

TITLE 'ASM MAIN MODULE'

CP/M RESIDENT ASSEMBLER MAIN PROGRAM

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1BA0      ORG      1BA0H
;          MODULE ENTRY POINTS
0200 =    IOMOD    EQU      200H      ;IO MODULE
1100 =    SCMOD    EQU      1100H     ;SCANNER MODULE
1340 =    SYMOD    EQU      1340H     ;SYMBOL TABLE MODULE
15A0 =    BMOD     EQU      15A0H     ;BINARY SEARCH MODULE
1860 =    OPMOD    EQU      1860H     ;OPERAND SCAN MODULE
;
0203 =    SETUP    EQU      IOMOD+3H  ;FILE SETUP FOR EACH PASS
0212 =    PCON     EQU      IOMOD+12H  ;WRITE CONSOLE BUFFER TO CR
0215 =    WOBUFF    EQU      IOMOD+15H  ;WRITE PRINT BUFFER AND REINITIALIZE
0218 =    PERR     EQU      IOMOD+18H  ;WRITE ERROR CHARACTER TO PRINT BUFFER
021B =    DHEX     EQU      IOMOD+1BH  ;SEND HEX CHARACTER TO MACHINE CODE FILE
021E =    EOR      EQU      IOMOD+1EH  ;END OF PROCESSING, CLOSE FILES AND TERMINATE
;
1103 =    INITS    EQU      SCMOD+3H   ;INITIALIZE SCANNER MODULE
1106 =    SCAN     EQU      SCMOD+6H   ;SCAN NEXT TOKEN
;
1343 =    INISY    EQU      SYMOD+3H   ;INITIALIZE SYMBOL TABLE
1346 =    LOOKUP   EQU      SYMOD+6H   ;LOOKUP SYMBOL IN ACCUMULATOR
1349 =    FOUND    EQU      SYMOD+9H   ;FOUND IF NZ FLAG
134C =    ENTER    EQU      SYMOD+0CH  ;ENTER SYMBOL IN ACCUMULATOR
134F =    SETTY    EQU      SYMOD+0FH  ;SET TYPE FIELD
1352 =    GETTY    EQU      SYMOD+12H  ;GET TYPE FIELD
1355 =    SETVAL   EQU      SYMOD+15H  ;SET VALUE FIELD
1358 =    GETVAL   EQU      SYMOD+18H  ;GET VALUE FIELD
;
15A6 =    BGET     EQU      BMOD+6H    ;BINARY SEARCH AND GET TYPE/VALUE PAIR
;
1863 =    OPAND    EQU      OPMOD+3H   ;GET OPERAND VALUE TO 'EVALUE'
1866 =    MULF     EQU      OPMOD+6H   ;MULT D,E BY H,L TO H,L
1869 =    DIVF     EQU      OPMOD+9H   ;DIVIDE HL BY DE, RESULT TO DE
;
;          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 =    ACCLLEN  EQU      VALUE+2   ;ACCUMULATOR LENGTH
0040 =    ACMAX    EQU      64        ;MAX ACCUMULATOR LENGTH
0189 =    ACCUM    EQU      ACCLLEN+1
;
01C9 =    EVALU    EQU      ACCUM+ACMAX ;VALUE FROM EXPRESSION ANALYSIS
;

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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 = _DEN EQU 1 ;IDE IIFIER
0002 = NUMB EQU 2 ;NUMBER
0003 = STRNG EQU 3 ;STRING
0004 = SPECL EQU 4 ;SPECIAL CHARACTER

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0001 = PLABT EQU 0001B ;PROGRAM LABEL
0002 = LABT EQU 0010B ;DATA LABEL
0004 = EQUT EQU 0100B ;EQUATE
0005 = SETT EQU 0101B ;SET
0006 = MACT EQU 0110B ;MACRO

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;
0008 = EXTT EQU 1000B ;EXTERNAL
000B = REFT EQU 1011B ;REFER
000C = GLBT EQU 1100B ;GLOBAL

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;
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

```

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;
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: ;PASS LOOP GOES FROM 0 TO 1
1BA7 CD0311 CALL INITS ;INITIALIZE THE SCANNER
1BAA CD0302 CALL SETUP ;SET UP THE INPUT FILE
1BAD 210000 LXI H,0
1BB0 22EB20 SHLD SYLAB ;ASSUME NO STARTING LABEL
1BB3 22D001 SHLD FPC
1BB6 22D201 SHLD ASPC
1BB9 22ED20 SHLD EPC ;END PC

```

; SCNEXT: ;SCAN THE NEXT INPUT ITEM

```

1BBC CD0611 CALL SCAN
1BBF 3A8501 SCNO: LDA TOKEN
1BC2 FE02 CPI NUMB ;SKIP LEADING NUMBERS FROM LINE EDITORS
1BC4 CABC1B JZ SCNEXT

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1BC7 FE04      CPI      SPECL      ;MAY BE PROCESSOR TECH'S COMMENT
1BC9 C2DD1B    JNZ      SCN1
;              SPECIAL CHARACTER, CHECK FOR *
1BCC 3A8901    LDA      ACCUM
1BCF FE2A      CPI      '*'
1BD1 C2311F    JNZ      CHEND      ;END OF LINE IF NOT *
;              * FOUND, NO PRECEDING LABEL ALLOWED
1BD4 CD0020    CALL     SETLA
1BD7 C27C1F    JNZ      STERR      ;ERROR IF LABEL
1BDA C3521F    JMP      CHEN1      ;SCAN THE COMMENT OTHERWISE
;
SCN1:          ;NOT NUMBER OR SPECIAL CHARACTER, CHECK FOR IDENTIFIER
1BDD FE01      CPI      IDEN
1BDF C27C1F    JNZ      STERR      ;ERROR IF NOT
;
;              IDENTIFIER FOUND, MAY BE LABEL, OPCODE, OR MACRO
1BE2 CDA615    CALL     EJET      ;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 0
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 C3521F    JMP      CHEN1      ;SCANS TO END OF CURRENT LINE
;
SETSY:         ;LABEL FOUND - IS IT THE ONLY ONE?
1C0C 2AEB20    LHL      SYLAB
1COF 7D        MOV      A,L
1C10 B4        ORA      H
1C11 C4DD20    CNZ      ERRL      ;LABEL ERROR IF NOT
1C14 2AD601    LHL      SYADR     ;ADDRESS OF SYMBOL
1C17 22EB20    SHLD     SYLAB     ;MARK AS LABEL FOUND
;
;              LABEL FOUND, SCAN OPTIONAL ':'
1C1A CD0611    CALL     SCAN
1C1D 3A8501    LDA      TOKEN
1C20 FE04      CPI      SPECL
1C22 C2BF1B    JNZ      SCNO      ;SKIP NEXT SCAN IF NOT SPECIAL
1C25 3A8901    LDA      ACCUM
1C28 FE3A      CPI      ':'
1C2A C2BF1B    JNZ      SCNO

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1C2D C3BC1B

JMP SCNEXT ;TO IGNORE ':'

1C30 FE11

CHKPT:

; BINARY SEARCH FOUND SYMBOL, CHECK FOR PSEUDO OR REAL OP

1C32 C2D71D

CPI PT ;PSEUDO OPCODE?

JNZ CHKOT

; PSEUDO OPCODE FOUND, BRANCH TO CASES

1C35 58

MOV E,B ;B HAS PARTICULAR OPERATOR NUMBER

1C36 1600

MVI D,0 ;DOUBLE PRECISION VALUE TO D,E

1C38 1B

DCX D ;BIASED BY +1

1C39 21431C

LXI H,PTTAB ;BASE OF JUMP TABLE

1C3C 19

DAD D

1C3D 19

DAD D

1C3E 5E

MOV E,M

1C3F 23

INX H

1C40 66

MOV H,M

1C41 6B

MOV L,E

1C42 E9

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:

1C5B CDOA20

CALL FILAB ;SET LABEL FOR THIS LINE TO ASPC

SDB0:

1C5E CD0611

CALL SCAN ;PAST DB TO NEXT ITEM

1C61 3A8501

LDA TOKEN ;LOOK FOR LONG STRING

1C64 FE03

CPI STRNG

1C66 C28C1C

JNZ SDBC ;SKIP IF NOT STRING

1C69 3A8801

LDA ACCLEN

1C6C 3D

DCR A ;LENGTH 1 STRING?

1C6D CA8C1C

JZ SDBC

; LENGTH 0,2,... STRING

1C70 47

MOV B,A

1C71 04

INR B

1C72 04

INR B ;BECOMES 1,3,... FOR 0,2,... LENGTHS

1C73 218901

LXI H,ACCUM ;ADDRESS CHARACTERS IN STRING

1C76 05

SDB1:

DCR B ;COUNT DOWN TO ZERO

1C77 CA861C

JZ SDB2 ;SCAN DELIMITER AT END OF STRING

1C7A C5

PUSH B ;SAVE COUNT

1C7B 46

MOV B,M ;GET CHARACTER

1C7C 23

INX H

1C7D E5

PUSH H ;SAVE ACCUM POINTER

1C7E CD4820

CALL FILHB ;SEND TO HEX FILE

1C81 E1

POP H

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1C82 C1          POP      B
1C83 C3761C      JMP      SDB1
1C86 CD0611      SDB2:   CALL   SCAN      ;TO THE DELIMITER
1C89 C39B1C      JMP      SDB3

;
;
; NOT A LONG STRING
1C8C CD6318      SDBC:   CALL   OPAND      ;COMPUTE OPERAND
1C8F 2AC901      LHL     EVALU     ;VALUE TO H,L
1C92 7C          MOV     A,H
1C93 B7          ORA     A              ;HIGH ORDER MUST BE ZERO
1C94 C4D120      CNZ     ERRD      ;DATA ERROR
1C97 45          MOV     B,L          ;GET LOW BYTE
1C98 CD4820      CALL    FILHB
1C9B CDF91F      SDB3:   ;END OF ITEM - UPDATE ASPC
1C9E CDBA1E      CALL    SETAS      ;SET ASPC TO FPC
1CA1 FE2C        CALL    DELIM
1CA3 CA5E1C      CPI     ','
1CA6 C3311F      JZ      SDBO      ;FOR ANOTHER ITEM
                        JMP      CHEND    ;CHECK END OF LINE SYNTAX

;
SDS:
1CA9 CD0A20      CALL    FILAB      ;HANDLE LABEL IF IT OCCURRED
1CAC CDA620      CALL    PADD      ;PRINT ADDRESS
1CAF CDD11E      CALL    EXP16     ;SCAN AND GET 16BIT OPERAND
1CB2 EB          XCHG             ;TO D,E
1CB3 2AD201      LHL     ASPC      ;CURRENT PSEUDO PC
1CB6 19          DAD     D          ;+EXPRESSION
1CB7 22D201      SHLD    ASPC
1CBA 22D001      SHLD    FPC      ;NEXT TO FILL
1CBD C3311F      JMP      CHEND

;
SDW:
1CC0 CD0A20      CALL    FILAB      ;HANDLE OPTIONAL LABEL

SDWO:
1CC3 CDD11E      CALL    EXP16     ;GET 16BIT OPERAND
1CC6 E5          PUSH    H          ;SAVE A COPY
1CC7 45          MOV     B,L          ;LOW BYTE FIRST
1CC8 CD4820      CALL    FILHB     ;SEND LOW BYTE
1CCB E1          POP     H          ;RECLAIM A COPY
1CCC 44          MOV     B,H          ;HIGH BYTE NEXT
1CCD CD4820      CALL    FILHB     ;SEND HIGH BYTE
1CD0 CDF91F      CALL    SETAS      ;SET ASPC=FPC
1CD3 CDBA1E      CALL    DELIM     ;CHECK DELIMITER SYNTAX
1CD6 FE2C        CPI     ','
1CD8 CAC31C      JZ      SDWO      ;GET MORE DATA
1CDB C3311F      JMP      CHEND

;
SEND:
1CDE CD0A20      CALL    FILAB
1CE1 CDA620      CALL    PADD      ;WRITE LAST LOC
1CE4 3A0C01      LDA     PBUFF
1CE7 FE20        CPI     ','
1CE9 C2311F      JNZ     CHEND
1CEC CDD11E      CALL    EXP16     ;GET EXPRESSION IF IT'S THERE
1CEF 3A0C01      LDA     PBUFF
1CF2 FE20        CPI     ','

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1CF4 C2FA1C      JNZ      SENDO
1CF7 22ED20      SHLD     EPC      ;EXPRESSION FOUND, STORE IT FOR LATER
1CFA 3E20        SENDO: MVI      A, ' '
1CFC 320C01      STA      PBUFF   ;CLEAR ERROR, IF IT OCCURRED
1CFF CD0611      CALL     SCAN    ;CLEAR CR
1D02 3A8501      LDA      TOKEN
1D05 FE04        CPI      SPECL
1D07 C27C1F      JNZ      STERR
1DOA 3A8901      LDA      ACCUM
1DOD FE0A        CPI      LF
1DOF C27C1F      JNZ      STERR
1D12 C38B1F      JMP      ENDAS   ;END OF ASSEMBLER

```

```

;
SENDIF:

```

```

1D15 C3D11D      JMP      POEND

```

```

;
SENDM:

```

```

1D18 CDE320      CALL     ERRN
1D1B C3D11D      JMP      POEND

```

```

;
SEQU:

```

```

1D1E CD0020      CALL     SETLA
1D21 CA7C1F      JZ       STERR   ;MUST BE A LABEL
1D24 2AD201      LHLD     ASPC    ;HOLD TEMP ASPC
1D27 E5          PUSH     H       ;IN STACK
1D28 CDD11E      CALL     EXP16   ;GET 16BIT OPERAND
1D2B 22D201      SHLD     ASPC    ;VALUE OF EXPRESSION
1D2E CDOA20      CALL     FILAB
1D31 CDA920      CALL     PADDR   ;COMPUTED VALUE
1D34 211201      LXI      H,PBUFF+6 ;SPACE AFTER VALUE
1D37 363D        MVI      M, '='
1D39 E1          POP      H       ;REAL ASPC
1D3A 22D201      SHLD     ASPC    ;CHANGE BACK
1D3D C3311F      JMP      CHEND

```

```

;
SIF:

```

```

1D40 CDOA20      CALL     FILAB   ;IN CASE OF LABEL
1D43 CDD11E      CALL     EXP16   ;GET IF EXPRESSION
1D46 3A0C01      LDA      PBUFF
1D49 FE20        CPI      ' '
1D4B C2311F      JNZ      CHEND   ;SKIP IF ERROR
1D4E 7D          MOV      A,L     ;GET LSB
1D4F 1F          RAR
1D50 DA311F      JC       CHEND   ;TRUE IF CARRY BIT SET

```

```

;
;
SKIP TO EOF OR ENDIF

```

```

1D53 CD0611      SIFO: CALL     SCAN
1D56 3A8501      LDA      TOKEN
1D59 FE04        CPI      SPECL
1D5B C26E1D      JNZ      SIF1
1D5E 3A8901      LDA      ACCUM
1D61 FE1A        CPI      EOF
1D63 3E42        MVI      A, 'B'  ;BALANCE ERROR
1D65 CC1802      CZ
1D68 CA8B1F      JZ
1D6B C3531D      JMP      SIFO   ;FOR ANOTHER

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SIF1: ;NOT A SPECIAL CHARACTER
1D6E FE01 CPI IDEN
1D70 C2531D JNZ SIFO ;NOT AN IDENTIFIER
1D73 CDA615 CALL BGET ;LOOK FOR ENDIF
1D76 C2531D JNZ SIFO ;NOT FOUND
1D79 FE11 CPI PT ;PSEUDO OP?
1D7B C2531D JNZ SIFO
1D7E 78 MOV A,B ;GET OPERATOR NUMBER
1D7F FE05 CPI PENDIF ;ENDIF?
1D81 C2531D JNZ SIFO ;GET ANOTHER TOKEN
1D84 C3D11D JMP POEND ;OK, CHECK END OF LINE

;
SMACRO:
1D87 CDE320 CALL ERRN
1D8A C3311F JMP CHEND

;
SORG:
1D8D CDD11E CALL EXP16
1D90 3A0C01 LDA PBUFF
1D93 FE20 CPI ' '
1D95 C2311F JNZ CHEND ;SKIP ORG IF ERROR
1D98 22D201 SHLD ASPC ;CHANGE PC
1D9B 22D001 SHLD FPC ;CHANGE NEXT TO FILL
1D9E CD0A20 CALL FILAB ;IN CASE OF LABEL
1DA1 CDA620 CALL PADD
1DA4 C3311F JMP CHEND

;
SSET:
1DA7 CD0020 CALL SETLA
1DAA CA7C1F JZ STERR ;MUST BE LABELLED

;
1DAD CD5213 CALL GETTY
1DB0 FE05 CPI SETT
1DB2 C4DD20 CNZ ERRL ;LABEL ERROR
1DB5 3E05 MVI A,SETT
1DB7 CD4F13 CALL SETTY ;REPLACE TYPE WITH 'SET'
1DBA CDD11E CALL EXP16 ;GET THE EXPRESSION
1DBD E5 PUSH H ;SAVE IT
1DBE CD0020 CALL SETLA ;RE-ADDRESS LABEL
1DC1 E1 POP H ;RECLAIM IT
1DC2 CD5513 CALL SETVAL
1DC5 210000 LXI H,0
1DC8 22EB20 SHLD SYLAB ;PREVENT LABEL PROCESSING
1DCB C3311F JMP CHEND

;
;
STITLE:
1DCE CDE320 CALL ERRN ;NOT IMPLEMENTED

;
POEND: ;PSEUDO OPERATOR END - SCAN TO NEXT TOKEN
1DD1 CD0611 CALL SCAN
1DD4 C3311F JMP CHEND

;
;
NOT A PSEUDO OPCODE, CHECK FOR REAL OPCODE
1DD7 D613 CHKOT: SUI 01 ;BASE OF OPCODES
1DD9 FE21 CPI 015 ;PAST LAST OPCODE?

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1DDB D27C1F

JNC STERR ;STATEMENT ERROR IF SO

;
;

FOUND OPCODE, COMPUTE INDEX INTO TABLE AND JUMP TO CASE

1DDE 5F

MOV E,A

1DDF 1600

MVI D,0

1DE1 21EB1D

LXI H,OPTAB

1DE4 19

DAD D

1DE5 19

DAD D

1DE6 5E

MOV E,M

1DE7 23

INX H

1DE8 66

MOV H,M

1DE9 6B

MOV L,E

1DEA E9

PCHL ;JUMP TO CASE

;

OPTAB: ;OPCODE CATEGORIES

1DEB 091E

DW SSIMP ;SIMPLE

1DED 121E

DW SLXI ;LXI

1DEF 1E1E

DW SDAD ;DAD

1DF1 241E

DW SPUSH ;PUSH/POP

1DF3 381E

DW SJMP ;JMP/CALL

1DF5 411E

DW SMOV ;MOV

1DF7 501E

DW SMVI ;MVI

1DF9 601E

DW SACCI ;ACCUM IMMEDIATE

1DFB 691E

DW SLDAX ;LDAX/STAX

1DFD 781E

DW SLHLD ;LHLD/SHLD/LDA/STA

1DFF 811E

DW SACCR ;ACCUM-REGISTER

1E01 881E

DW SINC ;INC/DCR

1E03 8F1E

DW SINX ;INX/DCX

1E05 9E1E

DW SRST ;RESTART

1E07 A51E

DW SIN ;IN/OUT

;

SSIMP: ;SIMPLE OPERATION CODES

1E09 CD4820

CALL FILHB ;SEND HEX VALUE TO MACHINE CODE FILE

1E0C CD0611

CALL SCAN ;TO NEXT TOKEN

1E0F C3B11E

JMP INCPC

;

SLXI: ;LXI H,16B

1E12 CDFC1E

CALL SHDREG ;SCAN DOUBLE PRECISION REGISTER

1E15 CD171F

CALL CHCOM ;CHECK FOR COMMA FOLLOWING REGISTER

1E18 CD111F

CALL SETADR ;SCAN AND EMIT DOUBLE PRECISION OPERAND

1E1B C3B11E

JMP INCPC

;

SDAD: ;DAD B

1E1E CDFC1E

CALL SHDREG ;SCAN AND EMIT DOUBLE PRECISION REGISTER

1E21 C3B11E

JMP INCPC

;

SPUSH: ;PUSH B POP D

1E24 CDF21E

CALL SHREG ;SCAN SINGLE PRECISION REGISTER TO A

1E27 FE38

CPI 111000B ;MAY BE PSW

1E29 CA311E

JZ SPU0

;

NOT PSW, MUST BE B,D, OR H

1E2C E608

ANI 001000B ;LOW BIT MUST BE 0

1E2E C4BD20

CNZ ERRR ;REGISTER ERROR IF NOT

1E31 79

SPU0: MOV A,C ;RECALL REGISTER AND MASK IN CASE OF ERROR

1E32 E630

ANI 110000B

1E34 B0

ORA B ;MASK IN OPCODE FOR PUSH OR POP

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1E35 C3AE1E      JMP      FILINC      ;FILL HEX VALUE AND INCREMENT PC
;
;SJMP:           ;JMP 16B/ CALL 16B
1E38 CD4820      CALL     FILHB       ;EMIT JMP OR CALL OPCODE
1E3B CD111F      CALL     SETADR      ;EMIT 16BIT OPERAND
1E3E C3B11E      JMP      INCPC
;
;SMOV:           ;MOV A,B
1E41 CDF21E      CALL     SHREG
1E44 B0          ORA      B           ;MASK IN OPCODE
1E45 47          MOV     B,A         ;SAVE IN B TEMPORARILY
1E46 CD171F      CALL     CHCOM       ;MUST BE COMMA SEPARATOR
1E49 CDE71E      CALL     EXP3        ;VALUE MUST BE 0-7
1E4C B0          ORA      B           ;MASK IN OPCODE
1E4D C3AE1E      JMP      FILINC
;
;SMVI:           ;MVI A,8B
1E50 CDF21E      CALL     SHREG
1E53 B0          ORA      B           ;MASK IN OPCODE
1E54 CD4720      CALL     FILHEX      ;EMIT OPCODE
1E57 CD171F      CALL     CHCOM       ;SCAN COMMA
1E5A CDOB1F      CALL     SETBYTE     ;EMIT 8BIT VALUE
1E5D C3B11E      JMP      INCPC
;
;SACCI:          ;ADI 8B
1E60 CD4820      CALL     FILHB       ;EMIT IMMEDIATE OPCODE
1E63 CDOB1F      CALL     SETBYTE     ;EMIT 8BIT OPERAND
1E66 C3B11E      JMP      INCPC
;
;SLDAX:          ;LDAX B/STAX D
1E69 CDF21E      CALL     SHREG
1E6C E628        ANI      101000B    ;MUST BE B OR D
1E6E C4BD20      CNZ     ERRR        ;REGISTER ERROR IF NOT
1E71 79          MOV     A,C         ;RECOVER REGISTER NUMBER
1E72 E610        ANI      010000B    ;CHANGE TO B OR D IF ERROR
1E74 B0          ORA      B           ;MASK IN OPCODE
1E75 C3AE1E      JMP      FILINC     ;EMIT OPCODE
;
;SLHLD:          ;LHLD 16B/ SHLD 16B/ LDA 16B/ STA 16B
1E78 CD4820      CALL     FILHB       ;EMIT OPCODE
1E7B CD111F      CALL     SETADR      ;EMIT OPERAND
1E7E C3B11E      JMP      INCPC
;
;SACCR:          ;ADD B
1E81 CDE71E      CALL     EXP3        ;RIGHT ADJUSTED 3BIT VALUE FOR REGISTER
1E84 B0          ORA      B           ;MASK IN OPCODE
1E85 C3AE1E      JMP      FILINC
;
;SINC:           ;INR B/DCR D
1E88 CDF21E      CALL     SHREG       ;GET REGISTER
1E8B B0          ORA      B
1E8C C3AE1E      JMP      FILINC
;
;SINX:           ;INX H/DCX B
1E8F CDF21E      CALL     SHREG
1E92 E608        ANI      001000B    ;MUST BE B D M OR SP

```

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```

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 CDF21E      CALL     SHREG      ;VALUE IS 0-7
1EA1 B0          ORA      B          ;OPCODE MASKED
1EA2 C3AE1E      JMP      FILINC

```

```

;
SIN:            ;IN 8B/OUT 8B

```

```

1EA5 CD4820      CALL     FILHB      ;EMIT OPCODE
1EA8 CD0B1F      CALL     SETBYTE    ;EMIT 8BIT OPERAND
1EAB C3B11E      JMP      INCPC

```

```

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

```

```

1EAE CD4720

```

```

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

```

```

1EB1 CDOA20
1EB4 CDF91F
1EB7 C3311F

```

UTILITY SUBROUTINES FOR OPERATION CODES

```

;
DELIM:          ;CHECK DELIMITER SYNTAX FOR DATA STATEMENTS

```

```

1EBA 3A8501      LDA      TOKEN
1EBD FE04        CPI      SPECL
1EBF C4D120      CNZ      ERRD
1EC2 3A8901      LDA      ACCUM
1EC5 FE2C        CPI      ','
1EC7 C8          RZ
1EC8 FE3B        CPI      ';'
1ECA C8          RZ
1ECB FE0D        CPI      CR
1ECD C4D120      CNZ      ERRD
1ED0 C9          RET

```

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```

;
EXP16:          ;GET 16BIT VALUE TO H,L

```

```

1ED1 C5          PUSH     B
1ED2 CD0611      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

```

```

;
EXP8:           ;GET 8BIT VALUE TO REG A

```

```

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

```

```

EXP3:  ;GET 3BIT VALUE TO REG A
1EE7 CDDD1E  CALL EXP8
1EEA FE08    CPI 8
1EEC D4C720  CNC ERRV ;VALUE ERROR IF >=8
1EEF E607    ANI 111B ;REDUCE IF ERROR OCCURS
1EF1 C9      RET

;
SHREG:  ;GET 3BIT VALUE AND SHIFT LEFT BY 3
1EF2 CDE71E  CALL EXP3
1EF5 17      RAL
1EF6 17      RAL
1EF7 17      RAL
1EF8 E638    ANI 111000B
1EFA 4F      MOV C,A ;COPY TO C
1EFB C9      RET

;
SHDREG: ;GET DOUBLE REGISTER TO A
1EFC CDF21E  CALL SHREG
1EFF E608    ANI 001000B ;CHECK FOR A,C,E, OR L
1F01 C4BD20  CNZ ERRR ;REGISTER ERROR
1F04 79      MOV A,C ;RECOVER REGISTER
1F05 E630    ANI 110000B ;FIX IT IF ERROR OCCURRED
1F07 B0      ORA B ;MASK OPCODE
1F08 C34720  JMP FILHEX ;EMIT IT

;
SETBYTE: ;EMIT 16BIT OPERAND
1FOB CDDD1E  CALL EXP8
1FOE 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

;
SPECIAL CHARACTER, CHECK FOR COMMA
1F21 3A8901  LDA ACCUM
1F24 FE2C    CPI ','
1F26 CA2E1F  JZ COMRET ;RETURN IF COMMA FOUND

COMER: ;COMMA ERROR
1F29 3E43    MVI A,'C'
1F2B CD1802  CALL PERR

COMRET:
1F2E C1      POP B
1F2F F1      POP PSW
1F30 C9      RET

;
CHEND: ;END OF LINE CHECK
1F31 CDOA20  CALL FILAB ;IN CASE OF A LABEL
1F34 3A8501  LDA TOKEN
1F37 FE04    CPI SPECL
1F39 C27C1F  JNZ STERR ;MUST BE A SPECIAL CHARACTER

```

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```

1F3C 3A8901      LDA      ACCUM
1F3F FE0D        CPI      CR          ;CARRIAGE RETURN
1F41 C24A1F      JNZ      CHENO
;
1F44 CD0611      CALL     SCAN
1F47 C3BC1B      JMP      SCNEXT
;
CHENO:          ;NOT CR, CHECK FOR COMMENT
1F4A FE3B        CPI      ':'
1F4C C2721F      JNZ      CHEN2
1F4F CD0A20      CALL     FILAB      ;IN CASE LABELLED EMPTY LINE
;
CHEN1:          CLEAR COMMENT TO END OF LINE
1F52 CD0611      CALL     SCAN
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 CA8B1F      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
;
;
;
CHEN2:          NOT CR OR LF, MAY BE LOGICAL END OF LINE
1F72 FE21        CPI      '!'
1F74 CABC1B      JZ       SCNEXT
1F77 FE1A        CPI      EOF
1F79 CA8B1F      JZ       ENDAS
;
;
;
STERR:          STATEMENT ERROR IN OPERAND FIELD
1F7C 3E53        MVI      A,'S'
1F7E CD1802      CALL     PERR
1F81 C3521F      JMP      CHEN1      ;TO DUMP LINE
;
DIFF:           ;COMPUTE DE-HL TO HL
1F84 7B          MOV      A,E
1F85 95          SUB      L
1F86 6F          MOV      L,A
1F87 7A          MOV      A,D
1F88 9C          SBB      H
1F89 67          MOV      H,A
1F8A C9          RET
;
ENDAS:          ;END OF ASSEMBLY FOR THIS PASS
1F8B 21CF01      LXI      H,PASS
1F8E 7E          MOV      A,M
1F8F 34          INR      M          ;PASS NUMBER INCREMENTED
1F90 B7          ORA      A
1F91 CAA71B      JZ       RESTART
1F94 CD0611      CALL     SCAN      ;TO CLEAR LAST LINE FEED
1F97 CDA620      CALL     PADD      ;WRITE LAST ADDRESS
1F9A 211101      LXI      H,PBUFF+5
1F9D 360D        MVI      M,CR      ;SET TO CR FOR END OF MESSAGE
1F9F 210D01      LXI      H,PBUFF+1

```

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```

1FA2 CD1202      CALL    PCON      ;PRINT LAST ADDRESS

;
;
1FA5 2ACB01      LHL    SYTOP
1FA8 EB          XCHG
1FA9 2AD401      LHL    SYBAS
1FAC CD841F      CALL    DIFF      ;DIFFERENCE TO H,L
1FAF E5          PUSH    H          ;SYTOP-SYBAS TO STACK
1FB0 2ACD01      LHL    SYMAX
1FB3 EB          XCHG
1FB4 2AD401      LHL    SYBAS
1FB7 CD841F      CALL    DIFF      ;SYMAX-SYBAS TO H,L
1FBA 5C          MOV     E,H
1FBB 1600        MVI     D,0        ;DIVIDED BY 256
1FBD E1          POP     H          ;SYTOP-SYBAS TO H,L
1FBE CD6918      CALL    DIVF      ;RESULT TO DE
1FC1 EB          XCHG
1FC2 CDA920      CALL    PADDR      ;PRINT H,L TO PBUF
1FC5 211101      LXI     H,PBUFF+5  ;MESSAGE
1FC8 11D61F      LXI     D,EMSG      ;END MESSAGE
1FCB 1A          ENDA0: LDAX    D
1FCC B7          ORA     A          ;ZERO?
1FCD CAE41F      JZ      ENDA1
1FDO 77          MOV     M,A
1FD1 23          INX     H
1FD2 13          INX     D
1FD3 C3CB1F      JMP     ENDA0

;
1FD6 4820555345EMSG: DB      'H USE FACTOR',CR,0

;
1FE4 210E01      ENDA1: LXI     H,PBUFF+2  ;BEGINNING OF RATIO
1FE7 CD1202      CALL    PCON
1FEA 2AED20      LHL    EPC
1FED 22D001      SHLD   FPC          ;END PROGRAM COUNTER
1FF0 C31E02      JMP     EOR

;
;
COMDH:           ;COMPARE D,E WITH H,L FOR EQUALITY (NZ FLAG IF NOT EQUAL)
1FF3 7A          MOV     A,D
1FF4 BC          CMP     H
1FF5 C0          RNZ
1FF6 7B          MOV     A,E
1FF7 BD          CMP     L
1FF8 C9          RET

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

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

```

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```

FILAB: ;FILL LABEL VALUE WITH CURRENT ASPC, IF LABEL FOUND
200A CD0020 CALL SETLA
200D C8 RZ ;RETURN IF NO LABEL DETECTED
;
; LABEL FOUND, MUST BE DEFINED ON PASS-1
200E 210000 LXI H,0
2011 22EB20 SHLD SYLAB ;TO MARK NEXT STATEMENT WITH NO LABEL
2014 3ACF01 LDA PASS
2017 B7 ORA A
2018 C23120 JNZ FIL1
;
PASS 0
201B CD5213 CALL GETTY
201E F5 PUSH PSW ;SAVE A COPY OF TYPE
201F E607 ANI 111B ;CHECK FOR UNDEFINED
2021 C4DD20 CNZ ERRL ;LABEL 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
2031 CD5213 CALL GETTY
2034 E607 ANI 111B
2036 CCD720 CZ ERRL ;PHASE ERROR
; GET VALUE AND COMPARE WITH ASPC
2039 CD5813 CALL GETVAL ;TO H,L
203C EB XCHG
203D 2AD201 LHLD ASPC
2040 CDF31F CALL COMDH
2043 C4D720 CNZ ERRL ;PHASE ERROR IF NOT THE SAME
2046 C9 RET
;
FILHEX: ;WRITE HEX BYTE IN REGISTER A TO MACHINE CODE FILE IF PASS-1
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
;
205F 3AEF20 LDA NBP
2062 FE10 CPI NBMAX ;TRUNCATE CODE IF TOO MUCH ON THIS LINE
2064 C1 POP B ;RECALL HEX DIGIT
2065 D26C20 JNC FILHI
; ROOM FOR DIGIT ON THIS LINE

```

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```

2068 78          MOV      A,B
2069 CD9620      CALL     WHEXB      ;WRITE HEX BYTE TO PRINT LINE
206C 2AD001      FILHI:  LHLD     FPC
206F 23          INX      H
2070 22D001      SHLD     FPC      ;READY FOR NEXT BYTE
2073 C9          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
207E C630      ADI      '0'
2080 FE3A      CPI      '0'+10
2082 D8          RC
2083 C607      ADI      'A'-'0'-10
2085 C9          RET

;
WHEXN: ;WRITE HEX NIBBLE
2086 CD7E20      CALL     CHEX      ;CONVERT TO ASCII FROM HEX
2089 21EF20      LXI      H,NBP
208C 5E          MOV      E,M      ;NEXT POSITION TO PRINT
208D 1600      MVI      D,0      ;DOUBLE PRECISION
208F 34          INR      M      ;NBP=NBP+1
2090 210C01      LXI      H,PBUFF
2093 19          DAD      D
2094 77          MOV      M,A      ;STORE IN PRINT BUFFER
2095 C9          RET

;
WHEXB: ;WRITE HEX BYTE TO PRINT BUFFER
2096 F5          PUSH     PSW
2097 1F          RAR
2098 1F          RAR
2099 1F          RAR
209A 1F          RAR
209B E60F      ANI      0FH      ;HIGH ORDER NIBBLE NORMALIZE IN A
209D CD8620      CALL     WHEXN    ;WRITE IT
20A0 F1          POP      PSW
20A1 E60F      ANI      0FH
20A3 C38620      JMP      WHEXN    ;WRITE AND RETURN

;
PADD: LHLD     ASPC
PADDR: ;PRINT ADDRESS FIELD OF PRINT LINE FROM H,L
20A9 EB          XCHG
20AA 21EF20      LXI      H,NBP    ;INITIALIZE NEXT TO FILL
20AD E5          PUSH     H      ;SAVE A COPY OF NBP'S ADDRESS
20AE 3601      MVI      M,1
20B0 7A          MOV      A,D      ;PRINT HIGH BYTE
20B1 D5          PUSH     D      ;SAVE A COPY
20B2 CD9620      CALL     WHEXB
20B5 D1          POP      D

```

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```

20B6 7B      MOV      A,E
20B7 CD9620  CALL     WHEXB
20BA E1      POP      H          ;ADDRESSING NBP
20BB 34      INR      M          ;SKIP A SPACE AFTER ADDRESS FIELD
20BC C9      RET

```

```

;
ERRR:        ;EMIT REGISTER ERROR

```

```

20BD F5      PUSH     PSW
20BE C5      PUSH     B
20BF 3E52    MVI      A,'R'
20C1 CD1802  CALL     PERR
20C4 C1      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

```

```

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

```

```

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

```

```

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

```

```

;
ERRN:        PUSH     PSW
20E3 F5      MVI      A,'N'      ;NOT IMPLEMENTED
20E4 3E4E

```

```

;
ERR:

```

```

20E6 CD1802  CALL     PERR
20E9 F1      POP      PSW
20EA C9      RET

```

```

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

```

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0188 ACCLN	0189 ACCUM	0040 ACMAX	01D2 ASPC	15A6 BGET
15A0 BMOD	1F17 CHCOM	1F4A CHENO	1F52 CHEN1	1F72 CHEN2
1F31 CHEND	207E CHEX	1DD7 CHKOT	1C30 CHKPT	1FF3 COMDH
1F29 COMER	1F2E COMRET	000D CR	1EBA DELIM	021B DHEX
1F84 DIFF	1869 DIVF	0002 DLABT	1FD6 EMSG	1FCB ENDAO
1FE4 ENDA1	1F8B ENDAS	134C ENTER	001A EOF	021E EOR
20ED EPC	0004 EQUT	20D1 ERRD	20DD ERRL	20E3 ERRN
20D7 ERRP	20BD ERRR	20C7 ERRV	20E6 ERR	01C9 EVALUE
1ED1 EXP16	1EE7 EXP3	1EDD EXP8	0008 EXTT	2031 FIL1
200A FILAB	2074 FILADR	2048 FILHB	2047 FILHEX	206C FILHI
1EAE FILINC	1349 FOUND	01D0 FPC	1352 GETTY	1358 GETVAL
000C GLBT	0001 IDEN	1EB1 INCPC	1343 INISY	1103 INITS
0200 IOMOD	000A LF	1BFE LFOUN	1346 LOOKUP	0006 MACT
1866 MULF	0010 NBMAX	20EF NBP	0002 NUMB	0013 O1
0021 O15	0012 OBASE	1863 OPAND	1860 OPMOD	1DEB OPTAB
20A6 PADD	20A9 PADDR	01CF PASS	0078 PBMAX	0184 PBP
010C PBUFF	0212 PCON	0005 PENDIF	0218 PERR	0001 PLABT
1DD1 POEND	0011 PT	1C43 PTTAB	000B REFT	1BA7 RESTART
0010 RT	1E60 SACCI	1E81 SACCR	1106 SCAN	1100 SCMOD
1BBF SCNO	1BDD SCN1	1BBC SCNEXT	1E1E SDAD	1C5B SDB
1C5E SDB0	1C76 SDB1	1C86 SDB2	1C9B SDB3	1C8C SDBC
1CA9 SDS	1CC0 SDW	1CC3 SDWO	1CDE SEND	1CFA SENDO
1D15 SENDIF	1D18 SENDM	1D1E SEQU	1F11 SETADR	1FF9 SETAS
1F0B SETBYTE	2000 SETLA	1C0C SETSY	0005 SETT	134F SETTY
0203 SETUP	1355 SETVAL	1EFC SHDREG	1EF2 SHREG	1D40 SIF
1D53 SIFO	1D6E SIF1	1E88 SINC	1EA5 SIN	1E8F SINX
1E38 SJMP	1E69 SLDAX	1E78 SLHLD	1E12 SLXI	1D87 SMACRO
1E41 SMOV	1E50 SMVI	1D8D SORG	0004 SPECL	1E31 SPUO
1E24 SPUSH	1E9E SRST	1DA7 SSET	1E09 SSIMP	1F7C STERR
1DCE STITLE	0003 STRNG	01D6 SYADR	01D4 SYBAS	20EB SYLAB
01CD SYMAX	1340 SYMOD	01CB SYTOP	0185 TOKEN	0186 VALUE
2096 WHEXB	2086 WHEXN	0215 WOBUFF		

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