALL NPR ;Z OR A?
0F3C CA4F0F    JZ EOPR
; FILL OUTPUT FILES WITH EOF'S
0F3F 2A9D06    EOR2: LHLD PBP
0F42 7D        MOV A,L
0F43 B4        ORA H ;VALUE ZERO?
0F44 CA4F0F    JZ EOPR

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0F47 3E1A      MVI    A,EOF  ;CTL-Z IS END OF FILE
0F49 CD340E      CALL   PNC   ;PUT ENDFILES IN PRINT BUFFER
0F4C C33F0F      JMP    EOR2  ;EVENTUALLY BUFFER IS WRITTEN
;
EOPR: ;END OF PRINT FILE, CHECK HEX
LDA    HDISK
CPI    'Z'-'A'
JZ     EORC
;
EOR0: ;WRITE TERMINATING RECORD INTO HEX FILE
LUA   DBL   ;MAY BE ZERO ALREADY
ORA   A
CNZ   WHEX  ;WRITE HEX BUFFER IF NOT ZERO
LHLD  FPC   ;GET CURRENT FPC AS LAST ADDRESS
SHLD  BPC   ;RECORD LENGTH ZERO, BASE ADDRESS 0000
CALL  WHEX  ;WRITE HEX BUFFER
;
; NOW CLEAR OUTPUT BUFFER FOR HEX FILE
EOR1: LHLD  HBP
MOV   A,L
JZ    EORC
MVI   A,EOF
CALL  PNB
JMP   EOR1
;
; CLOSE FILES AND TERMINATE
EORC: CALL  NPR
JZ    EORPC
CALL  SELP
LXI   D,PCB
CALL  CLOSE
;
EORPC: LDA   HDISK
CPI    'Z'-'A'
JZ     EORHC
;
EORHC: LXI   H,ENDA
CALL  PCON
JMP   BOOT
;
0FA0 43522F4D28TITLE: DB  'CP/M ASSEMBLER - VER 1.0',CR
0FB9 4E4F20534FERROP: DB  'NO SOURCE FILE PRESENT',CR
0FDC 4E4F204449ERRMA: DB  'NO DIRECTORY SPACE',CR
0FE3 534F555243ERRFN: DB  'SOURCE FILE NAME ERROR',CR
0FFA 534F555243ERRFR: DB  'SOURCE FILE READ ERROR',CR

```

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```

1011 4F55545055ERRFW: DB  'OUTPUT FILE WRITE ERROR',CR
1029 43414E4E4FERRCL: DB  'CANNOT CLOSE FILES',CR
103C 454E44204FENDA: DB  'END OF ASSEMBLY',CR
;
DHEX: ;DATA TO HEX BUFFER (BYTE IN REG-A)
104C C5      PUSH   B
104D 47      MOV    B,A  ;HOLD CHARACTER FOR 'Z' TEST
104E 3A3702  LDA    HDISK
CPI    'Z'-'A'
1051 FE19
1053 78      MOV    A,B  ;RECOVER CHARACTER
1054 CA9810  JZ    CHRET
1057 D5      PUSH   D  ;ENVIRONMENT SAVED
1058 FS      PUSH   PSW  ;SAVE DATA BYTE
1059 212302  LXI   H,DBL  ;CURRENT LENGTH
105C 7E      MOV    A,M  ;TO ACCUM
105D B7      ORA    A  ;ZERO?
105E CA8410  JZ    DHEX3
;
; LENGTH NOT ZERO, MAY BE FULL BUFFER
1061 FE10  CPI    16
1063 DA6C10  JC    DHEX1 ;BR IF LESS THAN 16 BYTES
;
1066 CDB810  ;BUFFER FULL, DUMP IT
CALL  WHEX  ;DBL = 0 UPON RETURN
1069 C38410  JMP    DHEX3 ;SET BPC AND DATA BYTE
;
DHEX1: ;PARTIAL BUFFER IN PROGRESS, CHECK FOR SEQUENTIAL BYTE LOAD
LHLD  FPC
XCHG
LHLD  BPC  ;BASE PC IN H,L
MOV   C,A  ;CURRENT LENGTH OF BUFFER
1073 4F      MVI    B,0  ;IS IN B,C
1074 0600  DAD    B  ;BPC+DBL TO H,L
1076 09      MOV    A,E  ;READY FOR COMPARE
1077 7B      CMP    L  ;EQUAL?
1078 BD      JNZ    DHEX2 ;BR IF NOT
1079 C28110  MOV    A,D  ;CHECK HO BYTE
107C 7A      CMP    H
107D BC      JZ    DHEX4 ;BR IF SAME ADDRESS
107E CA8A10
;
DHEX2: ;NON SEQUENTIAL ADDRESS, DUMP AND CHANGE BASE ADDRESS
1081 CDB810  CALL  WHEX
DHEX3: ;SET NEW BASE
LHLD  FPC
SHLD  BPC
;
DHEX4: ;STORE DATA BYTE AND INC DBL
108A 212302  LXI   H,DBL
108D 5E      MOV    E,M  ;LENGTH TO REG-E
108E 34      INR    M  ;DBL=DBL+1
108F 1600  MVI    D,0  ;HIGH ORDER ZERO FOR DOUBLE ADD

```

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1091 212402 LXI H,DBUFF
 1094 19 DAD D ;DBUFF+DBL TO H,L
 1095 F1 POP PSW ;RESTORE DATA BYTE
 1096 77 MOV M,A ;INTO DATA BUFFER
 1097 D1 POP D
 1098 C1 DHRET: POP B ;ENVIRONMENT RESTORED
 1099 C9 RET

;
 WRC: ;WRITE CHARACTER WITH CHECK SUM IN D
 PUSH PSW
 RRC
 RRC
 RRC
 RRC
 ANI 0FH
 CALL HEXC ;OUTPUT HEX CHARACTER
 POP PSW ;RESTORE BYTE
 PUSH PSW ;SAVE A VERSION
 ANI 0FH
 CALL HEXC ;WRITE LOW NIBBLE
 POP PSW ;RESTORE BYTE
 ADD D ;COMPUTE CHECKSUM
 MOV D,A ;SAVE CS
 RET

;
 HEXC: ;WRITE CHARACTER
 ADI 90H
 DAA
 ACI 40H
 DAA
 JMP PNB ;PUT BYTE

;
 WHEX: ;WRITE CURRENT HEX BUFFER
 MVI A, ":" ;RECORD HEADER
 CALL PNB ;PUT BYTE
 LXI H,DBL ;RECORD LENGTH ADDRESS
 MOV E,M ;LENGTH TO REG-E
 XRA A ;ZERO TO REG-A
 MOV D,A ;CLEAR CHECKSUM
 MOV M,A ;LENGTH IS ZEROED FOR NEXT WRITE
 LHLD BPC ;BASE ADDRESS FOR RECORD
 MOV A,E ;LENGTH TO A
 CALL WRC ;WRITE HEX VALUE
 MOV A,H ;HIGH ORDER BASE ADDR
 CALL WRC ;WRITE HO BYTE
 MOV A,L ;LOW ORDER BASE ADDR
 CALL WRC ;WRITE LO BYTE
 XRA A ;ZERO TO A
 CALL WRC ;WRITE RECORD TYPE 00
 MOV A,E ;CHECK FOR LENGTH 0

10D8 B7
 10D9 CAE810 ORA A
 JZ WHEX1
;
; NON - ZERO, WRITE DATA BYTES
 LXI H,DBUFF
 WHEX0: MOV A,M ;GET BYTE
 INX H
 CALL WRC ;WRITE DATA BYTE
 DCR E ;END OF BUFFER?
 JNZ WHEX0
;
; END OF DATA BYTES, WRITE CHECK SUM
 WHEX1: XRA A
 SUB D ;COMPUTE CHECKSUM
 CALL WRC
;
; SEND CRLF AT END OF RECORD
 MVI A,CR
 CALL PNB
 MVI A,LF
 CALL PNB
 RET

10E8 AF
 10E9 92
 10EA CD9A10
 10ED 3E0D
 10EF CDAA0E
 10F2 3E0A
 10F4 CDAA0E
 10F7 C9
;
;
;

1100 =
 10F8
 ENDMOD EOU
 END

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```

1100          ORG    1100H
1100 C30014  JMP    ENDMOD ;END OF THIS MODULE
1103 C33211  JMP    INIT5 ;INITIALIZE THE SCANNER
1106 C3C011  JMP    SCAN  ;CALL THE SCANNER
;
; ENTRY POINTS IN I/O MODULE
1100 C30014  IOMOD EQU    200H
1106 C33211  GNCF  EQU    IOMOD+6H
1106 C3C011  WOBUFF EQU    IOMOD+15H
1106 C3C011  PERR  EQU    IOMOD+18H
;
1129 LASTC: DS   1      ;LAST CHAR SCANNED
110A NEXTC: DS  1      ;LOOK AHEAD CHAR
110B STYPE: DS  1      ;RADIX INDICATOR
;
; COMMON EQUATES
0078 PBMAX EQU    120   ;MAX PRINT SIZE
010C PBUFF EQU    10CH  ;PRINT BUFFER
0184 PBP EQU    PBUFF+PBMAX ;PRINT BUFFER POINTER
;
0185 TOKEN EQU    PBP+1 ;CURRENT TOKEN UNDER SCAN
0186 VALUE EQU    TOKEN+1 ;VALUE OF NUMBER IN BINARY
0188 ACCLEN EQU    VALUE+2 ;ACCUMULATOR LENGTH
0040 ACMAX EQU    64     ;MAX ACCUMULATOR LENGTH
0189 ACCUM EQU    ACCLEN+1
;
01C9 EVALUE EQU    ACCUM+ACMAX ;VALUE FROM EXPRESSION ANALYSIS
;
01CB SYTOP EQU    EVALUE+2 ;CURRENT SYMBOL TOP
01CD SYMAX EQU    SYTOP+2 ;MAX ADDRESS+1
;
01CF PASS EQU    SYMAX+2 ;CURRENT PASS NUMBER
01D0 FPC EQU    PASS+1  ;FILL ADDRESS FOR NEXT HEX BYTE
01D2 ASPC EQU    FPC+2  ;ASSEMBLER'S PSEUDO PC
;
; GLOBAL EQUATES
0001 IDEN EQU    1      ;IDENTIFIER
0002 NUNB EQU    2      ;NUMBER
0003 STRNG EQU    3      ;STRING
0004 SPECL EQU    4      ;SPECIAL CHARACTER
;
0001 PLABT EQU    0001B  ;PROGRAM LABEL
0002 DLABT EQU    0010B  ;DATA LABEL
0004 EQUT EQU    0100B  ;EQUATE
0005 SETT EQU    0101B  ;SET
0006 HACT EQU    0110B  ;MACRO
;

```

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0008 =	EXTT	EQU	1000B	,EXTERNAL
000B =	REFT	EQU	1011B	;REFER
000C =	GLBT	EQU	1100B	;GLOBAL
0002 =	;			
0008 =	BINV	EQU	2	
000A =	OCTV	EQU	8	
0010 =	DECV	EQU	10	
000D =	HEXV	EQU	16	
000A =	CR	EQU	0DH	
001A =	LF	EQU	0AH	
0009 =	EOF	EQU	1AH	
	TAB	EQU	09H	,TAB CHARACTER
	;			
	;			
	GNC:	UTILITY SUBROUTINES		
	;	GET NEXT CHARACTER AND ECHO TO PRINT FILE		
	CALL	GNCF		
	PUSH	PSW		
	CPI	CR		
	JZ	GNC0		
	CPI	LF		;IF LF THEN DUMP CURRENT BUFFER
	JZ	GNC0		
	;			
	;			
	110C CD0602			
	110F F5			
	1110 FE0D			
	1112 CA3011			
	1115 FE0A			
	1117 CA3011			
	;			
	111A 3A8401			
	111D FE78			
	111F D23011			
	;			
	1122 5F			
	1123 1600			
	1125 3C			
	1126 328401			
	1129 210C01			
	112C 19			
	112D F1			
	112E 77			
	112F C9			
	;			
	1130 F1			
	1131 C9			
	;			
	INIT5:	INITIALIZE THE SCANNER		
	CALL	ZERO		
	STA	NEXTC		;CLEAR NEXT CHARACTER
	STA	PBP		
	MVI	A,LF		;SET LAST CHAR TO LF
	STA	LASTC		
	CALL	WOBUFF		;CLEAR BUFFER
	MVI	A,16		;START OF PRINT LINE
	STA	PBP		

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```

1148 C9      RET
;ZERO: XRA    A
STA    ACCLEN
STA    STYPE
RET

;SAVER: ;STORE THE NEXT CHARACTER INTO THE ACCUMULATOR AND UPDATE ACCLEN
1151 218801   LXI    H,ACCLEN
1154 7E        MOV    A,M
1155 FE40      CPI    ACMAX
1157 D45F11    JC     SAVL
115A 3500      MVI    M,0
115C CD1E13    CALL   ERRO
115F 5E        MOV    E,M ;D,E WILL HOLD INDEX
1160 1600      MVI    D,0
1162 34        INR    M
1163 23        INX    H ;ADDRESS ACCUMULATOR
1164 19        DAD    D ;ADD INDEX TO ACCUMULATOR
1165 3A0A11    LDA    NEXTC ;GET CHARACTER
1168 77        MOV    M,A ;INTO ACCUMULATOR
1169 C9        RET

;TDOLL: ;TEST FOR DOLLAR SIGN, ASSUMING H,L ADDRESS NEXTC
116A 7E        MOV    A,M
116B FE24      CPI    '$'
116D C0        RNZ
116E AF        XRA    A ;TO GET A ZERO
116F 77        MOV    M,A ;CLEAR NEXTC
1170 C9        RET ;WITH ZERO FLAG SET

;NUMERIC: ;CHECK NEXTC FOR NUMERIC, RETURN ZERO FLAG IF NOT NUMERIC
1171 3A0A11    LDA    NEXTC
1174 D630      SUI    '0'
1176 FE0A      CPI    10
;CARRY RESET IF NUMERIC
1178 17        RAL
1179 E601      ANI    1B ;ZERO IF NOT NUMERIC
117A C9        RET

;HEX: ;RETURN ZERO FLAG IF NEXTC IS NOT HEXADECIMAL
117C CD7111    CALL   NUMERIC
117F C0        RNZ ;RETURNS IF 0-9
1180 3A0A11    LDA    NEXTC
1183 D641      SUI    'A'
1185 FE06      CPI    6
;CARRY SET IF OUT OF RANGE
1187 17        RAL
1188 E601      ANI    1B
118A C9        RET

```

```

118B 3A0A11
118E D641
1190 FE1A
1192 17
1193 E601
1195 C9

```

```

;LETTER: ;RETURN ZERO FLAG IF NEXTC IS NOT A LETTER
LDA    NEXTC
SUI    'A'
CPI    26
RAL
ANI    1B
RET

```

```

1196 CD6B11
1199 C8
119A CD7111
119D C9

```

```

;ALNUM: ;RETURN ZERO FLAG IF NOT ALPHANUMERIC
CALL   LETTER
RNZ
CALL   NUMERIC
RET

```

```

119E 3A0A11
11A1 FE61
11A3 D8
11A4 FE7B
11A6 D0
11A7 E65F
11A9 320A11
11AC C9

```

```

;TRANS: ;TRANSLATE TO UPPER CASE
LDA    NEXTC
CPI    'A' OR 1100000B ;LOWER CASE A
RC
CPI    ('Z' OR 1100000B)+1 ;LOWER CASE Z
RNC
ANI    1011111B ;NO CARRY IF GREATER THAN LOWER A
STA    NEXTC ;CONVERT TO UPPER CASE
RET

```

```

11AD CD0C11
11B0 320A11
11B3 CD9E11
11B6 C9

```

```

;GNCN: ;GET CHARACTER AND STORE TO NEXTC
CALL   GNC
STA    NEXTC
CALL   TRANS ;TRANSLATE TO UPPER CASE
RET

```

```

11B7 FE0D
11B9 C8
11BA FE1A
11BC C8
11BD FE21
11BF C9

```

```

;EOLT: ;END OF LINE TEST FOR COMMENT SCAN
CPI    CR
RZ
CPI    EOF
RZ
CPI    'I'
RET

```

```

11C0 AF
11C1 328501
11C4 CD4911

```

```

;SCAN: ;FIND NEXT TOKEN IN INPUT STREAM

```

```

XRA    A
STA    TOKEN
CALL   ZERO

```

```

11C7 3A0A11
11CA FE09
11CC CAF411
11CF FE3B
11D1 CAE111

```

```

;DEBLANK
DEBL1: LDA    NEXTC
CPI    TAB ;TAB CHARACTER TREATED AS BLANK OUTSIDE STRING
JZ    DEB1 ;MAY BE A COMMENT
CPI    ;
JZ    DEBL1 ;DEBLANK THROUGH COMMENT

```

```

11D4 FE2A      CPI    '*' ;PROCESSOR TECH COMMENT
11D6 C2ED11    JNZ    DEB2 ;NOT *
11D9 3A0911    LDA    LASTC
11DC FE2A      CPI    LF ;LAST LINE FEED?
11D2 C2ED11    JNZ    DEB2 ;NOT LF*
; COMMENT FOUND, REMOVE IT
11E1 CDAD11    DEB1: CALL  GNCN
11E4 CDB711    CALL  EGOT ;CR, EOF, OR I
11E7 CAF411    JZ    FINDL ;HANDLE END OF LINE
11EA C3E111    JMP    DEB1 ;OTHERWISE CONTINUE SCAN
11ED F620      DEB2: ORI   ' '
11EF FE20      CPI    ' '
11F1 C2FA11    JNZ    FINDL
11F4 CDAD11    DEB0: CALL  GNCN ;GET NEXT AND STORE TO NEXTC
11F7 C3C711    JMP    DEBL

; LINE DEBLANKED, FIND TOKEN TYPE
FINDL: ;LOOK FOR LETTER, DECIMAL DIGIT, OR STRING QUOTE
      CALL  LETTER
      JZ    FIND0
      MVI   A, IDEN
      JMP   STOKEN

; FIND0: CALL NUMERIC
1225 CD7111    JZ    FIND1
1228 CA1012    MVI   A,NUMB
1229 3E02      JMP   STOKEN

; FIND1: LDA NEXTC
1210 3A0A11    CPI    LF
1213 FE27      JNZ    FIND2
1215 C22112    XRA   A
1218 AF        STA   NEXTC ;DON'T STORE THE QUOTE
1219 320A11    MVI   A,STRNG
121C 3E03      JMP   STOKEN

; FIND2: ;ASSUME IT IS A SPECIAL CHARACTER
1221 FE0A      CPI    LF ;IF LF THEN DUMP THE BUFFER
1223 C23712    JNZ    FIND3
; LF FOUND
1226 3ACF01    LDA    PASS
1229 37          ORA   A
122A C41502    CN2    WOBUFF
122D 210C01    LXI   H,PBUFF ;CLEAR ERROR CHAR ON BOTH PASSES
1230 3620      MVI   M,
1232 3E10      MVI   A,16
1234 328401    STA   FBP ;START NEW LINE
1237 3E04      FIND3: MVI   A,SPECL
1239 328501    STOKEN: STA   TOKEN

```

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```

; ; LOOP WHILE CURRENT ITEM IS ACCUMULATING
SCTOK: LDA   NEXTC
       STA   LASTC ;SAVE LAST CHARACTER
       ORA   A
       CNZ   SAVER ;STORE CHARACTER INTO ACCUM IF NOT ZERO
       CALL  GNCN ;GET NEXT TO NEXTC
       LDA   TOKEN
       CPI   SPECL
       RZ    ;RETURN IF SPECIAL CHARACTER
       CPI   STRNG
       CNZ   TRANS ;TRANSLATE TO UPPER CASE IF NOT IN STRING
       LXI   H,NEXTC
       LDA   TOKEN

; ; CPI   IDEN
125A FE01      JNZ   SCT2
125C C26C12    ; ; ACCUMULATING AN IDENTIFIER
125F CD6A11    CALL  TDOLL ;$?
1262 CA3C12    JZ    SCTOK ;IF SO, SKIP IT
1265 CD9611    CALL  ALNUM ;ALPHA NUMERIC?
1268 C8        RZ    ;RETURN IF END
1269 C33C12    ; ; NOT END OF THE IDENTIFIER
                  JMP   SCTOK

; ; SCT2: ;NOT SPECIAL OR IDENT, CHECK NUMBER
126C FE02      CPI   NUMB
126E C20213    JNZ   SCT3
; ; ACCUMULATING A NUMBER, CHECK FOR $
1271 CD6A11    CALL  TDOLL
1274 CA3C12    JZ    SCTOK ;SKIP IF FOUND
1277 CD7C11    CALL  HEX   ;HEX CHARACTER?
127A C23C12    JNZ   SCTOK ;STORE IT IF FOUND
; ; END OF NUMBER, LOOK FOR RADIX INDICATOR
127D 3A0A11    LDA   NEXTC
1280 FE4F      CPI   '0' ;OCTAL INDICATOR
1282 CA8A12    JZ    NOCT
1285 FE51      CPI   'Q' ;OCTAL INDICATOR
1287 C28F12    JNZ   NUM2

; ; NOCT: ;OCTAL
128A 3E08      MVI   A,OCTV
128C C39612    JMP   SSTYP
; ; NUM2: CPI   'H'
128F FE48      JNZ   NUM3
1291 C2A012    ; ; CPI   'H'
                  JNZ   NUM3

```

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1294 3E10 MVI A,HEXV
 1296 320B11 SSTYP: STA STYPE
 1299 AP XRA A
 129A 320A11 STA NEXTC ;CLEAR THE LOOKAHEAD CHARACTER
 129D C3BB12 JMP NCON

; RADIX MUST COME FROM ACCUM
 12A0 3A0911 NUM3: LDA LASTC
 12A3 FE42 CPI 'B'
 12A5 C2AD12 JNZ NUM4
 12A8 3E02 MVI A,BINV
 12AA C3B412 JMP SSTY1

;
 12AD FE44 NUM4: CPI 'D'
 12AF 3E0A MVI A,DECV
 12B1 C2B812 JNZ SSTY2
 12B4 218801 SSTY1: LXI H,ACCLEN
 12B7 35 DCR M ;ACCLEN DECREMENTED TO REMOVE RADIX INDICATOR
 12B8 320B11 SSTY2: STA STYPE

;
 NCON: ;NUMERIC CONVERSION OCCURS HERE
 12B9 210000 LXI H,0
 12B8 220601 SHLD VALUE ;VALUE ACCUMULATES BINARY EQUIVALENT
 12C1 218801 LXI H,ACCLEN
 12C4 4E MOV C,M ;ACCLEN
 12C5 23 INX H ;ADDRESSES ACCUM

CLOP: ;NEXT DIGIT IS PROCESSED HERE
 12C6 7E MOV A,M
 12C7 23 INX H ;READY FOR NEXT LOOP
 12C8 FE41 CPI 'A'
 12CA D2D212 JNC CLOP1 ;NOT HEX A-F
 12CD D638 SUI '0' ;NORMALIZE
 12CF C3D412 JMP CLOP2

;
 CLOP1: ;HEX A-F
 12D2 D637 SUI 'A'-10
 CLOP2: ;CHECK SIZE AGAINST RADIX
 12D4 E5 PUSH H ;SAVE ACCUM ADDR
 12D5 C5 PUSH B ;SAVE CURRENT POSITION
 12D6 4F MOV C,A
 12D7 210811 LXI H,STYPE
 12DA BE CMP M
 12D8 D41813 CNC ERRV ;VALUE ERROR IF DIGIT>=RADIX
 12DE 0600 MVI B,0 ;DOUBLE PRECISION DIGIT
 12E0 7E MOV A,M ;RADIX TO ACCUMULATOR
 12E1 2A8601 LHLD VALUE
 12E4 EB XCHG ;VALUE TO D,E - ACCUMULATE RESULT IN H,L
 12E5 210000 LXI H,0 ;ZERO ACCUMULATOR

CLOP3: ;LOOP UNTIL RADIX GOES TO ZERO
 12E8 B7 ORA A

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12E9 CAF712 JZ CLOP4
 12EC 1F RAR ,TEST LSB
 12ED D2F112 JNC TTWO ;SKIP SUMMING OPERATION IF LSB=0
 12F0 19 DAD D ;ADD IN VALUE
 TTWO: ;MULTIPLY VALUE * 2 FOR SHL OPERATION
 12F1 EB XCHG
 12F2 29 DAD H
 12F3 EB XCHG
 12F4 C3E810 JMP CLOP3

;
 CLOP4: ;END OF NUMBER CONVERSION
 12F7 09 DAD B ;DIGIT ADDED IN
 12F8 228601 SHLD VALUE
 12FB C1 POP B
 12FC E1 POP H
 12FD 0D DCR C ;MORE DIGITS?
 12FE C2C612 JNZ CLOP
 1301 C9 RET ;DONE WITH THE NUMBER

;
 SCT3: ;MUST BE A STRING
 1302 3A0A11 LDA NEXTC
 1305 FE0D CPI CR ;END OF LINE?
 1307 CA1E13 JZ ERRO ;AND RETURN

;
 130A FE27 CPI
 130C C23C12 JNZ SCTOK
 130F CDAD11 CALL GNCN
 1312 FE27 CPI
 1315 C33C12 JRP SCTOK ;RETURN IF SINGLE QUOTE ENCOUNTERED
 ; END OF SCANNER

;
 ERRV: ;'V' VALUE ERROR
 1318 F5 PUSH PSW
 1319 3E56 MVI A,'V'
 131B C32413 JMP ERR

;
 ERRO: ;'0' OVERFLOW ERROR
 131E F5 PUSH PSW
 131F 3E4F MVI A,'0'
 1321 C32413 JMP ERR

;
 ERR: ;PRINT ERROR MESSAGE
 1324 C5 PUSH B
 1325 E5 PUSH H
 1326 CD1802 CALL PERR
 1329 E1 POP H
 132A C1 POP B

132B F1
132C C9

POP
RET

PSW

1400 =
132D

ENDMOD EQU
END

(\$ AND 0FF00H) + 100H

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1340 ORG 1340H
0200 = IOMOD EQU 200H ;IO MODULE ENTRY POINT
0212 = PCON EQU IOMOD+12H
021E = EOR EQU IOMOD+1EH

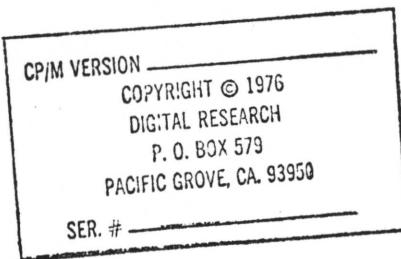
1340 C3A015
1343 C35C14
1346 C39E14
1349 C39814
134C C3EB14
134F C36015
1352 C37215
1355 C38D15
1358 C39615

; SYMBOL TABLE MANIPULATION MODULE
;
; ENTRY POINTS TO SYMBOL TABLE MODULE CP/M VERSION
;
; COMMON EQUATES
0078 = PBMAX EQU 120 ;MAX PRINT SIZE
010C = PBUFF EQU 10CH ;PRINT BUFFER
0184 = PBP EQU PBUFF+PBMAX ;PRINT BUFFER POINTER
;
0185 = TOKEN EQU PBP+1 ;CURRENT TOKEN UNDER SCAN
0186 = VALUE EQU TOKEN+1 ;VALUE OF NUMBER IN BINARY
0188 = ACCLEN EQU VALUE+2 ;ACCUMULATOR LENGTH
0040 = ACMAX EQU 64 ;MAX ACCUMULATOR LENGTH
0189 = ACCUM EQU ACCLEN+1
;
01C9 = EVALUE EQU ACCUM+ACMAX ;VALUE FROM EXPRESSION ANALYSIS
;
01CB = SYTOP EQU EVALUE+2 ;CURRENT SYMBOL TOP
01CD = SYMAX EQU SYTOP+2 ;MAX ADDRESS+1
;
01CF = PASS EQU SYMAX+2 ;CURRENT PASS NUMBER
01D0 = FPC EQU PASS+1 ;FILL ADDRESS FOR NEXT HEX BYTE
01D2 = ASPC EQU FPC+2 ;ASSEMBLER'S PSEUDO PC
01D4 = SYBAS EQU ASPC+2 ;BASE OF SYMBOL TABLE
01D6 = SYADR EQU SYBAS+2 ;CURRENT SYMBOL BEING ACCESSED
;
; GLOBAL EQUATES
0001 = IDEN EQU 1 ;IDENTIFIER
0002 = NUMB EQU 2 ;NUMBER
0003 = STRNG EQU 3 ;STRING
0004 = SPECL EQU 4 ;SPECIAL CHARACTER
;
0001 = PLAST EQU 0001B ;PROGRAM LABEL

```

0022 = DLABT EQU 0010B ;DATA LABEL
0024 = EOUT EQU 0100B ;EQUATE
0035 = SETT EQU 0101B ;SET
0036 = MACT EQU 0110B ;MACRO
;
EXTT EQU 1000B ;EXTERNAL
REPT EQU 1011B ;REFER
GLBT EQU 1100B ;GLOBAL
;
CR EQU 0DH
;
; DATA AREAS
; SYMBOL TABLE BEGINS AT THE END OF THIS MODULE
FIXD EQU 5 ;5 BYTES OVERHEAD WITH EACH SYMBOL ENTRY
; 2BY COLLISION, 1BY TYPE/LEN, 2BY VALUE
HSIZE EQU 128 ;HASH TABLE SIZE
HMASK EQU HSIZE-1 ;HASH MASK FOR CODING
HASHT: DS HSIZE*2 ;HASH TABLE
HASHC: DS 1 ;HASH CODE AFTER CALL ON LOOKUP
;
; SYMBOL TABLE ENTRY FORMAT IS
;
; : HIGH VAL BYTE :
; : LOW VAL BYTE :
; : CHARACTER N :
; : ...
; : CHARACTER 1 :
; : TYPE : LENG :
; : HIGH COLLISION:
; SYADR= : LOW COLLISION :
;
WHERE THE LOW/HIGH COLLISION FIELD ADDRESSES ANOTHER ENTRY WITH
THE SAME HASH CODE (OR ZERO IF THE END OF CHAIN), TYPE DESCRIBES
THE ENTRY TYPE (GIVEN BELOW), LENG IS THE NUMBER OF CHARACTERS IN
THE SYMBOL PRINTNAME -1 (I.E., LENG=0 IS A SINGLE CHARACTER PRINT-
NAME, WHILE LENG=15 INDICATES A 16 CHARACTER NAME). CHARACTER 1
THROUGH N GIVE THE PRINTNAME CHARACTERS IN ASCII UPPER CASE (ALL
LOWER CASE NAMES ARE TRANSLATED ON INPUT), AND THE LOW/HIGH VALUE
GIVE THE PARTICULAR ADDRESS OR CONSTANT VALUE ASSOCIATED WITH THE
NAME. THE REPRESENTATION OF MACROS DIFFERS IN THE FIELDS WHICH
FOLLOW THE VALUE FIELD (MACROS ARE NOT CURRENTLY IMPLEMENTED).

```



; THE TYPE FIELD CONSISTS OF FOUR BITS WHICH ARE ASSIGNED AS
FOLLOWS:

0000	UNDEFINED SYMBOL
0001	LOCAL LABELLED PROGRAM
0010	LOCAL LABELLED DATA
0011	(UNUSED)
0100	EQUATE
0101	SET
0110	MACRO
0111	(UNUSED)
1000	(UNUSED)
1001	EXTERN LABELLED PROGRAM
1010	EXTERN LABELLED DATA
1011	REFERENCE TO MODULE
1100	(UNUSED)
1101	GLOBAL UNDEFINED SYMBOL
1110	GLOBAL LABELLED PROGRAM
1111	(UNUSED)

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0001 =	PLABT EQU 0001B ;PROGRAM LABEL
0002 =	DLABT EQU 0010B ;DATA LABEL
0004 =	EOUT EQU 0100B ;EQUATE
0005 =	SETT EQU 0101B ;SET
0006 =	MACT EQU 0110B ;MACRO
0008 =	EXTT EQU 1000B ;EXTERNAL ATTRIBUTE
000B =	REFT EQU 1011B ;REFER
000C =	GLBT EQU 1100B ;GLOBAL ATTRIBUTE
;	;
INISY:	;INITIALIZE THE SYMBOL TABLE
LXI	H,HASHT ;ZERO THE HASH TABLE
MVI	B,HSIZE
XRA	A ;CLEAR ACCUM
INI0:	MOV M,A
INX	H
MOV	M,A ;CLEAR DOUBLE WORD
INX	H
DCR	B
JNZ	INI0
;	SET SYMBOL TABLE POINTERS
LXI	H,0
SHLD	SYADR

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1470 C9 ;
; RET
;
; HASH: ;COMPUTE HASH CODE FOR CURRENT ACCUMULATOR
1471 218801 LXI H,ACCLEN
1474 46 MOV B,M ;GET ACCUM LENGTH
1475 A7 XRA A ;CLEAR ACCUMULATOR
1476 23 CH0: INX H ;MOVE TO FIRST/NEXT CHARACTER POSITION
1477 86 ADD M ;ADD WITH OVERFLOW
1478 85 DCR B
1479 C27614 JNZ CH0
147C E67F ANI HMASK ;MASK BITS FOR MODULO HZISE
147E 325B14 STA HASHC ;FILL HASHC WITH RESULT
1481 C9 RET

; SETLN: ;SET THE LENGTH FIELD OF THE CURRENT SYMBOL
1482 47 MOV B,A ;SAVE LENGTH IN B
1483 2AD601 LHLD SYADR
1485 23 INX H
1487 23 INX H
1488 7E MOV A,M ;GET TYPE/LENGTH FIELD
1489 E6F0 ANI 0FH ;MASK OUT TYPE FIELD
148B 88 ORA B ;MASK IN LENGTH
148C 77 MOV M,A
148D C9 RET

; GETLN: ;GET THE LENGTH FIELD TO REG-A
148E 2AD601 LHLD SYADR
1491 23 INX H
1492 23 INX H
1493 7E MOV A,M
1494 E60F ANI 0FH
1496 3C IHR A ;LENGTH IS STORED AS VALUE - 1
1497 C9 RET

; FOUND: ;FOUND RETURNS TRUE IF SYADR IS NOT ZERO (TRUE IS NZ FLAG HERE)
1498 2AD601 LHLD SYADR
1493 7D MOV A,L
149C B4 ORA H
149D C9 RET

; LOOKUP: ;LOOK FOR SYMBOL IN ACCUMULATOR
149E CD7114 CALL CHASH ;COMPUTE HASH CODE
; NORMALIZE IDENTIFIER TO 16 CHARACTERS
14A1 218801 LXI H,ACCLEN
14A4 7E MOV A,M
14A5 FE11 CPI 17
14A7 DAAC14 JC LENOK
14AA 3610 MVI M,16

LENOK:
14AC 215B14
14AF 5E
14B0 1600
14B2 215B13
14B5 19
14B6 19
14B7 5E
14B8 23
14B9 66
14BA 6B
14BB 22D601
14BE CD9814
14C1 C8
14C2 CD8E14
14C5 218801
14C8 BE
14C9 C2E114
14CC 47
14CD 23
14CE EB
14CF 2AD601
14D2 23
14D3 23
14D4 23
14D5 1A
14D6 BE
14D7 C2E114
14DA 13
14DB 23
14DC 05
14DD C2D514
14E0 C9
14E1 2AD601
14E4 5E
14E5 23
14E6 56
14E7 EB
14E8 C3BB14
; LOOK FOR SYMBOL THROUGH HASH TABLE
LXI H,HASHC
MOV E,M
MVI D,0 ;DOUBLE HASH CODE IN D,ESER.#
LXI H,HASHT ;BASE OF HASH TABLE
DAD D
DAD D ;HASHT(HASHC)
INX H
MOV H,M
MOV L,E ;HEADER TO LIST OF SYMBOLS IS IN B,L
SIHL SYADR
CALL FOUND
RZ ;RETURN IF SYADR BECOMES ZERO
; OTHERWISE EXAMINE CHARACTER STRING FOR MATCH
CALL GETLN ;GET LENGTH TO REG-A
LXI H,ACCLEN
CMP M
JNZ LCOMP
; LENGTH MATCH, TRY TO MATCH CHARACTERS
MOV B,A ;STRING LENGTH IN B
INX H ;HL ADDRESSES ACCUM
XCHG ;TO D,E
LHLD SYADR
INX H
INX H
INX H ;ADDRESSES CHARACTERS
LDAX D ;NEXT CHARACTER FROM ACCUM
CMP M ;NEXT CHARACTER IN SYMBOL TABLE
JNZ LCOMP
; CHARACTER MATCHED, INCREMENT TO NEXT
INX D
INX H
DCR B
JNZ LOOK1
; COMPLETE MATCH AT CURRENT SYMBOL, SYADR IS SET
RET
; LCOMP: ;NOT FOUND, MOVE SYADR DOWN ONE COLLISION ADDRESS
LHLD SYADR
MOV E,M
INX H
MOV D,M ;COLLISION ADDRESS IN D,E
XCHG
JMP LOOK1

```

ENTER: ;ENTER SYMBOL IN ACCUMULATOR
; ENSURE THERE IS ENOUGH SPACE IN THE TABLE
14EB 218801 LXI H,ACCLEN
14EE 5E MOV E,M
14EF 1608 MVI D,0 ;DOUBLE PRECISION ACCLEN IN D,E
14F1 2ACB01 LHLD SYTOP
14F4 22D601 SHLD SYADR ;NEXT SYMBOL LOCATION
14F7 19 DAD D ;SYTOP+ACCLEN
14F8 110500 LXI D,FIXD ;FIXED DATA/SYMBOL
14F8 19 DAD D ;HL HAS NEXT TABLE LOCATION FOR SYMBOL
14FC EB XCCHG ;NEW SYTOP IN D,E
14FD 2ACD01 LHLD SYMAX ;MAXIMUM SYMTOP VALUE
1500 73 MOV A,E
1501 95 SUB L ;COMPUTE 16-BIT DIFFERENCE
1502 7A MOV A,D
1503 9C SBB H
1504 EB XCCHG ;NEW SYTOP IN H,L
1505 D24115 JNC OVERER ;OVERFLOW IN TABLE
;
; OTHERWISE NO ERROR
1508 22CB01 SHLD SYTOP ;SET NEW TABLE TOP
1509 2AD601 LHLD SYADR ;SET COLLISION FIELD
150E EB XCCHG ;CURRENT SYMBOL ADDRESS TO D,E
150F 215814 LXI H,HASHC ;HASH CODE FOR CURRENT SYMBOL TO H,L
1512 4E MOV C,M ;LOW BYTE
1513 0600 MVI B,0 ;DOUBLE PRECISION VALUE IN B,C
1515 215813 LXI H,HASHT ;BASE OF HASH TABLE
1518 09 DAD B
1519 09 DAD B ;HASHT(HASHC) IN H,L
;
; D,E ADDRESSES CURRENT SYMBOL - CHANGE LINKS
151A 4E MOV C,M ;LOW ORDER OLD HEADER
1518 23 INX H
151C 46 MOV B,M ;HIGH ORDER OLD HEADER
151D 72 MOV M,D ;HIGH ORDER NEW HEADER TO HASH TABLE
151E 2B DCX H
151F 73 MOV M,E ;LOW ORDER NEW HEADER TO HASH TABLE
1520 EB XCCHG ;H,L HOLDS SYMBOL TABLE ADDRESS
1521 71 MOV M,C ;LOW ORDER OLD HEADER TO COLLISION FIELD
1522 23 INX H
1523 70 MOV M,B ;HIGH ORDER OLD HEADER TO COLLISION FIELD
;
; HASH CHAIN NOW REPAIRED FOR THIS ENTRY, COPY THE PRINTNAME
1524 118801 LXI D,ACCLEN
1527 1A LDAX D ;GET SYMBOL LENGTH
1528 FE11 CPI 17 ;LARGER THAN 16 SYMBOLS?
152A DA2F15 JC ENT1
152D 3E10 MVI A,16 ;TRUNCATE TO 16 CHARACTERS
;
; COPY LENGTH FIELD, FOLLOWED BY PRINTNAME CHARACTERS
152F 47 ENT1: MOV B,A ;COPY LENGTH TO B
1530 3D DCR A ;1-16 CHANGED TO 0-15

```

```

1531 23 INX H ;FOLLOWING COLLISION FIELD
1532 77 MOV M,A ;STORE LENGTH WITH UNDEFINED TYPE (0000)
;
; ENT2: INX H
1533 23 INX D
1534 13 LOAX D
1535 1A MOV M,A ;STORE NEXT CHARACTER OF PRINTNAME
1536 77 DCR B ;LENGTH=LENGTH-1
1537 05 JNZ ENT2 ;FOR ANOTHER CHARACTER
1538 C23315
;
; PRINTNAME COPIED, ZERO THE VALUE FIELD
1538 AF XRA A ;ZERO A
153C 23 INX H ;LOW ORDER VALUE
153D 77 MOV M,A
153E 23 INX H
153F 77 MOV M,A ;HIGH ORDER VALUE
1540 C9 RET
;
; OVERER: LXI H,ERRO ;OVERFLOW IN SYMBOL TABLE
1541 214A15 CALL PCON
1544 CD1202 JMP EOR ;END OF EXECUTION
1547 C31E02 DB 'SYMBOL TABLE OVERFLOW',CR
;
; SETTY: SET CURRENT SYMBOL TYPE TO VALUE IN REG-A
154A 53594D424FERRO: RAL
1560 17 RAL
1561 17 RAL
1562 17 RAL
1563 17 RAL
1564 E6F0 ANI 0F0H ;TYPE MOVED TO HIGH ORDER 4-BITS
1566 47 MOV B,A ;SAVE IT IN B
1567 2AD601 LHLD SYADR ;BASE OF SYMBOL TO ACCESS
156A 23 INX H ;ADDRESS OF TYPE/LENGTH FIELD
156B 23 INX H
156C 7E MOV A,M ;GET IT AND MASK
156D E6F0 ANI 0FH ;LEAVE LENGTH
156F B0 ORA B ;MASK IN TYPE
1570 77 MOV M,A ;STORE IT
1571 C9 RET
;
; GETTY: RETURN THE TYPE OF THE VALUE IN CURRENT SYMBOL
1572 2AD601 LHLD SYADR
1575 23 INX H
1576 23 INX H
1577 7E MOV A,M
1578 1F RAR
1579 1F RAR
157A 1F RAR
157B 1F RAR
157C E6F0 ANI 0FH ;TYPE MOVED TO LOW 4-BITS OF REG-A
157E C9 RET

```

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```

157F CD8E14      ;VALADR:   GET VALUE FIELD ADDRESS FOR CURRENT SYMBOL
1582 2AD601      CALL    GETLN  ;PRINTNAME LENGTH TO ACCUM
1585 5P          LHLD    SYADR  ;BASE ADDRESS
1586 1600        MOV     E,A
1588 19          MVI    D,0
1589 23          DAD    D      ;BASE(LEN)
158A 23          INX    H      ;FOR COLLISION FIELD
1583 23          INX    H      ;FOR TYPE/LEN FIELD
158C C9          RET
;VALADR:   ;SET THE VALUE FIELD OF THE CURRENT SYMBOL
;           ;VALUE IS SENT IN H,L
158D E5          PUSH   H      ;SAVE VALUE TO SET
158E CD7F15      CALL    VALADR
1591 D1          POP    D      ;POP VALUE TO SET, HL HAS ADDRESS TO FILL
1592 73          MOV    M,B
1593 23          INX    H
1594 72          MOV    M,D  ;FIELD SET
1595 C9          RET
;GETVAL:   ;GET THE VALUE FIELD OF THE CURRENT SYMBOL TO H,L
1596 CD7F15      CALL    VALADR ;ADDRESS OF VALUE FIELD TO H,L
1599 5E          MOV    E,M
159A 23          INX    H
159B 56          MOV    D,M
159C EB          XCHG
159D C9          RET
;ENDMOD EQU      ($ AND 0FFE0H) + 20H
  
```

```

15A0             ORG    15A0H
15A0 C36018      JMP    ENDMOD ;TO NEXT MODULE
15A3 C38317      JMP    BSEAR
15A6 C31018      JMP    BGET
;COMMON EQUATES
0078 =          PBMAX EQU 120 ;MAX PRINT SIZE
010C' =          PBUFF EQU 10CH ;PRINT BUFFER
0184 =          PBP  EQU PBUFF+PBMAX ;PRINT BUFFER POINTER
0185 =          TOKEN EQU PBP+1 ;CURRENT TOKEN UNDER SCAN
0186 =          VALUE EQU TOKEN+1 ;VALUE OF NUMBER IN BINARY
0188 =          ACCLEN EQU VALUE+2 ;ACCUMULATOR LENGTH
0040 =          ACMAX EQU 64 ;MAX ACCUMULATOR LENGTH
0189 =          ACCUM EQU ACCLEN+1
;ACCUM+ACMAX ;VALUE FROM EXPRESSION ANALYSIS
01C9 =          EVALUE EQU SYTOP EQU EVALUE+2 ;CURRENT SYMBOL TOP
01CD =          SYMAX EQU SYTOP+2 ;MAX ADDRESS+1
;SYMAX+2 ;CURRENT PASS NUMBER
01CF =          PASS  EQU FPC EQU PASS+1 ;FILL ADDRESS FOR NEXT HEX BYTE
01D0 =          01D2 =          ASPC EQU FPC+2 ;ASSEMBLER'S PSEUDO PC
;GLOBAL EQUATES
0001 =          IDEN  EQU 1 ;IDENTIFIER
0002 =          NUMB  EQU 2 ;NUMBER
0003 =          STRNG EQU 3 ;STRING
0004 =          SPECL EQU 4 ;SPECIAL CHARACTER
;PLABT EQU 0001B ;PROGRAM LABEL
0002 =          DLABT EQU 0010B ;DATA LABEL
0004 =          EQUT  EQU 0100B ;EQUATE
0005 =          SETT  EQU 0101B ;SET
0006 =          MACT  EQU 0110B ;MACRO
;EXTT EQU 1000B ;EXTERNAL
0008 =          REFT  EQU 1011B ;REFER
000C =          GLBT  EQU 1100B ;GLOBAL
;CR EQU 0DH ;CARRIAGE RETURN
;TABLE DEFINITIONS
;TYPES
  
```

```

0000 - XBASE EQU 0 ;START OF OPERATORS
; O1 THROUGH O15 DENOTE OPERATIONS
0010 - PT EQU 16
0011 - PT EQU RT+1 ;RT IS REGISTER TYPE, PT IS PSEUDO OPERATION
0012 - OBASE EQU PT+1
0013 - O1 EQU OBASE+1 ;SIMPLE
0014 - O2 EQU OBASE+2 ;LXI
0015 - O3 EQU OBASE+3 ;DAD
0016 - O4 EQU OBASE+4 ;PUSH/POP
0017 - O5 EQU OBASE+5 ;JMP/CALL
0018 - O6 EQU OBASE+6 ;MOV
0019 - O7 EQU OBASE+7 ;MVI
001A - O8 EQU OBASE+8 ;ACC IMMEDIATE
001B - O9 EQU OBASE+9 ;LDAX/STAX
001C - O10 EQU OBASE+10 ;LHLD/SHLD/LDA/STA
001D - O11 EQU OBASE+11 ;ACCUM REGISTER
001E - O12 EQU OBASE+12 ;INC/DEC
001F - O13 EQU OBASE+13 ;INX/DCX
0020 - O14 EQU OBASE+14 ;RST
0021 - O15 EQU OBASE+15 ;IN/OUT
;
; X1 THROUGH X15 DENOTE OPERATORS
0022 - X1 EQU XBASE ;*
0023 - X2 EQU XBASE+1 ;/
0024 - X3 EQU XBASE+2 ;MOD
0025 - X4 EQU XBASE+3 ;SHL
0026 - X5 EQU XBASE+4 ;SHR
0027 - X6 EQU XBASE+5 ;+
0028 - X7 EQU XBASE+6 ;-
0029 - X8 EQU XBASE+7 ;UNARY -
0030 - X9 EQU XBASE+8 ;NOT
0031 - X10 EQU XBASE+9 ;AND
0032 - X11 EQU XBASE+10 ;OR
0033 - X12 EQU XBASE+11 ;XOR
0034 - X13 EQU XBASE+12 ;(
0035 - X14 EQU XBASE+13 ;)
0036 - X15 EQU XBASE+14 ;,
0037 - X16 EQU XBASE+15 ;CR
;
; RESERVED WORD TABLES
;
; BASE ADDRESS VECTOR FOR CHARACTERS
CINX: DW CHAR1 ;LENGTH 1 BASE
      DW CHAR2 ;LENGTH 2 BASE
      DW CHAR3 ;LENGTH 3 BASE
      DW CHAR4 ;LENGTH 4 BASE
      DW CHAR5 ;LENGTH 5 BASE
15A9 C415
15AB D415
15AD E615
15AF 8216
15B1 AE16
15B3 BD16
0005 = CMAX EQU ($-CINX)/2-1 ;LARGEST STRING TO MATCH
;
CLEN: ;LENGTH VECTOR GIVES THE NUMBER OF ITEMS IN EACH TABLE
15B5 10 DB CHAR2-CHAR1
15B6 09 DB (CHAR3-CHAR2)/2
15B7 34 DB (CHAR4-CHAR3)/3
15B8 0B DB (CHAR5-CHAR4)/4
15B9 03 DB (CHAR6-CHAR5)/5
;
TVINX: ;TABLE OF TYPE,VALUE PAIRS FOR EACH RESERVED SYMBOL
15BA BD16 DW TV1
15BC DD16 DW TV2
15BE EF16 DW TV3
15C0 5717 DW TV4
15C2 6D17 DW TV5
;
; CHARACTER VECTORS FOR 1,2,3,4, AND 5 CHARACTER NAMES
15C4 0D28292A CHAR1: DB CR, '('*
15C8 2B DB +
15C9 2C2D2F41 DB '-/A'
15CD 42434445 DB 'BCDE'
15D1 484C4D DB 'HLM'
;
15D4 4442444944CHAR2: DB 'DBDIDSDW'
15DC 4549494649 DB 'EIIFINOR'
15E4 5350 DB 'SP'
;
15E6 4143494144CHAR3: DB 'ACIADCADDADI'
15F2 414E41414E DB 'ANAANDANICMA'
15FE 434D43434D DB 'CMCCMPCPIDAA'
160A 4441444443 DB 'DADDCCRDXEND'
1616 455155484C DB 'EQUHLITINRINX'
1622 4A4D504C44 DB 'JMLPLDALXIMOD'
162E 4D4F564D56 DB 'MOVVMVINOPNOT'
163A 4F52414F52 DB 'ORACRGORIOUT'
1646 504F505053 DB 'POPGSWRALRAR'
1652 524554524C DB 'RETRLCRRRCRST'
165E 5342425342 DB 'SBBSEBISETSHL'
166A 5348525354 DB 'SHRSTASTCSUB'
1676 535549584F DB 'SUIXORXRAXRI'
;
1682 43414C4C45CHAR4: DB 'CALLENDMLDAXLHLDPCHL'
1696 5055534853 DB 'PUSHSHLDSPHLSTAX'
16A6 5843484758 DB 'XCHGXTHL'
;
16AE 454E444946CHAR5: DB 'ENDIFMACROTITLE'
;
CHAR6: ;END OF CHARACTER VECTOR

```

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```

;          ;TYPE,VALUE PAIRS FOR CHAR1 VECTOR
16BD 0F0A0C14  DB      X16,10,           X13,20
16C1 0D1E0050  DB      X14,30,           X1,80
16C5 0546     DB      X6,70
16C7 PE0A02646 DB      X15,10,           X7,70
16CB 01521007 DB      X2,80,           RT,7
16CP 10001001 DB      RT,0,            RT,1
16D3 10821003 DB      RT,2,            RT,3
16D7 10841005 DB      RT,4,            RT,5
16CB 1026     DB      RT,6

```

TV2: ;TYPE,VALUE PAIRS FOR CHAR2 VECTOR

16DD 1101113F3	DB	PT,1,	01,0F3H
16E1 11021103	DB	PT,2,	PT,3
16E5 13FB1108	DB	01,0FBH,	PT,8
16E9 21CB0A28	DB	015,0DBH,	X11,40
16ED 1036	DB	PT,6	

```

TV3:   ;TYPE,VALUE PAIRS FOR CHAR3 VECTOR
16EF 1ACE1D88    DB 08,0CEH,      011,88H
16F3 1D9801AC6   DB 011,80H,      08,PC6H
16F7 1CA00932   DB 011,0A0H,      X10,50
16FB 1A26132P   DB 08,0E6H,      01,2FH
16FF 13371D88   DR 01,3FH,       011,0B8H
1703 1AFE1327   DB 08,0FEH,      01,27H
1737 15391E05   DB 03,09H,       012,05H
172B 1FJB1104   DB 013,0BH,      PT,4
17JF 11171376   DB PT,7,        01,76H
1713 1E041F03   DB 012,04H,      013,03H
1717 17C31C3A   DB 05,0C3H,      010,3AH
171B 14610250   DB 02,01H,       X3,80
171F 18481986   DB 06,40H,       07,06H
1723 13200283C  DB 01,08H,       X9,60
1727 1DB3110A   DB 011,0B0H,     PT,10
1728 1AF621D3   DB 08,0F6H,      015,0D3H
172F 16C11006   DB 04,0C1H,      RT,6
1733 1317131F   DB 01,17H,       01,1FH
1737 13C91307   DB 01,0C9H,      01,07H
173B 139F2EC7   DB 01,0FFH,      014,0C7H
173F 1D981ADE   D3 011,098H,     03,0DEH
1743 110B0350   DB PT,11,       X4,80
1747 04501C32   DB X5,80,       010,32H
1743 13371D98   DB 01,37H,       011,90H
174F 1AD60B28   DB 08,0D6H,      X12,40
1753 1DA81AEE   DB 011,0A8H,     08,0EEH

```

TV4: ;TYPE,VALUE PAIRS FOR CHAR4 VECTOR

```

1757 17CD          DB      05,0CDH          ;CALL
1759 11061B0A      DB      PT,6,             ;ENDM LDAX
175D IC2A13E9      DB      010,02AH,        ;LHLD PCHL
1761 16C51C22      DB      04,0C5H,         ;PUSH SHLD
1765 13F91B02      DB      01,0F9H,         ;SPHL STAX
1769 13EB13E3      DB      01,0EBH,         ;XCHG XTHL

; TV5: ;TYPE,VALUE PAIRS FOR CHARS VECTOR
176D 11051109      DB      PT,5,             ;ENDIF MACRO
1771 110C          DB      PT,12            ;TITLE

; SUFTAB: ;TABLE OF SUFFIXES FOR J C AND R OPERATIONS
1773 4E5A5A204E      DB      'NZZ NCC POPEP M'

; BSEAR: ;BINARY SEARCH MNEMONIC TABLE
; INPUT: UR = UPPER BOUND OF TABLE (I.E., TABLE LENGTH-1)
; SR = SIZE OF EACH TABLE ELEMENT
; H,L ADDRESS BASE OF TABLE TO SEARCH
; OUTPUT: ZERO FLAG INDICATES MATCH WAS FOUND, IN WHICH CASE
; THE ACCUMULATOR CONTAINS AN INDEX TO THE ELEMENT
; NOT ZERO FLAG INDICATES NO MATCH FOUND IN TABLE

0000 =           UR    EQU    B      ;UPPER BOUND REGISTER
0001 =           LR    EQU    C      ;LOWER BOUND REGISTER
0002 =           SR    EQU    D      ;SIZE REGISTER
0003 =           MR    EQU    E      ;MIDDLE POINTER REGISTER
0000 =           SPL   EQU    B      ;SIZE PRIME, USED IN COMPUTING MIDDLE POSITION
0001 =           SPLP  EQU    C      ;ANOTHER COPY OF SIZE PRIME
0004 =           KR    EQU    H      ;K

; 1783 1EFF          MVI   MR,255  ;MARK M <> OLD M
1785 04          INR   UR      ;U=U+1
1786 0E00          MVI   LR,0    ;L = 0

; ; COMPUTE M' = (U+L)/2
; NEXT: XRA   A
1788 AF          MOV   A,UR   ;CY=0, A=U
1789 78          ADD   LR      ;(U+L)
178A 81          RAR   ;(U+L)/2
178B 1F          CMP   MR      ;SAME AS LAST TIME THROUGH?
178C BB          JZ    NMATCH ;JUMP IF = TO NO MATCH
178D CAC417          SER# _____
; ; MORE ELEMENTS TO SCAN
1790 5F          MOV   MR,A   ;NEW MIDDLE VALUE
1791 E5          PUSH  H      ;SAVE A COPY OF THE BASE ADDRESS
1792 D5          PUSH  D      ;SAVE S,M
1793 C5          PUSH  B      ;SAVE U,L
1794 E5          PUSH  H      ;SAVE ANOTHER COPY OF THE BASE ADDRESS
1795 42          MOV   SP1,SR ;S' = S
1796 48          MOV   SPLP,SPL1 ;S'' = S'

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1797 1600      MVI    SR,0    ;FOR DOUBLE ADD OPERATION BELOW (DOUBLE M)
1799 210000     ; LXI    KR,0    ;K=0
179C 19        SUMK: DAD    D      ;K = K + M
179D 05        DCR    SP1    ;S' = S' - 1
179E C29C17     JNZ    SUMK   ;DECREMENT IF SP1 <> 0

; K IS NOW RELATIVE BYTE POSITION
17A1 D1        POP    D      ;TABLE BASE ADDRESS
17A2 19        DAD    D      ;H,L CONTAINS ABSOLUTE ADDRESS OF BYTE TO COMPARE
17A3 118901     LXI    D,ACCUM ;D,E ADDRESS CHARACTERS TO COMPARE

; COMK: ;COMPARE NEXT CHARACTER
17A6 1A        LDAX   D      ;ACCUM CHARACTER TO REG A
17A7 BE        CMP    M      ;SAME AS TABLE ENTRY?
17A8 13        INX    D
17A9 23        INX    H      ;TO NEXT POSITIONS
17AA C2B617     JNZ    NCOM   ;JUMP IF NOT THE SAME
17AD 0D        DCR    SP1P   ;MORE CHARACTERS?
17AE C2A617     JNZ    COMK

; COMPLETE MATCH AT M
17B1 C1        POP    B
17B2 D1        POP    D      ;M RESTORED
17B3 E1        POP    H
17B4 7B        MOV    A,MR   ;VALUE OF M COPIED IN A
17B5 C9        RET
17B6 C1        POP    B      ;U,L
17B7 D1        POP    D      ;S,M
17B8 E1        POP    H      ;TABLE ADDRESS
17B9 DAC017     JC     NCOML  ;ACCUM IS HIGHER
17BC 4B        MOV    LR,MR   ;L = M
17BD C38817     JMP    NEXT

; NCOML: ;ACCUMULATOR IS LOW
17C0 43        MOV    UR,MR   ;U = M
17C1 C38817     JMP    NEXT

; NMATCH: ;NO MATCH
17C4 AF        XRA    A
17C5 3C        INR    A      ;SETS NOT ZERO FLAG
17C6 C9        RET

; PREFIX: ;J C OR R PREFIX?
17C7 3A8901     LDA    ACCUM
17CA 0117C2     LXI    B,(0C2H SHL 8) OR 05 ;JNZ OPCODE TO B, TYPE TO C
17CD FE4A     CPI

17CF C8        RZ
17D0 06C4     MVI   B,0C4H  ;RETURN WITH ZERO FLAG SET IF J
17D2 FE43     CPI   'C'    ;CNZ OPCODE TO B, TYPE IS IN C
17D4 C8        RZ
17D5 0113C0     LXI   B,(0C0H SHL 8) OR 01 ;RNZ OPCODE
17D8 FE52     CPI   'R'
17DA C9        RET

; SUFFIX: ;J R OR C RECOGNIZED, LOOK FOR SUFFIX
17DB 3A8801     LDA    ACCLEN
17DE FE04     CPI   4      ;CHECK LENGTH
17E0 D20D18     JNC   NSUFF  ;CARRY IF 0,1,2,3 IN LENGTH
17E3 FE03     CPI   3
17E5 CAF217     JZ    SUF0  ;ASSUME 1 OR 2 IF NO BRANCH
17E8 FE02     CPI   2
17EA C20D18     JNZ   NSUFF  ;RETURNS IF 0 OR 1
17ED 218B01     LXI   H,ACCUM+2
17F0 3620     MVI   M,     ;BLANK-OUT FOR MATCH ATTEMPT
17F2 010800     SUF0: ;SEARCH 'TIL END OF TABLE
17F5 117317     LXI   B,8    ;B=0, C=8 COUNTS TABLE DOWN TO ZERO OR MATCH
17F8 218A01     LXI   H,ACCUM+1 ;NEXTS: ;LOOK AT NEXT SUFFIX
17FB 1A        LDAX   D      ;SUFFIX POSITION
17FC BE        CMP    M      ;CHARACTER TO ACCUM
17FD 13        INX    D
17FE C20518     JNZ   NEXT0 ;READY FOR NEXT CHARACTER
1801 1A        LDAX   D      ;JMP IF NO MATCH
1802 23        INX    H      ;GET NEXT CHARACTER
1803 BE        CMP    M      ;READY FOR COMPARE WITH ACCUM
1804 C8        RZ
1805 13        INX    D      ;SAME?
1806 04        INR    B      ;RETURN WITH ZERO FLAG SET, B IS SUFFIX
1807 0D        DCR    C      ;MOVE TO NEXT CHARACTER
1808 C2F817     INR    B      ;COUNT SUFFIX UP
180B 0C        DCR    C      ;COUNT TABLE LENGTH DOWN
180C C9        JNZ   NEXTS ;NEXTS
180D AF        INR    C      ;END OF TABLE, MARK WITH NON ZERO FLAG
180E 3C        RET
180F C9        NSUFF: ;NOT PROPER SUFFIX - SET NON ZERO FLAG
1810 3A8801     XRA    A
1813 4F        INR    A
1814 00        RET
1815 00        BGET: ;PERFORM BINARY SEARCH, AND EXTRACT TYPE AND VAL FIELDS FOR
1816 00        ;THE ITEM. ZERO FLAG INDICATES MATCH WAS FOUND, WITH TYPE
1817 00        ;IN THE ACCUMULATOR, AND VAL IN REGISTER B. THE SEARCH IS BASED
1818 00        ;UPON THE LENGTH OF THE ACCUMULATOR
1819 00        LDA    ACCLEN ;ITEM LENGTH
181A 00        MOV    C,A    ;SAVE A COPY

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1814 3D	DCR	A	;ACCLEN-1	1855 B0	ORA	B	;VALUE SET TO JNZ ...
1815 5P	MOV	E,A		1856 47	MOV	B,A	;REPLACE
1816 1600	MVI	D,0	;DOUBLE ACCLEN-1 TO D, E SER. #	1857 79	MOV	A,C	;RETURN WITH TYPE IN REGISTER A
1818 D5	PUSH	D	;SAVE A COPY FOR LATER	1858 BF	CMP	A	;CLEAR THE ZERO FLAG
1819 FE05	CPI	CMAX	;TOO LONG?	1859 C9	RET		
181B D25A18	JNC	NGET	;NOT IN RANGE IF CARRY				
181E 21B515	LXI	H,CLEN	;LENGTH VECTOR				
1821 19	DAD	D		185A D1	NGET:	;CAN'T FIND THE ENTRY, RETURN WITH ZERO FLAG RESET	
1822 46	MOV	UR,M	;FILL UPPER BOUND FROM MEMORY	185B AF	POP	D	;GET THE ELEMENT BACK
1823 21A915	LXI	H,CINX		185C 3C	XRA	A	;CLEAR
1826 19	DAD	D		185D C9	INR	A	;ZERO FLAG RESET
1827 19	DAD	D	;BASE ADDRESS TO H,L		RET		
1828 56	MOV	D,M					
1829 23	INX	H		1860 =	ENDMOD EQU	(\$ AND 0FFE0H) + 20H	
182A 66	MOV	H,M		185E	END		,NEXT MODULE ADDRESS
1828 6A	MOV	L,D	;NOW IN H,L				
182C 51	MOV	SR,C	;FILL THE SIZE REGISTER				
182D CD8317	CALL	BSEAR	;PERFORM THE BINARY SEARCH				
1830 C24518	JNZ	SCASE	;ZERO IF FOUND				
1833 D1	POP	D	;RESTORE INDEX				
1834 21BA15	LXI	H,TVINX					
1837 19	DAD	D					
1838 19	DAD	D	;ADDRESSING PROPER TV ELEMENT				
1839 5E	MOV	E,M					
183A 23	INX	H					
183B 56	MOV	D,M					
	;	D,E	IS BASE ADDRESS OF TYPE/VALUE VECTOR, ADD DISPLACEMENT				
183C 6F	MOV	L,A					
183D 2600	MVI	H,0					
183F 29	DAD	H	;DOUBLED				
1840 19	DAD	D	;INDEXED				
1841 7E	MOV	A,M	;TYPE TO ACC				
1842 23	INX	H					
1843 46	MOV	B,M	;VALUE TO B				
1844 C9	RET		;TYPE IN ACC, VALUE IN B				
	;	SCASE:	;NAME NOT TOO LONG, BUT NOT FOUND IN TABLES, MAY BE J C OR R				
1845 D1	POP	D	;RESTORE INDEX				
1846 CDC717	CALL	PREFIX					
1849 C0	RNZ		;NOT FOUND AS PREFIX J C OR R IF NOT ZERO FLAG				
184A C5	PUSH	B	;SAVE VALUE AND TYPE				
1843 CDDB17	CALL	SUFFIX	;ZERO IF SUFFIX MATCHED				
184E 78	MOV	A,B	;READY FOR MASK IF ZERO FLAG				
184F C1	POP	B	;RECALL VALUE AND TYPE				
1850 C0	RNZ		;RETURN IF NOT ZERO FLAG SET.				
	;	MASK IN THE PROPER BITS AND RETURN					
1851 B7	ORA	A	;CLEAR CARRY				
1852 17	RAL						
1853 17	RAL						
1854 17	RAL						

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1860 ; OPERAND SCAN MODULE
      ; ORG 1860H

; EXTERNALS
0200 = IOMOD EQU 200H ;I/O MODULE
1100 = SCMOD EQU 1100H ;SCANNER MODULE
1340 = SYMOD EQU 1340H ;SYMBOL TABLE MODULE
15A0 = BMOD EQU 15A0H ;BINARY SEARCH MODULE
;
; LOCALS
0218 = PERR EQU IOMOD+18H
1106 = SCAN EQU SCMOD+6H ;SCANNER ENT
00FD = CR EQU 0DH ;CARRIAGE RETURN
;
1346 = LOOKUP EQU SYMOD+6H ;LOOKUP
1349 = FOUND EQU LOOKUP+3 ;FOUND SYMBOL
134C = ENTER EQU FOUND+3 ;ENTER SYMBOL
134F = SETTY EQU ENTER+3 ;SET TYPE FILE
1352 = GETTY EQU SETTY+3 ;SET TYPE FILE
1355 = SETVAL EQU GETTY+3 ;SET VALUE FILE
1358 = GETVAL EQU SETVAL+3 ;GET VALUE FILE
;
15A3 = BSEAR EQU BMOD+3 ;BINARY SEARCH ROUTINE
15A6 = BGET EQU BSEAR+3 ;GET VALUES WITH SEA
;
; COMMON EQUATES
0078 = PBMAX EQU 120 ;MAX PRINT SIZE
010C = PBUFF EQU 10CH ;PRINT BUFFER
0184 = PBP EQU PBUFF+PBMAX ;PRINT BUFFER
;
0185 = TOKEN EQU PBP+1 ;CURRENT TOKEN UNDER
0186 = VALUE EQU TOKEN+1 ;VALUE OF NUMBER IN
0188 = ACCLEN EQU VALUE+2 ;ACCUMULATOR LENGTH
0240 = ACMAX EQU 64 ;MAX ACCUMULATOR LENGTH
0189 = ACCUM EQU ACCLEN+1

; LOCALS
01C9 = EVALUE EQU ACCUM+ACMAX ;VALUE FROM
;
01CB = SYTOP EQU EVALUE+2 ;CURRENT SYMBOL
01CD = SYMAX EQU SYTOP+2 ;MAX ADDRESS
;
01CP = PASS EQU SYMAX+2 ;CURRENT PASS NUMBER
01D0 = FPC EQU PASS+1 ;FILL ADDRESS FOR NE
01D2 = ASPC EQU FPC+2 ;ASSEMBLER'S PSEUDO
;
; GLOBAL EQUATES
0001 = IDEN EQU 1 ;IDENTIFIER
0002 = NUMB EQU 2 ;NUMBER

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0003 -	STRNG	EQU	3	;STRING	CP/M VERSION
0004 -	SFCL	EQU	4	;SPECIAL CHARACTER	COPYRIGHT © 1976
0001 -	;				DIGITAL RESEARCH
0002 -	PLABT	EQU	0001B	;PROGRAM LABEL	P. O. BOX 579
0004 -	DLABT	EQU	0010B	;DATA LABEL	PACIFIC GROVE, CA 93950
0005 -	EOUT	EQU	0100B	;EQUATE	SER. #
0006 -	SETT	EQU	0101B	;SET	
0006 -	MACT	EQU	0110B	;MACRO	
0008 -	;				
0008 -	EXTT	EQU	1000B	;EXTERNAL	
0008 -	REFT	EQU	1011B	;REFER	
000C -	GLBT	EQU	1100B	;GLOBAL	
0008 -	;				
0008 -	;				
0008 -	TABLE DEFINITIONS				
0000 -	XBASE	EQU	0	;START OF OPERATORS	
000F -	OPER	EQU	15	;LAST OPERATOR	
0010 -	RT	EQU	16		
0011 -	PT	EQU	RT+1	;RT IS REGISTER TYPE, PT IS PSEUDO OPERATION	
0012 -	OBASE	EQU	PT+1		
0005 -	;				
0005 -	PLUS	EQU	5		
0006 -	MINUS	EQU	6		
0008 -	NOTF	EQU	8	;NOT	
000C -	LPAR	EQU	12		
000D -	RPAR	EQU	13		
000A -	OSMAX	EQU	10		
0010 -	VSMAX	EQU	8*2		
0005 -	;				
0005 -	;				
0005 -	BEGINNING OF MODULE				
1860 C3A01B	JMP	ENDMOD		;PAST THIS MODULE	
1863 C3191A	JMP	OPAND		;SCAN OPERAND FIELD	
1866 C36E19	JMP	MULF		;MULTIPLY FUNCTION	
1869 C33819	JMP	DIVE		;DIVIDE FUNCTION	
186C	UNARY: DS	1		;TRUE IF NEXT OPERATOR IS UNARY	
186D	OPERV: DS	OSMAX		;OPERATOR STACK	
1877	HIERV: DS	OSMAX		;OPERATOR PRIORITY	
1881	VSTACK: DS	VS MAX		;VALUE STACK	
1891	OSP: DS	1		;OPERATOR STACK POINTER	
1892	VSP: DS	1		;VALUE STACK POINTER	
1893 EB	;				
1894 219218	;				
1897 7E	;				
1898 FE10	;				
189A DAA218	;				
1893 EB	STKVN: PLACE CURRENT H,L VALUE AT TOP OF VSTACK				
1894 219218	XCHG			;HOLD VALUE IN D,E	
1897 7E	LXI			H,VSP	
1898 FE10	MOV			A,M	
189A DAA218	CPI			VS MAX	
1893 EB	JC			STKVN	

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189D CD851B
18A0 3600
18A2 7E
18A3 34
18A4 34
18A5 4F
18A6 0600
18A6 218118
18AB 29
18AC 73
18AD 23
18AE 72
18AF C9

CALL ERREX ;OVERFLOW IN EXPRESSION
STK0: MOV M,0 ;VSP=0
MOV A,M ;GET VSP
INR M ;VSP=VSP+1
INR M ;VSP=VSP+2
MOV C,A ;SAVE VSP
MOV B,0 ;DOUBLE VSP
LXI H,VSTACK
DAD B
MOV M,E ;LOW BYTE
INX H
MOV M,D ;HIGH BYTE
RET

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18B8 F5
18B1 219118
18B4 7E
18B5 FE0A
18B7 CABC18
18B8 3600
18BC CD851B
18BF 5E
STK0: ;STACK OPERATOR (REG-A) AND PRIORITY (REG-B)
PUSH PSW ;SAVE IT
LXI H,OSP
MOV A,M
CPI OSMAX
JC STK01
MVI M,0
CALL ERREX ;OPERATOR STACK OVERFLOW
STK01: MOV E,M ;GET OSP
MVI D,0
INR M ;OSP=OSP+1
POP PSW ;RECALL OPERATOR
LXI H,OPERV
DAD D ;OPERV(OSP)
MOV M,A ;OPERV(OSP)=OPERATOR
LXI H,HIERV
DAD D
MOV M,B ;HIERV(OSP)=PRIORITY
RET

18CF 219218
18D2 7E
18D3 B7
18D4 C2DE18
18D7 CD851B
18DA 210000
18DD C9

;LODV1: ;LOAD TOP ELEMENT FROM VSTACK TO H,L
LXI H,VSP
MOV A,M
ORA A
JNZ LODOK
CALL ERREX ;UNDERFLOW
LXI H,0
RET

LODOK: DCR M
DCR M ;VSP=VSP-2
MOV C,M ;LOW BYTE
MVI B,0
LXI H,VSTACK
DAD B ;VSTACK(VSP)
MOV C,M ;GET LOW BYTE

18E0 35
18E0 35
18E0 4E
18E1 2600
18E3 218118
18E6 09
18E7 4E

18E8 23
18E9 66
18EA 69
18EB C9

INX H
MOV H,M
MOV L,C
RET

;LODV2: ;LOAD TOP TWO ELEMENTS DE HOLDS TOP, HL HOLDS TOP-1

CALL LODV1
XCHG
CALL LODV1
RET

;APPLY: ;APPLY OPERATOR IN REG-A TO TOP OF STACK

MOV L,A
MVI H,0
DAD H ;OPERATOR NUMBER*2
LXI D,OPTAB
DAD D ;INDEXED OPTAB
MOV E,M ;LOW ADDRESS
INX H
MOV H,M ;HIGH ADDRESS
MOV L,E
PCHL ;SET PC AND GO TO SUBROUTINE

;OPTAB: DW MULOP
DW DIVOP
DW MODOP
DW SHIOP
DW SHROP
DW ADDOP
DW SUROP
DW NEGOP
DW NOTOP
DW ANDOP
DW OROP
DW XOROP
DW ERREX ;{

;SPECIFIC HANDLERS FOLLOW
SHFT: ;SET UP OPERANDS FOR SHIFT L AND R
CALL LODV2
MOV A,D ;ENSURE 0-15
ORA A
JNZ SHERR

191B CDEC18
191E 7A
191F B7
1920 C22719
1923 7B
1924 FE11
1926 D8
1927 CD851B
192A 3E18
192C C9

SHERR: CALL ERREX ;RETURN IF 0-16 SHIFT

MOV A,E
CPI 17
RC
MVI A,16
RET

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192D AF      NEGP: ;COMPUTE @-H,L TO H,L
192E 95      XRA   A
192F 6F      SUB   L
1930 3E00     MOV   L,A
1932 9C      MVI   A,0
1933 67      SBB   H
1934 C9      MOV   H,A
1935 CDEC18   RET

1938 E8      DIVF: CALL LODV2
              DIVE: ;(EXTERNAL ENTRY FROM MAIN PROGRAM)
              XCHG ;SWAP D,E WITH H,L FOR DIVIDE FUNCTION
              ; COMPUTE X/Y WHERE X IS IN D,E AND Y IS IN H,L
              ; THE VALUE OF X/Y APPEARS IN D,E AND X MOD Y IS IN H,L
              ;
              SHLD  DTTEMP ;SAVE X IN TEMPORARY
              LXI   H,BNUM ;STORE BIT COUNT
              MVI   M,11H
              LXI   B,0 ;INITIALIZE RESULT
              PUSH  B
              XRA   A ;CLEAR FLAGS
              DLOOP:
              MOV   A,E ;GET LOW Y BYTE
              RAL
              MOV   E,A
              MOV   A,D
              RAL
              MOV   D,A
              DCR   M ;DECREMENT BIT COUNT
              POP   H ;RESTORE TEMP RESULT
              RZ   ;ZERO BIT COUNT MEANS ALL DONE
              MVI   A,0 ;ADD IN CARRY
              ACI   0 ;CARRY
              DAD   H ;SHIFT TEMP RESULT LEFT ONE BIT
              MOV   B,H ;COPY HA AND L TO A A ND C
              ADD   L
              LHLD  DTTEMP ;GET ADDRESS OF X
              SUB   L ;SUBTRACT FROM TEMPORARY RESULT
              MOV   C,A
              MOV   A,B
              SBB   H
              MOV   B,A
              PUSH  B ;SAVE TEMP RESULT IN STACK
              JNC   DSkip ;NO BORROW FROM SUBTRACT
              DAD   B ;ADD X BACK IN
              XTHL ;REPLACE TEMP RESULT ON STACK
              LXI   H,BNUM ;RESTORE H,L
              DLOOP ;REPEAT LOOP STEPS
              ;

```

196B 196D DTEMP: DS 2
 BNUM: DS 1
 ;
 MULP: ;MULTIPLY D,E BY H,L AND REPLACE H,L WITH RESULT
 MOV B,H
 MOV C,L ;COPY OF 1ST VALUE TO B,C FOR SHIFT AND ADD
 LXI H,0 ;H,L IS THE ACCUMULATOR
 1973 AF MUL0: XRA A
 1974 78 MOV A,B ;CARRY IS CLEARED
 1975 1F RAR
 1976 47 MOV B,A
 1977 79 MOV A,C
 1978 1F RAR
 1979 4F MOV C,A
 197A DA8219 JC MUL1 ;SKIP THIS ADD IF LSB IS ZERO
 197D B0 ORA B
 197E C8 RZ
 197F C38319 JMP MUL2 ;RETURN WITH H,L
 1982 19 MUL1: DAD D ;SKIP ADD
 1983 EB MUL2: XCHG ;ADD CURRENT VALUE OF D
 1984 29 DAD H
 1985 EB XCHG
 1986 C37319 JMP MUL0
 ;
 MULOP: ;MULTIPLY D,E BY H,L
 CALL LODV2
 CALL MULF
 JMP ENDOP
 ;
 DIVOP: ;DIVIDE H,L BY D,E
 CALL DIVF
 XCHG ;RESULT TO H,L
 JMP ENDOP
 ;
 MODOP: CALL DIVF
 JMP ENDOP
 ;
 SHL0: CALL SHFT
 SHL0: ORA A ;DONE?
 JZ ENDOP
 19A2 B7 DAD H ;HL=HL*2
 19A3 CA011A DCR A
 19A6 29 JMP SHL0
 19A7 3D SHL0: CALL SHFT
 19A8 C3A219 SHR0: ORA A ;DONE?
 19AB CD1B19 SHR0: JZ ENDOP
 19AE B7 PUSH PSW ;SAVE CURRENT COUNT
 19AF CA011A 19B2 F5 XRA A
 19B3 AF MOV A,H
 19B4 7C MOV A,H
 ;

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19B5 1F
19B6 67
19B7 7D
19B8 1F
19B9 6F
19B A F1
19B B 3D
19C C 3AE19

RAR
MOV H,A
MOV A,L
RAR
MOV L,A
POP PSW
DCR A
JMP SHR0

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19C2 19
19C3 C3011A

; ADDOP: CALL LODV2
ADD0: DAD D
JMP ENDOP

19C6 CDEC18
19C9 EB
19CA CD2D19
19CD C3C219

; SUBOP: CALL LODV2
XCHG ;TREAT AS HL+(-DE)
CALL NEGF ;@-HL
JMP ADD0

19D0 CDCF18
19D3 CD2D19
19D6 C3011A

; NEGOP: CALL LODV1
NEG0: CALL NEGF ;COMPUTE @-HL
JMP ENDOP

19C9 CDCF18
19DC 23
19DD C3D319

; NOTOP: CALL LODV1
INX H ;65536-HL = 65535-(HL+1)
JMP NEG0

19E0 CDEC18
19E3 7A
19E4 A4
19E5 67
19E6 7B
19E7 A5
19E8 6F
19E9 C3011A

; ANDOP: CALL LODV2
MOV A,D
ANA H
MOV H,A
MOV A,E
ANA L
MOV L,A
JMP ENDOP

19EC CDEC18
19EF 7A
19FB B4
19F1 67
19F2 78
19F3 B5
19F4 6F
19F5 C3011A

; OROP: CALL LODV2
MOV A,D
ORA H
MOV H,A
MOV A,E
ORA L
MOV L,A
JMP ENDOP

19F8 CDEC18
19FB 7A
19FC AC
19FD 67
19FE 7B
19FF AD

; XOROP: CALL LODV2
MOV A,D
XRA H
MOV H,A
MOV A,E
XRA L

1A00 6F	MOV	L,A	
1A01 C39318	,ENDOP: JMP	STKV	
	;		
	;		
	;		
1A04 3A8501	LDA		;RETURNS ZERO FLAG IF SYMBOL IS CR, :, OR .
1A07 FE04	CPI		TOKEN
1A09 C0	RNZ		SPEC1
	;		
1A0A 3A8901	LDA	ACCUM	
1A0D FE0D	CPI	CR	
1A0F C8	RZ		
1A10 FE3B	CPI	''	
1A12 C8	RZ		
1A13 FE2C	CPI	''	
1A15 C8	RZ		
1A16 FE21	CPI	'	
1A18 C9	RET		
	;		
1A19 AF	XRA	A	
1A1A 329118	STA	OSP	;ZERO OPERATOR STACK POINTER
1A1D 329218	STA	VSP	
1A20 3D	DCR	A	:255
1A21 326C18	STA	UNARY	
1A24 210000	LXI	H,0	
1A27 22C901	SHLD	EVALUE	
	;		
1A2A CD041A	OP0:	ARRIVE HERE WITH NEXT ITEM ALREADY SCANNED	
1A2D C25D1A	CALL	ENDEXP ;DONE?	
	JNZ	OPI	
	;	EMPTY THE OPERATOR STACK	
1A30 219118	EMPOP:	LXI H,OSP	
1A33 7E	MOV	A,M	;GET THE OSP AND CHECK FOR EMPTY
1A34 B7	ORA	A	
1A35 CA481A	JZ	CHKVAL	;JUMP IF EMPTY
1A38 35	DCR	M	;POP ELEMENT
1A39 5F	MOV	E,A	;COPY FOR DOUBLE ADD
1A3A 1D	DCR	E	
1A3B 1600	MVI	D,0	
1A3D 216D18	LXI	H,OPERV	
1A40 19	DAD	D	;INDEXED - OPERV(OSP)
1A41 7E	MOV	A,M	;GET OPERATOR
1A42 CDF418	CALL	APPLY	;APPLY OPERATOR
1A45 C3301A	JMP	EMPOP	
	;	CHKVAL:	

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1A48 3A921B      LDA    VSP      ;MUST HAVE ONE ELEMENT IN THE STACK
1A4B FE02         CPI    2
1A4D C4851B      CNZ    ERREX
1A50 3A0C01      LDA    PBUFF
1A53 FE28         CPI
1A55 C0           RNZ
1A56 2A8118      LHLD   VSTACK  ;EVALUATE REMAINS AT ZERO
1A59 22C901      SHLD   EVALUE ;GET DOUBLE BYTE IN STACK
1A5C C9           RET
;OP1: ;MORE TO SCAN
1A5D 3A0C01      LDA    PBUFF
1A60 FE20         CPI
1A62 C27F1B      JNZ    GETOP
1A65 3A8501      LDA    TOKEN
1A68 FE03         CPI    STRNG ;IS THIS A STRING?
1A6A C2891A      JNZ    OP3
;STRING - CONVERT TO DOUBLE PRECISION
1A6D 3A8801      LDA    ACCLEN
1A73 B7           ORA    A
1A71 CC851B      CZ    ERREX ;ERROR IF LENGTH=0
1A74 FE03         CPI    3
1A76 D4851B      CNC    ERREX ;ERROR IF LENGTH>2
1A79 1600         MVI    D,0
1A7B 218901      LXI    H,ACCUM
1A7E 5E           MOV    E,M ;LSBYTE
1A7F 23           INX    H
1A80 3D           DCR    A ;A HAS THE LENGTH
1A81 CA851A      JZ    OP2 ;ONE OR TWO BYTES
1A84 56           MOV    D,M ;FILL HIGH ORDER
1A85 EB           OP2: XCHG  ;VALUE TO H,L
1A86 C3711B      JMP    STNUM ;STORE TO STACK
;OP3: ;NOT A STRING, CHECK FOR NUMBER
1A89 FE02         CPI    NUMB
1A88 C2941A      JNZ    OP4
1A8E 2A8601      LHLD   VALUE  ;NUMERIC VALUE
1A91 C3711B      JMP    STNUM
;OP4: ;NOT STRING OR NUMBER, MUST BE ID OR SPECI
1A94 CDA615       CALL   BGET   ;BINARY SEARCH, GET ATTRIBUTES
1A97 C2311B      JNZ    OP6 ;MATCH?
;YES, MAY BE OPERATOR
1A9A FE10         CPI    OPER+1
1A9C D2261B      JNC    OP5
;OPERATOR ENCOUNTERED MS NIBBLE OF B IS PRIORITY NUMBER LS NIBBLE
;IS THE OPERATOR
;ACC HAS THE OPERATOR NUMBER, B HAS PRIORITY
1A9F FE0C         CPI    LPAR  ;(?

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1AA1 4F           IAA2 3A6C18
1AA5 C2B51A      IAA8 B7
1AA9 CC851B      IAAAC 3EFF
1AAE 326C18      IAB1 79
1AB2 C3031B      IAB5 B7
1AB6 C20E1B      IAC1 5F
1AC2 1D           IAC3 1630
1AC5 217718      IAC8 19
1ACB DADE1A      IAC9 7E
1ACE 219118      IACA B8
1AD1 73           IACB DADE1A
1AD2 216D18      IAD5 19
1AD6 7E           IAD7 CDF418
1ADA C1           IAD8 C3B91A
1AE2 C2031B      IADE C1
1AEF 79           IAE0 FE0D
1AE2 C2031B      IAE5 219118
1AE8 7E           IAE8 7E
;MOV C,A ;SAVE COPY OF OPERATOR NUMBER
;LDA UNARY
;JNZ OPER1 ;JUMP IF NOT A (
;ENCOUNTERED, UNARY MUST BE TRUE
;ORA A
;CZ ERREX
;MVI A,OFFH
;STA UNARY ;UNARY IS SET TRUE
;MOV A,C ;RECOVER OPERATOR
;JMP OPER4 ;CALLS STKO AND SETS UNARY TO TRUE
;OPR1: ;NOT A LEFT PAREN
;ORA A
;JNZ OPER6 ;MUST BE + OR - SINCE UNARY IS SET
;UNARY NOT SET, MUST BE BINARY OPERATOR
;OPR2: ;COMPARE HIERARCHY OF TOS
;PUSH B ;SAVE PRIORITY AND OPERATOR NUMBER
;LDA OSP
;ORA A
;JZ OPER3 ;NO MORE OPERATORS IN STACK
;MOV E,A ;OSP TO E
;DCR E ;OSP-1
;MVI D,0
;LXI H,HIERV
;DAD D ;HL ADDRESSES TOP OF OPERATOR STACK
;MOV A,M ;PRIORITY OF TOP OPERATOR
;CMP B ;CURRENT GREATER?
;JC OPER3 ;JUMP IF SO
;APPLY TOP OPERATOR TO VALUE STACK
;LXI H,OSP
;MOV M,E ;OSP=OSP-1
;LXI H,OPERV
;DAD D
;MOV A,M ;OPERATOR NUMBER TO ACC
;CALL APPLY
;POP B ;RESTORE OPERATOR NUMBER AND PRIORITY
;JMP OPER2 ;FOR ANOTHER TEST
;OPR3: ;ARRIVE HERE WHEN OPERATOR IS STACKED
;CHECK FOR RIGHT PAREN BALANCE
;POP B ;OPERATOR NUMBER IN C, PRIORITY IN B
;MOV A,C
;CPI RPAR
;JNZ OPER4 ;JUMP IF NOT A RIGHT PAREN
;RIGHT PAREN FOUND, STACK MUST CONTAIN LEFT PAREN TO DELETE
;LXI H,OSP
;MOV A,M

```

```

1AE9 B7
1AEA CAF1A
1AED 3D
1AEE 77
1AEF 5F
1AF0 1600
1AF2 216018
1AF5 19
1AF6 7E
1AF7 FE0C
1AF9 CAFF1A
1AFC CD851B
1AFF AF
1B00 C3081B
1B03 CDB018
1B06 3EFF
1B08 326C18
1B08 C37F1B
1B0E 79
1B0F FE05
1B11 CA7F1B
1B14 FE36
1B16 C21E1B
1B19 3C
1B1A 4F
1B1B C3B91A
1B1E FE08
1B20 C4851B
1B23 C3B91A
1B26 FE11
1B28 CC851B
1B28 68
1B2C 2600
1B2E C3711B
1B31 3A8501
1B34 FE04
1B36 C25018
1B39 3A8901
1B3C FE24

ORA A ;ZERO?
JZ LPERR ;PAREN ERROR IF SO
DCR A ;OSP-1
MOV M,A ;STORED TO MEMORY
MOV E,A
MVI D,0
LXI H,OPERV
DAD D
MOV A,M ;TOP OPERATOR IN REG-A
CPI LPAR
JZ NLERR ;JMP IF NO ERROR - PARENS BALANCE
LPERR: CALL ERREX
NLERR: ;ERROR REPORTING COMPLETE
XRA A
JMP OPERS ;TO CLEAR UNARY FLAG
; OPER4: ;ORDINARY OPERATOR
CALL STKO
MVI A,0FFH ;TO SET UNARY FLAG
OPERS: STA UNARY
JMP GETOP ;FOR ANOTHER ELEMENT
; OPER6: ;UNARY SET, MUST BE + OR -
MOV A,C ;RECALL OPERATOR
CPI PLUS
JZ GETOP ;IGNORE UNARY PLUS
CPI MINUS
JNZ CHKNOT
INR A ;CHANGE TO UNARY MINUS
MOV C,A
JMP OPER2
CHKNOT: ;UNARY NOT SYMBOL?
CPI NOTF
CNZ ERREX
JMP OPER2
; OP5: ;ELEMENT FOUND IN TABLE, NOT AN OPERATOR
CPI PT ;PSEUDO OPERATOR?
CZ ERREX ;ERROR IF SO
MOV L,B ;GET LOW VALUE TO L
MVI H,0 ;ZERO HIGH ORDER BYTE
JMP STNUM ;STORE IT
OP6: ;NOT FOUND IN TABLE SCAN, $?
LDA TOKEN
CPI SPEC1
JNZ OP7
LDA ACCUM
CPI '$'

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1B3E CA4A18
1B41 CD851B
1B44 210000
1B47 C3711B
1B4A 2AD201
1B4D C3711B

1B50 CD4613
1B53 CD4913
1B56 C2641B
1B59 3E50
1B58 CD1802
1B5E CD4C13
1B61 C36E1B
1B64 CD5213
1B67 E607
1B69 3E55
1B6B CC1802
1B6E CD5813
1B71 3AGC18
1B74 B7
1B78 02851B
1B7C CD9318
1B7F C09A1A
1B85 E5
1B86 3E45
1B88 CD1802
1B8B E1
1B8C C9
1BA0 =
1B8D

JZ CURPC ;USE CURRENT PC
CALL ERREX
LXI H,0
JMP STNUM
CURPC: LHLD ASPC ;GET CURRENT PC
JMP STNUM

; OP7: ;NOT \$, LOOK IT UP
CALL LOOKUP
CALL FOUND
JNZ FIDENT
; NOT FOUND IN SYMBOL TABLE, ENTER IF PASS 1
MVI A,'P'
CALL PERR
CALL ENTER ;ENTER SYMBOL WITH ZERO TYPE FIELD
JMP FIDE0

FIDENT: CALL GETTY ;TYPE TO H,L
ANI 111B
MVI A,'U'
CZ PERR

; FIDE0: CALL GETVAL ;VALUE TO H,L

; STNUM: ;STORE H,L TO VALUE STACK
LDA UNARY
QSA A,ERREX ;UNARY OPERATION SET
STA UNARY ;SET TO OFF CENTERED WITH UNARY OFF
CALL STKV ;STACK THE VALUE

GETOP: CALL SCAN

; ERREX: PUSH 'E' ;ERROR IN OUTPUT BUFFER
MVI A,'E'
CALL PERR
POP H
RET

; ENDMOD EQU (\$ AND 0FFE0H) + 20H ;NEXT HALF PAGE
END

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; CP/M RESIDENT ASSEMBLER MAIN PROGRAM
;
; COPYRIGHT (C) 1976
; GARY A. KILDALL
;
; ORG 1BA0H
; MODULE ENTRY POINTS
; IOMOD EQU 200H ;IO MODULE
; SCMOD ECU 1100H ;SCANNER MODULE
; SYMOD EQU 1340H ;SYMBOL TABLE MODULE
; BMOD EQU 15A0H ;BINARY SEARCH MODULE
; OPMOD EQU 1860H ;OPERAND SCAN MODULE
;
; SETUP EQU IOMOD+3H ;FILE SETUP FOR EACH PASS
; PCON EQU IOMOD+12H ;WRITE CONSOLE BUFFER TO CR
; WOBUFF EQU IOMOD+15H ;WRITE PRINT BUFFER AND REINITIALIZE
; PERR EQU IOMOD+18H ;WRITE ERROR CHARACTER TO PRINT BUFFER
; DHEX EQU IOMOD+1BH ;SEND HEX CHARACTER TO MACHINE CODE FILE
; EGR EQU IOMOD+1EH ;END OF PROCESSING, CLOSE FILES AND TERMINATE
;
; INITI SCMOD+3H ;INITIALIZE SCANNER MODULE
; SCAN EQU SCMOD+6H ;SCAN NEXT TOKEN
;
; INISY EQU SYMOD+3H ;INITIALIZE SYMBOL TABLE
; LOOKUP EQU SYMOD+6H ;LOOKUP SYMBOL IN ACCUMULATOR
; FOUND EQU SYMOD+9H ;FOUND IF NZ FLAG
; ENTER EQU SYMOD+0CH ;ENTER SYMBOL IN ACCUMULATOR
; SETTY EQU SYMOD+0FH ;SET TYPE FIELD
; GETTY EQU SYMOD+12H ;GET TYPE FIELD
; SETVAL EQU SYMOD+15H ;SET VALUE FIELD
; GETVAL EQU SYMOD+18H ;GET VALUE FIELD
;
; BGET EQU BMOD+6H ;BINARY SEARCH AND GET TYPE/VALUE PAIR
;
; OPAND EQU OPMOD+3H ;GET OPERAND VALUE TO 'EVALUE'
; MULP EQU OPMOD+6H ;MULT D,E BY H,L TO H,L
; DIVF EQU OPMOD+9H ;DIVIDE HL BY DE, RESULT TO DE
;
; COMMON EQUATES
; PBMAX EOU 120 ;MAX PRINT SIZE
; PBUFF EOU 10CH ;PRINT BUFFER
; PSP EOU PBUFF+PBMAX ;PRINT BUFFER POINTER
;
; TOKEN EOU PBP+1 ;CURRENT TOKEN UNDER SCAN
; VALUE EOU TOKEN+1 ;VALUE OF NUMBER IN BINARY
; ACCLEN EOU VALUE+2 ;ACCUMULATOR LENGTH
; ACMAX EOU 64 ;MAX ACCUMULATOR LENGTH
  
```

0189 -	ACCUM EQU	ACCLEN+1	
01C9 -	; EVALUE EQU	ACCUM+ACMAX	; VALUE FROM EXPRESSION ANALYSIS
01CB -	; SYTOP EQU	EVALUE+2	; CURRENT SYMBOL TOP
01CD -	; SYMAX EQU	SYTOP+2	; MAX ADDRESS+1
01CF -	PASS EQU	SYMAX+2	; CURRENT PASS NUMBER
01D0 -	FPC EQU	PASS+1	; FILL ADDRESS FOR NEXT HEX BYTE
01D2 -	ASPC EQU	FPC+2	; ASSEMBLER'S PSEUDO PC
01D4 -	SYBAS EQU	ASPC+2	; BASE OF SYMBOL TABLE
01D6 -	SYADR EQU	SYBAS+2	; CURRENT SYMBOL ADDRESS
;			
; GLOBAL EQUATES			
0001 -	IDEN EQU	1	; IDENTIFIER
0002 -	NUMB EQU	2	; NUMBER
0003 -	STRNG EQU	3	; STRING
0004 -	SPECL EQU	4	; SPECIAL CHARACTER
;			
0001 -	PLABT EQU	0001B	; PROGRAM LABEL
0002 -	DLABT EQU	0010B	; DATA LABEL
0004 -	ECUT EQU	0100B	; EQUATE
0005 -	SETT EQU	0101B	; SET
0006 -	MACT EQU	0110B	; MACRO
;			
0008 -	EXTT EQU	1000B	; EXTERNAL
000B -	REFT EQU	1011B	; REFER
000C -	GLBT EQU	1100B	; GLOBAL
;			
000D -	CR EQU	0DH	; CARRIAGE RETURN
000A -	LF EQU	0AH	; LINE FEED
001A -	EOF EQU	1AH	; END OF FILE
0010 -	NBMAX EQU	16	; STARTING POSITION OF PRINT LINE
;			
0010 -	RT EQU	16	; REGISTER TYPE
0011 -	PT EQU	RT+1	; PSEUDO OPERATION
0005 -	PENDIF EQU	5	; PSEUDO OPERATOR 'ENDIF'
0012 -	OBASE EQU	PT+1	
0013 -	O1 EQU	OBASE+1	; FIRST OPERATOR
0021 -	O15 EQU	OBASE+15	; LAST OPERATOR
;			
; MAIN STATEMENT PROCESSING LOOP			
1BA0 AF	XRA	A	
1BA1 32CF01	STA	PASS	; SET TO PASS 0 INITIALLY
1BA4 CD4313	CALL	INISY	; INITIALIZE THE SYMBOL TABLE
RESTART:			
1BA7 CD0311	CALL	PASS	; PASS LOOP GOES FROM 0 TO 1
1BA8 CD0302	CALL	INITS	; INITIALIZE THE SCANNER
1BAD 210000	LXI	SETUP	; SET UP THE INPUT FILE
	H,0		

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1BB3 22EB20      SHLD  SYLAB ;ASSUME NO STARTING LABEL
1BB3 22D001      SHLD  FPC
1B26 22D001      SHLD  ASPC
1BB9 22ED20      SHLD  EPC ;END PC

; SCNEXT: ;SCAN THE NEXT INPUT ITEM
1BBC CD0611      CALL   SCAN
1BBF 3A8501      SCN0: LDA   TOKEN
1BC2 FEJ2        CPI   NUMB ;SKIP LEADING NUMBERS FROM LINE EDITORS
1BC4 CABC1B      JZ    SCNEXT
1BC7 FE04        CPI   SPEC1 ;MAY BE PROCESSOR TECH'S COMMENT
1BC9 C2DD1B      JNZ   SCN1
; SPECIAL CHARACTER, CHECK FOR *
1BCC 3A8901      LDA   ACCUM
1BCF FE2A        CPI   '*'
1BD1 C2311P      JNZ   CHEND ;END OF LINE IF NOT *
; FOUND, NO PRECEDING LABEL ALLOWED
1BD4 CD0020      CALL  SETLA
1BD7 C27C1P      JNZ   STERR ;ERROR IF LABEL
1BDA C3521P      JMP   CHEN1 ;SCAN THE COMMENT OTHERWISE

; SCN1: ;NOT NUMBER OR SPECIAL CHARACTER, CHECK FOR IDENTIFIER
1BDD FE01        CPI   IDEN
1BDF C27C1P      JNZ   STERR ;ERROR IF NOT
; IDENTIFIER FOUND, MAY BE LABEL, OPCODE, OR MACRO
1BE2 CDA615      CALL  BGET ;BINARY SEARCH FIXED DATA
1BE5 CA301C      JZ    CHKPT ;CHECK FOR PSEUDO OR REAL OPERATOR
; BINARY SEARCH WAS UNSUCCESSFUL, CHECK FOR MACRO
1BE8 CD4613      CALL  LOOKUP
1BEB CD4913      CALL  FOUND
1BEE C2FE1B      JNZ   LFOUN ;NZ FLAG SET IF FOUND
; NOT FOUND, ENTER IT
1BF1 CD4C13      CALL  ENTER ;THIS MUST BE PASS
1BF4 3ACF01      LDA   PASS
1BF7 B7          ORA   A
1BF8 C4D720      CNZ   ERRP ;PHASE ERROR IF NOT
1BFB C30C1C      JMP   SETSY ;SET SYLAB

; ITEM WAS FOUND, CHECK FOR MACRO
1BFE CD5213      LFOUN: CALL GETTY
1C01 FE06        CPI   MACT
1C03 C20C1C      JNZ   SETSY

; MACRO DEFINITION FOUND, EXPAND MACRO
1C06 CDE320      CALL  ERRN ;NOT CURRENTLY IMPLEMENTED
1C09 C3521P      JMP   CHEN1 ;SCANS TO END OF CURRENT LINE

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1C0C 2AEB20      ;LABEL FOUND - IS IT THE ONLY ONE?
1C0F 7D          LHLD  SYLAB
1C10 B4          MOV   A,L
1C11 C4DD20      ORA   H
1C14 2AD601      CNZ   ERRL ;LABEL ERROR IF NOT
1C17 22EB20      LHLD  SYADR ;ADDRESS OF SYMBOL
; LABEL FOUND, SCAN OPTIONAL :
1C1A CD0611      SHLD  SYLAB ;MARK AS LABEL FOUND
1C1D 3A8501      ; SKIP NEXT SCAN IF NOT SPECIAL
1C20 FE04        CALL  SCAN
1C22 C2BF1B      LDA   TOKEN
1C25 3A8901      CPI   SPEC1
1C28 FE3A        JNZ   SCN0
1C2A C2BF1B      LDA   ACCUM
1C2D C38C1B      CPI   '*'
1C30 FE11        JNZ   SCNEXT ;TO IGNORE *
1C32 C2D71D      ; BINARY SEARCH FOUND SYMBOL, CHECK FOR PSEUDO OR REAL OP
; CHKPT: CPI PT ;PSEUDO OPCODE?
1C35 58          ; PSEUDO OPCODE FOUND, BRANCH TO CASES
1C36 1600        MOV   E,B ;B HAS PARTICULAR OPERATOR NUMBER
1C38 1B          MVI   D,0 ;DOUBLE PRECISION VALUE TO D,E
1C39 21431C      DCX   D ;BIASED BY +1
1C3C 19          LXI   H,PTTAB ;BASE OF JUMP TABLE
1C3D 19          DAD   D
1C3E 5E          DAD   D
1C3F 23          MOV   E,M
1C40 66          INX   H
1C41 6B          MOV   H,M
1C42 E9          MOV   L,E
; PCHL ;JUMP INTO TABLE
; PTTAB: ;PSEUDO OPCODE JUMP TABLE
1C43 5B1C        DW   SDB ;DB
1C45 A91C        DW   SDS ;DS
1C47 C01C        DW   SDW ;DW
1C49 DE1C        DW   SEND ;END
1C4B 151D        DW   SENDIF ;ENDIF
1C4D 181D        DW   SENDM ;ENDM
1C4F 1E1D        DW   SEQU ;EQU
1C51 401D        DW   SIF ;IF
1C53 871D        DW   SMACRO ;MACRO
1C55 8D1D        DW   SORG ;ORG
1C57 A71D        DW   SSET ;SET
1C59 CE1D        DW   STITLE ;TITLE
; SDB:

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1C5B CD0A20
 1C5E CD0611
 1C61 3A8501
 1C64 FE03
 1C66 C28C1C
 1C69 3A8801
 1C6C 3D
 1C6D CA8C1C
 1C70 47
 1C71 04
 1C72 04
 1C73 218901
 1C76 05
 1C77 CA861C
 1C7A C5
 1C7B 46
 1C7C 23
 1C7D E5
 1C7E CD4820
 1C81 E1
 1C82 C1
 1C83 C3761C
 1C86 CDF611
 1C89 C3981C
 1C8C CD6318
 1C8F 2AC981
 1C92 7C
 1C93 B7
 1C97 45
 1C98 CD4820
 1C99 CDF91F
 1C9E CDBA1E
 1CA1 FE2C
 1CA3 CA5E1C
 1CA6 C3311F
 1CA9 CD0A20
 1CAC CDA620
 1CAF CDD11E
 1CB2 ES
 1CB3 2AD201
 1CB6 19
 1CB7 22D201

SDB0: CALL FILAB ;SET LABEL FOR THIS LINE TO ASPC
 CALL SCAN ;PAST DB TO NEXT ITEM
 LDA TOKEN ;LOOK FOR LONG STRING
 CPI STRNG
 JNZ SDBC ;SKIP IF NOT STRING
 LDA ACCLEN
 DCR A ;LENGTH 1 STRING?
 JZ SDBC
 LENGTH 0,2,... STRING
 MOV B,A
 INR B
 INR B ;BECOMES 1,3,... FOR 0,2,... LENGTHS
 LXI H,ACCUM ;ADDRESS CHARACTERS IN STRING
 DCR B ;COUNT DOWN TO ZERO
 JZ SDB2 ;SCAN DELIMITER AT END OF STRING
 PUSH B ;SAVE COUNT
 MOV B,M ;GET CHARACTER
 INX H
 PUSH H ;SAVE ACCUM POINTER
 CALL FILHB ;SEND TO HEX FILE

SDB1: CALL SCAN ;TO THE DELIMITER
 JMP SDB3 ;NOT A LONG STRING
 SDB2: CALL OPAND ;COMPUTE OPERAND
 LHLD EVALUE ;VALUE TO H,L
 MOV A,H
 ORA A ;HIGH ORDER MUST BE ZERO
 ERD B,L ;GET LOW BYTE
 CALL FILHB

SDB3: END OF ITEM - UPDATE ASPC
 CALL SETAS ;SET ASPC TO FPC
 CALL DELIM
 CPI
 JZ SD30 ;FOR ANOTHER ITEM
 JMP CHEND ;CHECK END OF LINE SYNTAX

SDS: CALL FILAB ;HANDLE LABEL IF IT OCCURRED
 CALL PADD ;PRINT ADDRESS
 CALL EXP16 ;SCAN AND GET 16BIT OPERAND
 XCHG TO D,E
 LHLD ASPC ;CURRENT PSEUDO PC
 DAD D ;+EXPRESSION
 SHLD ASPC

1CBA 22D001
 1CBD C3311F
 ; SDW:
 1CC0 CD0A20
 1CC3 CDD11E
 1CC6 E5
 1CC7 45
 1CC8 CD4820
 1CCB E1
 1CCC 44
 1CCD CD4820
 1CD0 CDF91F
 1CD3 CDBA1E
 1CD6 FE2C
 1CD8 CAC31C
 1CDB C3311F

; SDW0:
 CALL EXP16 ;GET 16BIT OPERAND
 PUSH H ;SAVE A COPY
 MOV B,L ;LOW BYTE FIRST
 CALL FILHB ;SEND LOW BYTE
 POP H ;RECLAIM A COPY
 MOV B,H ;HIGH BYTE NEXT
 CALL FILHB ;SEND HIGH BYTE
 CALL SFTAS ;SET ASPC=FPC
 CALL DELIM ;CHECK DELIMITER
 CPI
 JZ SDW0 ;GET MORE DATA
 JMP CHEND

; SEND:
 1CDE CD0A20
 1CE1 CDA620
 1CE4 3A0C01
 1CE7 FE20
 1CE9 C2311F
 1CEC CDD11E
 1CEF 3A0C01
 1CF2 FE20
 1CF4 C2FA1C
 1CF7 22ED20
 1CFA 3E20
 1CF3 320C01
 1CF5 CD0611
 1D02 3A8501
 1D05 FE04
 1D07 C27C1F
 1D0A 3A8901
 1D0D FE0A
 1D0F C27C1F
 1D12 C36B1F
 1D15 C3D11D
 1D18 CDE320
 1D1B C3D11D
 1D1E CD0020

; SEND0:
 MVI A, ;
 STA ;
 CALL ;
 LDA ;
 CPI ;
 JNZ ;
 CHEND ;
 CALL EXP16 ;GET EXPRESSION IF IT'S THERE
 LDA PBUFF ;
 CPI ;
 JNZ ;
 CHEND ;
 CALL SEND0 ;
 SHLD EPC ;
 CPI ;
 JNZ ;
 STERR ;
 LDA ACCUM ;
 CPI LF ;
 JNZ STERR ;
 JMP ENDAS ;
 ; SENDIF:
 JMP POEND ;
 ; SENDM:
 CALL ERRN ;
 JMP POEND ;
 ; SEQU:
 CALL SETLA ;

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1D21 CA7C1F
 1D24 2AD201
 1D27 E5
 1D28 CDD11E
 1D28 22D201
 1D2E CD9A20
 1D31 CDA920
 1D34 211201
 1D37 363D
 1D39 E1
 1D3A 22D201
 1D3D C3311F

JZ STERR ;MUST BE A LABEL
 LHLD ASPC ;HOLD TEMP ASPC
 PUSH H ;IN STACK
 CALL EXP16 ;GET 16BIT OPERAND
 SHLD ASPC ;VALUE OF EXPRESSION
 CALL FILAB
 LXI H, PBUFF+6 ;COMPUTED VALUE
 MVI M, '=' ;SPACE AFTER VALUE
 POP H ;REAL ASPC
 SHLD ASPC ;CHANGE BACK
 JMP CHEND

; SIP:
 1D40 CD9A20
 1D43 CDD11E
 1D45 3A0C01
 1D49 FE20
 1D4B C2311F
 1D4E 7D
 1D4F 1F
 1D50 DA311F

CALL FILAB ;IN CASE OF LABEL
 CALL EXP16 ;GET IF EXPRESSION
 LDA PBUFF
 CPI
 JNZ CHEND ;SKIP IF ERROR
 MOV A,L ;GET LSB
 RAR
 JC CHEND ;TRUE IF CARRY BIT SET

; SIF0:
 1D53 CD0611
 1D56 3A8501
 1D59 FE04
 1D5B C26E1D
 1D5E 3A9901
 1D61 FE1A
 1D63 3E42
 1D65 CC1602
 1D68 CA881F
 1D69 C3531D

CALL SCAN
 LDA TOKEN
 CPI SPEC1
 JNZ SIF1
 LDA ACCUM
 CPI EOF
 MVI A, 'B' ;BALANCE ERROR
 CZ PERR
 JZ ENDAS
 JMP SIF0 ;FOR ANOTHER

; SIF1: ;NOT A SPECIAL CHARACTER
 1D6E FE01
 1D70 C2531D
 1D73 CDA615
 1D75 C2531D
 1D78 C2531D
 1D7E 78
 1D7F FE05
 1D81 C2531D
 1D84 C3D11D

CPI IDEN
 JNZ SIF0 ;NOT AN IDENTIFIER
 CALL BGET ;LOOK FOR ENDIF
 JNZ SIF0 ;NOT FOUND
 CPI PT
 JNZ SIF0
 MOV A,B ;GET OPERATOR NUMBER
 CPI PENDIF ;ENDIF?
 JNZ SIF0 ;GET ANOTHER TOKEN
 JMP POEND ;OK, CHECK END OF LINE

; SMACRO:
 1D87 CDE320
 1D8A C3311F

CALL ERRN
 JMP CHEND

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1D8D CDD11E
 1D98 3A0C01
 1D93 FE20
 1D95 C2311F
 1D98 22D201
 1D9B 22D201
 1D9E CD9A20
 1DA1 CDA620
 1DA4 C3311F

SORG: CALL EXP16
 LDA PBUFF
 CPI
 JNZ CHEND ;SKIP ORG IF ERROR
 SHLD ASPC ;CHANGE PC
 SHLD FPC ;CHANGE NEXT TO FIX CP/M VERSION
 CALL FILAB ;IN CASE OF LABEL

; SSET:
 1DA7 CD0020
 1DAA CA7C1F

; CALL SETLA
 JZ STERR ;MUST BE LABELED

; CALL GETTY
 CPI SETT
 CNZ ERRL ;LABEL ERROR

1DB2 C4DD20
 1DB5 3E05
 1DB7 CD4F13
 1DBA CDD11E
 1DBD E5
 1DBE CD0020
 1DC1 E1
 1DC2 CD5513
 1DC5 210000
 1DC8 22EB20
 1DCB C3311F

CALL EXP16 ;REPLACE TYPE WITH 'SET'
 PUSH H ;GET THE EXPRESSION
 CALL SETLA ;SAVE IT
 POP H ;RE-ADDRESS LABEL
 CALL SETVAL ;RECLAIM IT

LXI H, R
 SHLD SYLAB ;PREVENT LABEL PROCESSING

JMP CHEND

; STITLE:
 1DCE CDE320
 CALL ERRN ;NOT IMPLEMENTED

; POEND: ;PSEUDO OPERATOR END - SCAN TO NEXT TOKEN
 CALL SCAN
 JMP CHEND

; CHKOT: SUI 01 ;BASE OF OPCODES
 1DD1 CD0611
 1DD4 C3311F
 CPI 015 ;PAST LAST OPCODE?
 JNC STERR ;STATEMENT ERROR IF SO

; NOT A PSEUDO OPCODE, CHECK FOR REAL OPCODE
 1DD7 D613
 1DD9 FE21
 1DBB D27C1F

; FOUND OPCODE, COMPUTE INDEX INTO TABLE AND JUMP TO CASE

1DE1 5F
 1DDF 1600
 1DE1 21EB1D
 1DE4 19
 1DE5 19
 1DE6 5E
 1DE7 23
 MOV E,A
 MVI D, 0
 LXI H, OPTAB
 DAD D
 DAD D
 MOV E,M
 INX H

1E8 66
1E9 68
1EA E9

MOV H,M
MOV L,E
PCHL ;JUMP TO CASE

,
OPTAB: ;OPCODE CATEGORIES
DW SSIMP ;SIMPLE
DW SLXI ;LXI
DW SDAD ;DAD
DW SPUSH ;PUSH/POP
DW SJMP ;JMP/CALL
DW SMOV ;MOV
DW SMVI ;MVI
DW SACCI ;ACCUM IMMEDIATE
DW SLDAK ;LDAX/STAX
DW SLHLD ;LHLD/SHLD/LDA/STA
DW SCCR ;ACCUM-REGISTER
DW INC ;INC/DCR
DW SINX ;INX/DCX
DW SRST ;RESTART
DW SIN ;IN/OUT

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1E83 891E
1E8D 121E
1E8F 1E1E
1DF1 241E
1DF3 381E
1DF5 411E
1DF7 501E
1DF9 601E
1DFB 691E
1DFD 781E
1DF7 811E
1E81 681E
1E83 8F1E
1E85 9E1E
1E87 A51E

,
SSIMP: ;SIMPLE OPERATION CODES
CALL FILHB ;SEND HEX VALUE TO MACHINE CODE FILE
CALL SCAN ;TO NEXT TOKEN
JMP INCPC

,
SLXI: ;LXI H,16B
CALL SHDRG ;SCAN DOUBLE PRECISION REGISTER
CALL CHCOM ;CHECK FOR COMMA FOLLOWING REGISTER
CALL SETADR ;SCAN AND EMIT DOUBLE PRECISION OPERAND
JMP INCPC

,
SDAD: ;DAD B
CALL SHDRG ;SCAN AND EMIT DOUBLE PRECISION REGISTER
JMP INCPC

,
SPUSH: ;PUSH B POP D
CALL SHREG ;SCAN SINGLE PRECISION REGISTER TO A
JZ SPUB ;NOT PSW, MUST BE B,D, OR H
ANI 001000B ;LOW BIT MUST BE 0
CNZ ERRC ;REGISTER ERROR IF NOT
SPU0: MOV A,C ;RECALL REGISTER AND MASK IN CASE OF ERROR
ANI 110000B ;MASK IN OPCODE FOR PUSH OR POP
JMP FILINC ;FILL HEX VALUE AND INCREMENT PC

,
SJMP: ;JMP 16B/ CALL 16B
CALL FILHB ;EMIT JMP OR CALL OPCODE

1E38 CD111F
1E3E C3B11E
CALL SETADR ;EMIT 16BIT OPERAND
JMP INCPC

,
SMOV: ;MOV A,B
CALL SHREG ;MASK IN OPCODE
ORA B,A ;SAVE IN B TEMPORARILY
MOV B,A ;MUST BE COMMA SEPARATOR
CALL CHCOM ;VALUE MUST BE 0-7
CALL EXP3 ;MASK IN OPCODE
JMP FILINC

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,
SMVI: ;MVI A,B
CALL SHREG ;MASK IN OPCODE
ORA B ;EMIT OPCODE
CALL FILHEX ;SCAN COMMA
CALL CHCOM ;SETBYTE ;EMIT 8BIT VALUE
JMP INCPC

,
SACCI: ;ADI B
CALL FILHB ;EMIT IMMEDIATE OPCODE
CALL SETBYTE ;EMIT 8BIT OPERAND
JMP INCPC

,
SLDAX: ;LDAX B/STAX D
CALL SHREG ;MUST BE B OR D
ANI 101000B ;REGISTER ERROR IF NOT
CNZ ERRC ;RECOVER REGISTER NUMBER
MOV A,C ;CHANGE TO B OR D IF ERROR
ANI 010000B ;MASK IN OPCODE
ORA B ;EMIT OPCODE
JMP FILINC

,
SLHLD: ;LHLD 16B/ SHLD 16B/ LDA 16B/ STA 16B
CALL FILHB ;EMIT OPCODE
CALL SETADR ;EMIT OPERAND
JMP INCPC

,
SACCR: ;ADD B
CALL EXP3 ;RIGHT ADJUSTED 3BIT VALUE FOR REGISTER
ORA B ;MASK IN OPCODE
JMP FILINC

,
SINC: ;INR B/DCR D
CALL SHREG ;GET REGISTER
ORA B
JMP FILINC

,
SINX: ;INX H/DCX B

```

1E8F CDF21E      CALL    SHREG
1E92 E608        ANI     001000B ;MUST BE B D M OR SP
1E94 C4BD20      CNZ     ERRR ;REGISTER ERROR IF NOT
1E97 79          MOV     A,C ;RECOVER REGISTER
1E98 E630        ANI     110000B ;IN CASE OF ERROR
1E9A B0          ORA     B   ;MASK IN OPCODE
1E9B C3AE1E      JMP     FILINC

;SRST: ;RESTART 4
1E9E CDP21E      CALL    SHREG ;VALUE IS 0-7
1EA1 B0          ORA     B   ;OPCODE MASKED
1EA2 C3AE1E      JMP     FILINC

;SIN: ;IN 8B/OUT 8B
1E45 CD4820      CALL    FILHB ;EMIT OPCODE
1E48 CD831F      CALL    SETBYTE ;EMIT 8BIT OPERAND
1E4B C3B11E      JMP     INCPC

;FILINC: ;FILL HEX VALUE FROM A BEFORE INCREMENTING PC
1E4E CD4720      CALL    FILHEX

;INCPC: ;CHANGE ASSEMBLER'S PSEUDO PROGRAM COUNTER
1E81 CD8A20      CALL    FILAB ;SET ANY LABELS WHICH OCCUR ON THE LINE
1E84 CDF91F      CALL    SETAS ;ASPC=FPC
1E87 C3311F      JMP     CHEND ;END OF LINE SCAN

; ; UTILITY SUBROUTINES FOR OPERATION CODES
; ; DELIM: ;CHECK DELIMITER SYNTAX FOR DATA STATEMENTS
1EBA 3A8501      LDA     TOKEN
1EB0 FE34        CPI     SPECL
1EBF C4D120      CNZ     ERRD
1EC2 3A8901      LDA     ACCUM
1EC5 FE2C        CPI     '
1EC7 C8          R2
1EC8 FE3B        CPI     ;
1EC9 C8          RZ
1ECB FE0D        CPI     CR
1EC0 C4D120      CNZ     ERRD
1ED0 C9          RET

;EXP16: ;GET 16BIT VALUE TO H,L
1ED1 C5          PUSH   B
1ED2 CD8611      CALL    SCAN  ;START SCANNING OPERAND FIELD
1ED5 CD6318      CALL    OPAND
1ED8 2AC901      LHLD   EVALUE ;VALUE TO H,L
1EDB C1          POP    B
1EDC C9          RET

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1EDD CDD11E      EXP8: ;GET 8BIT VALUE TO REG A
1EE0 7C          CALL    EXP16
1EE1 B7          MOV    A,H
1EE2 C4C720      ORA    A
1EE5 7D          CNZ    ERRV ;VALUE ERROR IF HIGH BYTE NOT ZERO
1EE6 C9          MOV    A,L
1EE7 CDD11E      RET

;EXP3: ;GET 3BIT VALUE TO REG A
1EEA FE08        CALL    EXP8
1EEC D4C720      CPI    8
1EEF E607        CNC    ERRV ;VALUE ERROR IF >=8
1EF1 C9          ANI    111B ;REDUCE IF ERROR OCCURS
1EF2 CDE71E      RET

;SHREG: ;GET 3BIT VALUE AND SHIFT LEFT BY 3
1EF5 17          CALL    EXP3
1EF6 17          RAL
1EF7 17          RAL
1EF8 E638        RAL
1EFA 4F          ANI    111000B
1EFB C9          MOV    C,A ;COPY TO C
1EF2 CDF21E      RET

;SHDRREG: ;GET DOUBLE REGISTER TO A
1EFF E608        CALL    SHREG
1F01 C4BD20      ANI    001000B ;CHECK FOR A,C,E, OR L
1F04 79          CNZ    ERRR ;REGISTER ERROR
1F05 E630        MOV    A,C ;RECOVER REGISTER
1F07 B0          ANI    110000B ;FIX IT IF ERROR OCCURRED
1F08 C34720      ORA    B   ;MASK OPCODE
1F09 C34720      JMP    FILHEX

;SETBYTE: ;EMIT 16BIT OPERAND
1F0B CDD11E      CALL    EXP8
1F0E C34720      JMP    FILHEX

;SETADR: ;EMIT 16BIT OPERAND
1F11 CDD11E      CALL    EXP16
1F14 C37420      JMP    FILADR

;CHCOM: ;CHECK FOR COMMA FOLLOWING EXPRESSION
1F17 F5          PUSH   PSW
1F18 C5          PUSH   B
1F19 3A8501      LDA    TOKEN
1F1C FE04        CPI    SPECL
1F1E C2291F      JNZ    COMER
1F21 3A8901      SPECIAL CHARACTER, CHECK FOR COMMA
1F24 FE2C        LDA    ACCUM
1F25 FE2C        CPI    '

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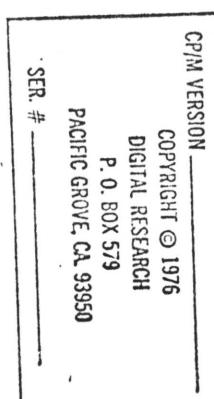
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1F26 CA2E1F      JZ      COMRET ;RETURN IF COMMA FOUND
COMER: ;COMMA ERROR
        MVI    A,'C'
        CALL   PERR
COMRET:
1F28 CD1802      POP    B
1F2F F1          POP    PSW
1F30 C9          RET
;
CHEND: ;END OF LINE CHECK
        CALL   FILAB ;IN CASE OF A LABEL
        LDA    TOKEN
        CPI    SPECL
        JNZ    STERR ;MUST BE A SPECIAL CHARACTER
        LDA    ACCUM
        CPI    CR    ;CARRIAGE RETURN
        JNZ    CHEN0
;
; CARRIAGE RETURN FOUND, SCAN PICKS UP LF AND PUSHES LINE
        CALL   SCAN
        JMP    SCNEXT
;
CHEN0: ;NOT CR, CHECK FOR COMMENT
        CPI    ;
        JNZ    CHEN2
        CALL   FILAB ;IN CASE LABELLED EMPTY LINE
;
CLEAR COMMENT TO END OF LINE
CHEN1: CALL  SCAN
;
1F52 CC0611      CPI    LF
1F55 3A8501      LDA    TOKEN
1F58 FE04        CPI    SPECL
1F5A C2521F      JNZ    CHEN1
1F5D 3A8901      LDA    ACCUM
1F60 FE0A        CPI    LF
1F62 CABC1B      JZ    SCNEXT
1F65 FE1A        CPI    EOF
1F67 CA861F      JZ    ENDAS ;END OF ASSEMBLY IF EOF
1F6A FE21        CPI    !
1F6C CABC1B      JZ    SCNEXT ;LOGICAL END OF LINE
1F6F C3521F      JMP    CHEN1 ;NONE OF THE ABOVE
;
; NOT CR OR LF, MAY BE LOGICAL END OF LINE
CHEN2: CPI    !
        JZ    SCNEXT
        CPI    EOF
        JZ    ENDAS
;
; STATEMENT ERROR IN OPERAND FIELD
STERR: MVI   A,'S'
        CALL   PERR
        JMP    CHEN1 ;TO DUMP LINE
;

```



```

        DIFF: ;COMPUTE DE-HL TO HL
        MOV    A,E
        SUB    L
        MOV    L,A
        MOV    A,D
        SBB    H
        MOV    H,A
        RET
;
ENDAS: ;END OF ASSEMBLY FOR THIS PASS
        LXI   H,PASS
        MOV   A,M
        INR   M      ;PASS NUMBER INCREMENTED
        ORA   A
        JZ    RESTART
        CALL  SCAN  ;TO CLEAR LAST LINE FEED
        CALL  PADD  ;WRITE LAST ADDRESS
        LXI   H,PBUFF+5
        MVI   M,CR  ;SET TO CR FOR END OF MESSAGE
        LXI   H,PBUFF+1
        CALL  PCON  ;PRINT LAST ADDRESS
;
; COMPUTE REMAINING SPACE
        LHLD  SYTOP
        LHLD  SYBAS
        CALL  DIFF  ;DIFFERENCE TO H,L
        PUSH  H      ;SYTOP-SYBAS TO STACK
        LHLD  SYMAX
        LHLD  SYBAS
        CALL  DIFF  ;SYMAX-SYBAS TO H,L
        LHBD  5C
        MOV   E,H
        LFBD  1600
        MVI   D,0      ;DIVIDED BY 256
        LFBD  E1
        POP   H      ;SYTOP-SYBAS TO H,L
        LFBE  CD6919
        CALL  DIVF  ;RESULT TO DE
        LFC1  FB
        XCHG
        IFC2  CDA920
        CALL  PADDR ;PRINT H,L TO PBUFF
        IFC5  211101
        LXI   H,PBUFF+5 ;MESSAGE
        IFC8  11D61F
        LXI   D,EMSG ;END MESSAGE
        IFCB  1A
        ENDA0: LDAX D
        ORA   A      ;ZERO?
        IFC0  B7
        JZ    ENDA1
        IFC0  CAE41F
        JZ    IFD0
        IFD0  77
        MOV   M,A
        IFD1  23
        INX   H
        IFD2  13
        INX   D
        IFD3  C3CB1F
        JMP    ENDA0
;
        1FD6  4820555345EMSG: DB    "H USE FACTOR",CR,0
;
```

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1FE4 210E01 ENDA1: LXI H,PBUFF+2 ;BEGINNING OF RATIO
1F27 CD1202 CALL PCON
1FEA 2AED20 LHLD EPC
1FED 22D001 SHLD FPC ;END PROGRAM COUNTER
1FF8 C31E02 JMP EOR

; UTILITY SUBROUTINES
COMDH: ;COMPARE D,E WITH H,L FOR EQUALITY (NZ FLAG IF NOT EQUAL)
1FP3 7A MOV A,D
1FP4 BC CMP H
1FP5 C0 RNZ
1FP6 7B MOV A,E
1FP7 BD CMP L
1FP8 C9 RET

SETAS: ;ASPC=FPC
1FF9 2AD001 LHLD FPC
1FFC 22D201 SHLD ASPC
1FFF C9 RET

SETLA: ;SYADR=SYLAB, FOLLOWED BY CHECK FOR ZERO
2000 2AEB20 LHLD SYLAB
2003 22D601 SHLD SYADR
2006 CD4913 CALL FOUND
2009 C9 RET

; FILAB: ;FILL LABEL VALUE WITH CURRENT ASPC, IF LABEL FOUND
200A CD3020 CALL SETLA
200D C8 RZ ;RETURN IF NO LABEL DETECTED

; LABEL FOUND, MUST BE DEFINED ON PASS-1
2025 31E000 SHLD SYLAB ;TO MARK NEXT STATEMENT WITH NO LABEL
2021 3ACF01 LDA PASS
2017 B7 ORA A
2018 C23120 JNZ FIL1

; PASS #
201B CD5213 CALL GETTY
201E F5 PUSH PSW ;SAVE A COPY OF TYPE
201F E607 ANI 111B ;CHECK FOR UNDEFINED
2021 C4DD20 CNZ ERRL ;LABFL ERROR
2024 F1 POP PSW ;RESTORE TYPE
2025 F601 ORI PLABT ;SET TO LABEL TYPE
2027 CD4F13 CALL SETTY ;SET TYPE FIELD
202A 2AD201 LHLD ASPC ;GET CURRENT PC
202D CD5513 CALL SETVAL ;PLACE INTO VALUE FIELD
2030 C9 RET

; FIL1: ;CHECK FOR DEFINED VALUE

```

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2031 CD5213 CALL GETTY
2034 E607 ANI 111B
2036 CCD720 CZ ERRP ;PHASE ERROR
; GET VALUE AND COMPARE WITH ASPC
2039 CD5813 CALL GETVAL ;TO H,L
203C E8 XCHG
203D 2AD201 LHLD ASPC
2040 CDF31F CALL COMDH
2043 C4D720 CNZ ERRP ;PHASE ERROR IF NOT THE SAME
2046 C9 RET

; FILHEX: ;WRITE HEX BYTE IN REGISTER A TO MACHINE CODE FILE IF PASS
2047 47 MOV B,A
2048 3ACF01 FILHB: LDA PASS
204B B7 ORA A
204C 78 MOV A,B
204D CA6C20 JZ FILHI

; PASS - 1, WRITE HEX AND PRINT DATA
2050 C5 PUSH B ;SAVE A COPY
2051 CD1B02 CALL DHEX ;INTO MACHINE CODE FILE
; MAY BE COMPLETELY EMPTY LINE, SO CHECK ADDRESS
2054 3A0D01 LDA PBUFF+1
2057 FE20 CPI
2059 2AD201 LHLD ASPC
205C CCA920 CZ PADDR ;PRINT ADDRESS FIELD

; LDA NBP
205F 3AEF20 CPI NBMAX ;TRUNCATE CODE IF TOO MUCH ON THIS LINE
2062 FE10 POP B ;RECALL HEX DIGIT
2064 C1 JNC FILHI
2065 D26C20 ROOM FOR DIGIT ON THIS LINE
; MOV A,B
2068 78 CALL WHEXB ;WRITE HEX BYTE TO PRINT LINE
2069 CD9620 FILHI: LHLD FPC
206C 2AD001 INX H
206F 23 SHLD FPC ;READY FOR NEXT BYTE
2070 22D001 RET

; FILADR: ;EMIT DOUBLE PRECISION VALUE FROM H,L
2074 E5 PUSH H ;SAVE A COPY
2075 45 MOV B,L
2076 CD4820 CALL FILHB ;LOW BYTE EMITTED
2079 E1 POP H ;RECOVER A COPY OF H,L
207A 44 MOV B,H
207B C34820 JMP FILHB ;EMIT HIGH BYTE AND RETURN

; ; UTILITY FUNCTIONS FOR PRINTING HEX ADDRESSES AND DATA
CHEX: ;CONVERT TO HEX
; ADI '0'
207E C630

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2080 FE3A CPI    '0'+10
2082 D8 RC
2083 C607 ADI    'A'-'0'-10
2085 C9 RET

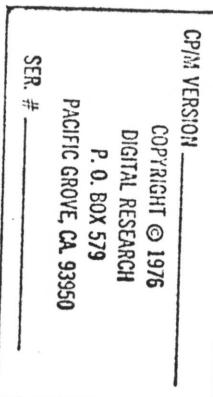
; WHEXN: ;WRITE HEX NIBBLE
CALL  CHEX    ;CONVERT TO ASCII FROM HEX
LXI   H,NBP
MOV   E,M    ;NEXT POSITION TO PRINT
MVI   D,0    ;DOUBLE PRECISION
INR   M      ;NBP=NBP+1
LXI   H,PBUFF
DAD   D
MOV   M,A    ;STORE IN PRINT BUFFER
RET

; WHEXB: ;WRITE HEX BYTE TO PRINT BUFFER
PUSH  PSW
RAR
RAR
RAR
RAR
ANI   0FH    ;HIGH ORDER NIBBLE NORMALIZE IN A
CALL  WHEXN  ;WRITE IT
POP   PSW
ANI   0FH
JMP   WHEXN  ;WRITE AND RETURN

; PADD: LHLD  ASPC
PADDR: ;PRINT ADDRESS FIELD OF PRINT LINE FROM H,L
XCHG
LXI   H,NBP
PUSH  H,D    ;INITIALIZE NEXT TO FILL COPY OF NBP'S ADDRESS
MOV   A,D    ;PRINT HIGH BYTE
PUSH  D      ;SAVE A COPY
CALL  WHEXB
POP   D
MOV   A,E
CALL  WHEXB
POP   H      ;ADDRESSING NBP
INR   M      ;SKIP A SPACE AFTER ADDRESS FIELD
RET

; ERRR: ;EMIT REGISTER ERROR
PUSH  PSW
PUSH  B
MVI   A,'R'
CALL  PERR
POP   B

```



```

20C5 F1 POP    PSW
20C6 C9 RET

; ERRV: ;EMIT VALUE ERROR
20C7 F5 PUSH  PSW
20C8 E5 PUSH  H
20C9 3E56 MVI   A,'V'
20CB CD1802 CALL  PERR
20CE E1 POP   H
20CF F1 POP   PSW
20D0 C9 RET

; 20D1 F5 ERRD: PUSH  PSW
20D2 3E44 MVI   A,'D' ;DATA ERROR
20D4 C3E620 JMP   ERR

; 20D7 F5 ERRP: PUSH  PSW
20D8 3E50 MVI   A,'P'
20DA C3E620 JMP   ERR

; 20DD F5 ERRL: PUSH  PSW
20DE 3E4C MVI   A,'L' ;LABEL ERROR
20E0 C3E620 JMP   ERR

; 20E3 F5 ERRN: PUSH  PSW
20E4 3E4E MVI   A,'N' ;NOT IMPLEMENTED
20E5 C9 ERR: CALL  PERR
20E6 CD1802 POP   PSW
20E9 F1 RET
20EA C9

; 20EB SYLAB: DS  2 ;ADDRESS OF LINE LABEL
20ED EPC:  DS  2 ;END PC VALUE
20EF NBP:  DS  1 ;NEXT BYTE POSITION TO WRITE FOR MACHINE CODE
20F0 END

```

CP/M VERSION
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SER. # _____