



The Spectrum MACHINE CODE Reference Guide

Microdrive-Interface1
Complete ROM Disassembly



Richard Ross-Langley

The Spectrum

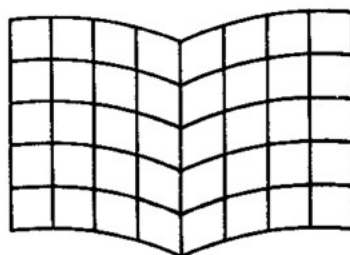
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INTRODUCTION

This book contains a full disassembly listing of the Sinclair ZX Spectrum 16K ROM and a machine code programmer's guide to the Microdrive & Interface 1 unit. Enough detail is included to help you, as a machine code programmer, to understand the operation of the Sinclair ZX Spectrum and its Interface 1 and to design machine code routines for your own purposes.

The ROM disassembly is an edited version of the output of the Phipps Associates disassembler, ZXDISASM, published in their "Spectrum Pocket Book". Features of the disassembler include :-

- Zilog mnemonics are used, eg LD A,(HL) instead of MOV A,M.
- Relative jumps show the signed decimal offset and the result.
- Hexadecimal (hex) values are default and are printed without suffix
- Decimal values are preceded by a plus or minus sign.
- Some restart instructions are followed by data bytes.

The absolute addresses of all system variables and several important routines have been named using where possible the standard names shown in the manual. In addition, the Z80 index register IY is assumed throughout to point to the variable ERRNR at address 5C3A and so offsets have also been named by a Y- prefix to the standard name.

In the disassembly, the first column gives the memory address. The second column shows the instruction in hex, whilst the remainder of the line shows the instruction in assembly language mnemonics. The disassembly contains some notes inserted into the listing to assist in understanding the coding.

Throughout the book, the typeface selected has printed the crosshatch character as a pound sign. Thus OPEN £ and CLOSE £ are actually the tokens shown in red under the keys for the digits 4 and 5 on the Spectrum keyboard.

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

;ROM Contents Copyright 1982 Sinclair Research Ltd
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;Edition 2 of September 1983

;Standard names used for absolute address of system variables
;Prefix Y- implies IY index from ERRNR (ie YMODE = +7)

; constants
; CR EQU +13
; HI EQU +255

;Addr Hex Op Operand ; notes

; Power on reset jumps here

0000 F3 DI
0001 AF XOR A
0002 11FFFF LD DE,FFFF
0005 C3CB11 JP 11CB

; RST 08 followed by one byte

; Causes entry to Interface 1 (if fitted)

; Error number or Interface function number

0008 2A5D5C LD HL,(CHADD)
000B 225F5C LD (XPTR),HL
000E 1843 JR +67;0053

; RST 10 output (A) to current stream

0010 C3F215 JP 15F2
0013 FFFFFFFF DEFB HI,HI,HI,HI
0017 FF DEFB HI

; RST 18 get char to be interpreted

0018 2A5D5C LD HL,(CHADD)
001B 7E LD A,(HL)
001C CD7D00 CALL 007D
001F D0 RET NC

; RST 20 get next char

0020 CD7400 CALL 0074
0023 18F7 JR -9;001C
0025 FFFFFFFF DEFB HI,HI,HI

; RST 28 floating point calculator

0028 C35B33 JP FPCALC ;335B
002B FFFFFFFF DEFB HI,HI,HI,HI
002F FF DEFB HI

; RST 30 make space of BC bytes

0030 C5 PUSH BC
0031 2A615C LD HL,(WORKSP)
0034 E5 PUSH HL
0035 C39E16 JP 169E

; RST 38 Interrupt mode 1 => here

; Frames counter & keyboard scan

0038 F5 PUSH AF
0039 E5 PUSH HL
003A 2A785C LD HL,(FRAMES)
003D 23 INC HL
003E 22785C LD (FRAMES),HL
0041 7C LD A,H
0042 B5 OR L
0043 2003 JR NZ,+3;0048

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```

0045 FD3440      INC      (IY+YFRAME+2);1sb
0048 C5         PUSH     BC
0049 D5         PUSH     DE
004A CDEF02      CALL     KSCAN      ;02BF
004D D1         POP      DE
004E C1         POP      BC
004F E1         POP      HL
0050 F1         POP      AF
0051 FB         EI
0052 C9         RET
; save error code & reset stack
0053 E1         POP      HL
0054 6E         LD       L,(HL)
0055 FD7500      LD       (IY+YERRNR),L
0058 ED7B3D5C    LD       SP,(ERRSP)
005C C3C516      JP       16C5
005F FFFFFFFF    DEFB     HI,HI,HI,HI
0063 FFFFFF      DEFB     HI,HI,HI
; Non Maskable Interrupt => here
; hangover from ICE development equipment?
0066 F5         PUSH     AF
0067 E5         PUSH     HL
0068 2AB05C      LD       HL,(SPARE2)
006B 7C         LD       A,H
006C B5         OR       L
006D 2001        JR       NZ,+1;0070
006F E9         JP       (HL)      ;HL=0
0070 E1         POP      HL
0071 F1         POP      AF
0072 ED45        RETN
; select char from currently interpreted line
0074 2A5D5C      LD       HL,(CHADD)
0077 23         INC      HL
0078 225D5C      LD       (CHADD),HL
007B 7E         LD       A,(HL)
007C C9         RET
; test char to be interpreted
007D FE21        CP       21
007F D0         RET      NC
0080 FE0D        CP       CR
0082 C8         RET      Z
0083 FE10        CP       10
0085 D8         RET      C
0086 FE18        CP       18
0088 3F         CCF
0089 D8         RET      C
008A 23         INC      HL
008B FE16        CP       16
008D 3801        JR       C,+1;0090
008F 23         INC      HL
0090 37         SCF
0091 225D5C      LD       (CHADD),HL
0094 C9         RET
;      Expanded keyword table
; Note: bit 7 set on last byte of each string

```

0095 BF	DEFB	'?'
0096 524EC4	DEFB	'RND'
0099 494E4B45	DEFB	'INKEY\$'
009D 59A4		
009F 50C9	DEFB	'PI'
00A1 46CE	DEFB	'FN'
00A3 504F494E	DEFB	'POINT'
00A7 D4		
00A8 53435245	DEFB	'SCREEN\$'
00AC 454EA4		
00AF 415454D2	DEFB	'ATTR'
00B3 41D4	DEFB	'AT'
00B5 5441C2	DEFB	'TAB'
00B8 56414CA4	DEFB	'VAL\$'
00BC 434F44C5	DEFB	'CODE'
00C0 5641CC	DEFB	'VAL'
00C3 4C45CE	DEFB	'LEN'
00C6 5349CE	DEFB	'SIN'
00C9 434FD3	DEFB	'COS'
00CC 5441CE	DEFB	'TAN'
00CF 4153CE	DEFB	'ASN'
00D2 4143D3	DEFB	'ACS'
00D5 4154CE	DEFB	'ATN'
00D8 4CCE	DEFB	'LN'
00DA 4558D0	DEFB	'EXP'
00DD 494ED4	DEFB	'INT'
00E0 5351D2	DEFB	'SQR'
00E3 5347CE	DEFB	'SGN'
00E6 4142D3	DEFB	'ABS'
00E9 504545CB	DEFB	'PEEK'
00ED 49CE	DEFB	'IN'
00EF 5553D2	DEFB	'USR'
00F2 535452A4	DEFB	'STR\$'
00F6 434852A4	DEFB	'CHR\$'
00FA 4E4FD4	DEFB	'NOT'
00FD 4249CE	DEFB	'BIN'
0100 4FD2	DEFB	'OR'
0102 414EC4	DEFB	'AND'
0105 3CBD	DEFB	'<='
0107 3EBD	DEFB	'>='
0109 3CBE	DEFB	'<>'
010B 4C494EC5	DEFB	'LINE'
010F 544845CE	DEFB	'THEN'
0113 54CF	DEFB	'TO'
0115 535445D0	DEFB	'STEP'
0119 44454620	DEFB	'DEF FN'
011D 46CE		
011F 4341D4	DEFB	'CAT'
0122 464F524D	DEFB	'FORMAT'
0126 41D4		
0128 4D4F56C5	DEFB	'MOVE'
012C 45524153	DEFB	'ERASE'
0130 C5		
0131 4F50454E	DEFB	'OPEN £'
0135 20A3		

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0137	434C4F53	DEFB	'CLOSE £'
013B	4520A3		
013E	4D455247	DEFB	'MERGE'
0142	C5		
0143	56455249	DEFB	'VERIFY'
0147	46D9		
0149	424545D0	DEFB	'BEEP'
014D	43495243	DEFB	'CIRCLE'
0151	4CC5		
0153	494ECB	DEFB	'INK'
0156	50415045	DEFB	'PAPER'
015A	D2		
015B	464C4153	DEFB	'FLASH'
015F	C8		
0160	42524947	DEFB	'BRIGHT'
0164	48D4		
0166	494E5645	DEFB	'INVERSE'
016A	5253C5		
016D	4F5645D2	DEFB	'OVER'
0171	4F55D4	DEFB	'OUT'
0174	4C505249	DEFB	'LPRINT'
0178	4ED4		
017A	4C4C4953	DEFB	'LLIST'
017E	D4		
017F	53544FD0	DEFB	'STOP'
0183	524541C4	DEFB	'READ'
0187	444154C1	DEFB	'DATA'
018B	52455354	DEFB	'RESTORE'
018F	4F52C5		
0192	4E45D7	DEFB	'NEW'
0195	424F5244	DEFB	'BORDER'
0199	45D2		
019B	434F4E54	DEFB	'CONTINUE'
019F	494E55C5		
01A3	4449CD	DEFB	'DIM'
01A6	5245CD	DEFB	'REM'
01A9	464FD2	DEFB	'FOR'
01AC	474F2054	DEFB	'GO TO'
01B0	CF		
01B1	474F2053	DEFB	'GO SUB'
01B5	55C2		
01B7	494E5055	DEFB	'INPUT'
01BB	D4		
01BC	4C4F41C4	DEFB	'LOAD'
01C0	4C4953D4	DEFB	'LIST'
01C4	4C45D4	DEFB	'LET'
01C7	50415553	DEFB	'PAUSE'
01CB	C5		
01CC	4E4558D4	DEFB	'NEXT'
01D0	504F4BC5	DEFB	'POKE'
01D4	5052494E	DEFB	'PRINT'
01D8	D4		
01D9	504C4FD4	DEFB	'PLOT'
01DD	5255CE	DEFB	'RUN'
01E0	534156C5	DEFB	'SAVE'

```

01E4 52414E44      DEFB      'RANDOMIZE'
01E8 4F4D495A
01EC C5
01ED 49C6          DEFB      'IF'
01EF 434CD3          DEFB      'CLS'
01F2 445241D7          DEFB      'DRAW'
01F6 434C4541          DEFB      'CLEAR'
01FA D2
01FB 52455455          DEFB      'RETURN'
01FF 52CE
0201 434F50D9          DEFB      'COPY'
;      DATA (assembly level coding omitted)
; key code lookup table in scan order
0205 42485936      ;      B H Y 6
0209 35544756      ;      5 T G V
020D 4E4A5537      ;      N J U 7
0211 34524643      ;      4 R F C
0215 4D4B4938      ;      M K I 8
0219 33454458      ;      3 E D X
021D 0E4C4F39      ;      e-mode L 0 9
0221 3257535A      ;      2 W S Z
0225 200D5030      ;      space ENTER 2 0
0229 315141      ;      1 Q A
; extended mode key codes in alpha order
022C E3C4E0E4      ;ABCD      READ BIN LPRINT DATA
0230 B4BCBDBB      ;EFGH      TAN SGN ABS SQR
0234 AFB0B1C0      ;IJKL      CODE VAL LEN USR
0238 A7A6BEAD      ;MNOP      PI INKEY$ PEEK TAB
023C B2BAE5A5      ;QRST      SIN INT RESTORE RND
0240 C2E1B3B9      ;UVWX      CHR$ LLIST COS EXP
0244 C1B8          ;YZ      STR$ LN
; extended mode shifted key codes in alpha order
0246 7EDC          ;AB      tilde BRIGHT
0248 DA5CB77B      ;CDEF      PAPER backslash ATN left-brace
024C 7DD8BFAE      ;GHIJ      right-brace CIRCLE IN VAL$
0250 AAABDDDE      ;KLMN      SCREEN$ ATTR INVERSE OVER
0254 DF7FB5D6      ;OPQR      OUT copyright ASN VERIFY
0258 7CD55DDB      ;STUV      bar MERGE right-sq FLASH
025C B6D95BD7      ;WXYZ      ACS INK left-sq BEEP
; shifted numeric key codes
0260 0C070604      ;0123      DELETE EDIT Caps-lock true-video
0264 05080A0B      ;4567      inv-video left down up
0268 090F          ;89      right graphics
; shifted alpha
026A E22A          ;AB      STOP asterisk
026C 3FCDC8CC      ;CDEF      query STEP geq TO
0270 CB5EAC2D      ;GHIJ      THEN uparrow AT minus
0274 2B3D2E2C      ;KLMN      plus equals period comma
0278 3B22C73C      ;OPQR      semicolon quote leq less
027C C33EC52F      ;STUV      NOT greater OR slash
0280 C960C63A      ;WXYZ      not-equal pound AND colon
; extended mode shifted numeric
0284 D0CEA8CA      ;0123      FORMAT DEF-FN FN LINE
0288 D3D4D1D21      ;4567      OPEN-£ CLOSE-£ MOVE ERASE
028C A9CF          ;89      POINT CAT

```



```

;          CODING RESUMES ...
; poll keyboard & build up key code in DE
028E 2E2F      LD      L,2F
0290 11FFFF    LD      DE,FFFF
0293 01FEFE    LD      EC,FEFE
0296 ED78      IN      A,(C)
0298 2F        CPL
0299 E61F      AND     1F
029B 280E      JR      Z,+14;02AB
029D 67        LD      H,A
029E 7D        LD      A,L
029F 14        INC     D
02A0 C0        RET     NZ
02A1 D608      SUB     08
02A3 CB3C      SRL     H
02A5 30FA      JR      NC,-6;02A1
02A7 53        LD      D,E
02A8 5F        LD      E,A
02A9 20F4      JR      NZ,-12;029F
02AB 2D        DEC     L
02AC CB00      RLC     B
02AE 38E6      JR      C,-26;0296
02B0 7A        LD      A,D
02B1 3C        INC     A
02B2 C8        RET     Z
02B3 FE28      CP      28
02B5 C8        RET     Z
02B6 FE19      CP      19
02B8 C8        RET     Z
02B9 7B        LD      A,E
02BA 5A        LD      E,D
02BB 57        LD      D,A
02BC FE18      CP      18
02BE C9        RET
; full keyboard scanning & debounce
; bit 5,(IY+YFLAGS) set when valid key detected
02BF          KSCAN :
02BF CD8E02    CALL     028E
02C2 C0        RET     NZ
02C3 21005C    LD      HL,KSTATE
02C6 CB7E      BIT     7,(HL)
02C8 2007      JR      NZ,+7;02D1
02CA 23        INC     HL
02CB 35        DEC     (HL)
02CC 2B        DEC     HL
02CD 2002      JR      NZ,+2;02D1
02CF 36FF      LD      (HL),FF
02D1 7D        LD      A,L
02D2 21045C    LD      HL,5C04
02D5 BD        CP      L
02D6 20EE      JR      NZ,-18;02C6
02D8 CD1E03    CALL     031E
02DB D0        RET     NC
02DC 21005C    LD      HL,KSTATE
02DF BE        CP      (HL)

```

```

02E0 282E      JR      Z,+46;0310
02E2 EB        EX      DE,HL
02E3 21045C    LD      HL,5C04
02E6 BE        CP      (HL)
02E7 2827      JR      Z,+39;0310
02E9 CB7E      BIT     7,(HL)
02EB 2004      JR      NZ,+4;02F1
02ED EB        EX      DE,HL
02EE CB7E      BIT     7,(HL)
02F0 C8        RET     Z
02F1 5F        LD      E,A
02F2 77        LD      (HL),A
02F3 23        INC     HL
02F4 3605      LD      (HL),05
02F6 23        INC     HL
02F7 3A095C    LD      A,(REPDEL)
02FA 77        LD      (HL),A
02FB 23        INC     HL
02FC FD4E07    LD      C,(IY+YMODE)
02FF FD5601    LD      D,(IY+YFLAGS)
0302 E5        PUSH    HL
0303 CD3303    CALL    0333
0306 E1        POP     HL
0307 77        LD      (HL),A
0308 32085C    LD      (LASTK),A
030B FDCB01EE  SET     5,(IY+YFLAGS)
030F C9        RET
;
0310 23        INC     HL
0311 3605      LD      (HL),05
0313 23        INC     HL
0314 35        DEC     (HL)
0315 C0        RET     NZ
0316 3A0A5C    LD      A,(REPPER)
0319 77        LD      (HL),A
031A 23        INC     HL
031B 7E        LD      A,(HL)
031C 18EA      JR      -22;0308
031E 42        LD      B,D
031F 1600      LD      D,00
0321 7B        LD      A,E
0322 FE27      CP      27
0324 D0        RET     NC
0325 FE18      CP      18
0327 2003      JR      NZ,+3;032C
0329 CB78      BIT     7,B
032B C0        RET     NZ
032C 210502    LD      HL,0205 ;Lmode
032F 19        ADD     HL,DE
0330 7E        LD      A,(HL)
0331 37        SCF
0332 C9        RET
;
0333 7B        LD      A,E
0334 FE3A      CP      3A

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```

0336 382F      JR      C,+47;0367
0338 0D        DEC      C
0339 FA4F03    JP      M,034F
033C 2803      JR      Z,+3;0341
033E C64F      ADD      4F
0340 C9        RET
;
0341 21EB01    LD      HL,01EB
0344 04        INC      B
0345 2803      JR      Z,+3;034A
0347 210502    LD      HL,0205 ;Lmode
034A 1600      LD      D,00
034C 19        ADD      HL,DE
034D 7E        LD      A,(HL)
034E C9        RET
;
034F 212902    LD      HL,0229 ;Emode
0352 CB40      BIT      0,B
0354 28F4      JR      Z,-12;034A
0356 CB5A      BIT      3,D
0358 280A      JR      Z,+10;0364
035A FDCB305E  BIT      3,(IY+YFLGS2)
035E C0        RET      NZ
035F 04        INC      B
0360 C0        RET      NZ
0361 C620      ADD      20
0363 C9        RET
;
0364 C6A5      ADD      A5
0366 C9        RET
;
0367 FE30      CP      30
0369 D8        RET      C
036A 0D        DEC      C
036B FA9D03    JP      M,039D
036E 2019      JR      NZ,+25;0389
0370 215402    LD      HL,0254 ;Emode+shift
0373 CB68      BIT      5,B
0375 28D3      JR      Z,-45;034A
0377 FE38      CP      38
0379 3007      JR      NC,+7;0382
037B D620      SUB      20
037D 04        INC      B
037E C8        RET      Z
037F C608      ADD      08
0381 C9        RET
;
0382 D636      SUB      36
0384 04        INC      B
0385 C8        RET      Z
0386 C6FE      ADD      FE
0388 C9        RET
;
0389 213002    LD      HL,0230
038C FE39      CP      39

```

```

038E 28BA      JR      Z,-70;034A
0390 FE30      CP      30
0392 28B6      JR      Z,-74;034A
0394 E607      AND     07
0396 C680      ADD     80
0398 04        INC     B
0399 C8        RET     Z
039A EE0F      XOR     0F
039C C9        RET
;
039D 04        INC     B
039E C8        RET     Z
039F CB68      BIT     5,B
03A1 213002    LD      HL,0230
03A4 20A4      JR      NZ,-92;034A
03A6 D610      SUB     10
03A8 FE22      CP      22
03AA 2806      JR      Z,+6;03B2
03AC FE20      CP      20
03AE C0        RET     NZ
03AF 3E5F      LD      A,5F
03B1 C9        RET
;
03B2 3E40      LD      A,40
03B4 C9        RET
; sound with HL=frequency DE=duration
03B5      BEEPER:
03B5 F3        DI
03B6 7D        LD      A,L
03B7 CB3D      SRL     L
03B9 CB3D      SRL     L
03BB 2F        CPL
03BC E603      AND     03
03BE 4F        LD      C,A
03BF 0600      LD      B,00
03C1 DD21D103  LD      IX,03D1
03C5 DD09      ADD     IX,BC
03C7 3A485C    LD      A,(BORDCR)
03CA E638      AND     38
03CC 0F        RRCA
03CD 0F        RRCA
03CE 0F        RRCA
03CF F608      OR      08
03D1 00        NOP
03D2 00        NOP
03D3 00        NOP
03D4 04        INC     B
03D5 0C        INC     C
03D6 0D        DEC     C
03D7 20FD      JR      NZ,-3;03D6
03D9 0E3F      LD      C,3F
03DB 05        DEC     B
03DC C2D603    JP      NZ,03D6
03DF EE10      XOR     10
03E1 D3FE      OUT     (FE),A

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```

03E3 44      LD      B,H
03E4 4F      LD      C,A
03E5 CB67    BIT     4,A
03E7 2009    JR      NZ,+9;03F2
03E9 7A      LD      A,D
03EA B3      OR      E
03EB 2809    JR      Z,+9;03F6
03ED 79      LD      A,C
03EE 4D      LD      C,L
03EF 1B      DEC     DE
03F0 DDE9    JP      (IX)
;
03F2 4D      LD      C,L
03F3 0C      INC     C
03F4 DDE9    JP      (IX)
;
03F6 FB      EI
03F7 C9      RET
;      BEEP command
03F8 EF      RST     28
03F9 31      DEFB    +49;copy
03FA 27      DEFB    +39;INT
03FB C0      DEFB    +192;store 0
03FC 03      DEFB    +3;subtract
03FD 34      DEFB    +52;literal
03FE EC      DEFB    +236
03FF 6C      DEFB    +108
0400 98      DEFB    +152
0401 1F      DEFB    +31
0402 F5      DEFB    +245
0403 04      DEFB    +4;multiply
0404 A1      DEFB    +161
0405 0F      DEFB    +15;add
0406 38      DEFB    +56;fp exit
0407 21925C  LD      HL,MEMBOT
040A 7E      LD      A,(HL)
040B A7      AND     A
040C 205E    JR      NZ,+94;046C err
040E 23      INC     HL
040F 4E      LD      C,(HL)
0410 23      INC     HL
0411 46      LD      B,(HL)
0412 78      LD      A,B
0413 17      RLA
0414 9F      SBC     A
0415 B9      CP      C
0416 2054    JR      NZ,+84;046C err
0418 23      INC     HL
0419 BE      CP      (HL)
041A 2050    JR      NZ,+80;046C err
041C 78      LD      A,B
041D C63C    ADD     3C
041F F22504  JP      P,0425
0422 E26C04  JP      PO,046C
0425 06FA    LD      B,FA

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0427 04      INC      B
0428 D60C    SUB      0C
042A 30FB    JR       NC,-5;0427
042C C60C    ADD      0C
042E C5      PUSH     BC
042F 216E04  LD        HL,046E beep constants
0432 CD0634  CALL     3406
0435 CDB433  CALL     33B4
0438 EF      RST      28
0439 04      DEFB     +4;multiply
043A 38      DEFB     +56;fp exit
043B F1      POP      AF
043C 86      ADD      (HL)
043D 77      LD        (HL),A
043E EF      RST      28
043F C0      DEFB     +192;store 0
0440 02      DEFB     +2;delete
0441 31      DEFB     +49;copy
0442 38      DEFB     +56;fp exit
0443 CD941E  CALL     1E94
0446 FE0B    CP       0B
0448 3022    JR       NC,+34;046C
044A EF      RST      28
044B E0      DEFB     +224;get 0
044C 04      DEFB     +4;multiply
044D E0      DEFB     +224;get 0
044E 34      DEFB     +52;literal
044F 80      DEFB     +128
0450 43      DEFB     +67
0451 55      DEFB     +85
0452 9F      DEFB     +159
0453 80      DEFB     +128
0454 01      DEFB     +1;exchg
0455 05      DEFB     +5;divide
0456 34      DEFB     +52;literal
0457 35      DEFB     +53
0458 71      DEFB     +113
0459 03      DEFB     +3
045A 38      DEFB     +56
045B CD991E  CALL     1E99
045E C5      PUSH     BC
045F CD991E  CALL     1E99
0462 E1      POP      HL
0463 50      LD        D,B
0464 59      LD        E,C
0465 7A      LD        A,D
0466 B3      OR        E
0467 C8      RET       Z
0468 1B      DEC       DE
0469 C3B503  JP        BEEPER
;
046C CF      RST      08
046D 0A      DEFB     +10;out of range
;      DATA (coding omitted)
; beep frequency value table (5 bytes/entry)

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; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

046E 8902D01286 ;C
0473 890A976075 ;C£
0478 8912D5171F ;D
047D 891E904102 ;D£
0482 8924D053CA ;E
0487 892E9D36E1 ;F
048C 8938FF493E ;F£
0491 8943FF6A73 ;G
0496 894FA70054 ;G£
049B 895C000000 ;A
04A0 896914F624 ;A£
04A5 8976F11005 ;B
;
04AA CDFB24      CALL    24FB
04AD 3A3B5C      LD      A,(FLAGS)
04B0 87          ADD     A
04B1 FA8A1C      JP      M,1C8A
04B4 E1          POP     HL
04B5 D0          RET     NC
04B6 E5          PUSH    HL
04B7 CDF12B      CALL    2BF1
04BA 62          LD      H,D
04BB 6B          LD      L,E
04BC 0D          DEC     C
04BD F8          RET     M
04BE 09          ADD     HL,BC
04BF CBFE        SET     7,(HL)
04C1 C9          RET
;
; CASSETTE ROUTINES Load Save Verify Merge
; save CODE where IX=address DE=byte count
04C2 213F05      LD      HL,053F ;(test for break)
04C5 E5          PUSH    HL
04C6 21801F      LD      HL,1F80 ;header timing
04C9 CB7F        BIT     7,A
04CB 2803        JR      Z,+3;04D0 header
04CD 21980C      LD      HL,0C98 ;data timing
04D0 08          EX      AF,AF
04D1 13          INC     DE
04D2 DD2B        DEC     IX
04D4 F3          DI
04D5 3E02        LD      A,02
04D7 47          LD      B,A
04D8 10FE        DJNZ    -2;04D8
04DA D3FE        OUT     (FE),A
04DC EE0F        XOR     0F
04DE 06A4        LD      B,A4
04E0 2D          DEC     L
04E1 20F5        JR      NZ,-11;04D8
04E3 05          DEC     B
04E4 25          DEC     H
04E5 F2D804      JP      P,04D8
04E8 062F        LD      B,2F
04EA 10FE        DJNZ    -2;04EA
04EC D3FE        OUT     (FE),A
04EE 3E0D        LD      A,0D

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```

04F0 0637      LD      B,37
04F2 10FE      DJNZ    -2;04F2
04F4 D3FE      OUT     (FE),A
04F6 010E3B    LD      BC,3B0E
04F9 08        EX      AF,AF
04FA 6F        LD      L,A
04FB C30705    JP      0507
;
04FE 7A        LD      A,D
04FF E3        OR      E
0500 280C      JR      Z,+12;050E
0502 DD6E00    LD      L,(IX+0)
0505 7C        LD      A,H
0506 AD        XOR     L
0507 67        LD      H,A
0508 3E01      LD      A,01
050A 37        SCF
050B C32505    JP      0525
;
050E 6C        LD      L,H
050F 18F4      JR      -12;0505
;
0511 79        LD      A,C
0512 CB78      BIT     7,B
0514 10FE      DJNZ    -2;0514
0516 3004      JR      NC,+4;051C
0518 0642      LD      B,42
051A 10FE      DJNZ    -2;051A
051C D3FE      OUT     (FE),A
051E 063E      LD      B,3E
0520 20EF      JR      NZ,-17;0511
0522 05        DEC     B
0523 AF        XOR     A
0524 3C        INC     A
0525 CB15      RL      L
0527 C21405    JP      NZ,0514
052A 1B        DEC     DE
052B DD23      INC     IX
052D 0631      LD      B,31
052F 3E7F      LD      A,7F      ;test for break
0531 DBFE      IN      A,(FE)
0533 1F        RRA
0534 D0        RET     NC
0535 7A        LD      A,D
0536 3C        INC     A
0537 C2FE04    JP      NZ,04FE ;test end
053A 063B      LD      B,3B
053C 10FE      DJNZ    -2;053C
053E C9        RET
;      test for break key
053F F5        PUSH    AF
0540 3A485C    LD      A,(BORDCR)
0543 E638      AND     38
0545 0F        RRCA
0546 0F        RRCA

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```

0547 0F          RRCA
0548 D3FE        OUT      (FE),A
054A 3E7F        LD       A,7F
054C DEFE        IN       A,(FE)
054E 1F          RRA
054F FB          EI
0550 3802        JR       C,+2;0554
; message 'Break - CONT repeats'
0552 CF          RST      08
0553 0C          DEFB     +12
0554 F1          POP      AF
0555 C9          RET
; LOAD if Carry set (NC=VERIFY)
; Load tape header if A=0 (NZ=data)
; IX=address DE=byte count
0556 14          INC      D
0557 08          EX       AF,AF' ;save parameters
0558 15          DEC      D
0559 F3          DI
055A 3E0F        LD       A,0F
055C D3FE        OUT      (FE),A
055E 213F05      LD       HL,053F ; (test for break)
0561 E5          PUSH     HL
0562 DBFE        IN       A,(FE)
0564 1F          RRA
0565 E620        AND      20
0567 F602        OR       02
0569 4F          LD       C,A
056A BF          CP       A
056B C0          RET      NZ
056C CDE705      CALL     05E7
056F 30FA        JR       NC,-6;056B
0571 211504      LD       HL,0415
0574 10FE        DJNZ     -2;0574
0576 2B          DEC      HL
0577 7C          LD       A,H
0578 B5          OR       L
0579 20F9        JR       NZ,-7;0574
057B CDE305      CALL     05E3
057E 30EB        JR       NC,-21;056B
0580 069C        LD       B,9C
0582 CDE305      CALL     05E3
0585 30E4        JR       NC,-28;056B
0587 3EC6        LD       A,C6
0589 B8          CP       B
058A 30E0        JR       NC,-32;056C
058C 24          INC      H
058D 20F1        JR       NZ,-15;0580
058F 06C9        LD       B,C9
0591 CDE705      CALL     05E7
0594 30D5        JR       NC,-43;056B
0596 78          LD       A,B
0597 FED4        CP       D4
0599 30F4        JR       NC,-12;058F
059B CDE705      CALL     05E7

```

```

059E D0      RET      NC
059F 79      LD        A,C
05A0 EE03    XOR      03
05A2 4F      LD        C,A
05A3 2600    LD        H,00
05A5 06E0    LD        B,B0
05A7 181F    JR        +31;05C8
05A9 08      EX        AF,AF      ;entry parameters
05AA 2007    JR        NZ,+7;05B3
05AC 300F    JR        NC,+15;05BD
05AE DD7500  LD        (IX+0),L
05B1 180F    JR        +15;05C2
05B3 CB11    RL        C
05B5 AD      XOR      L
05B6 C0      RET      NZ
05B7 79      LD        A,C
05B8 1F      RRA
05B9 4F      LD        C,A
05BA 13      INC      DE
05BB 1807    JR        +7;05C4
05BD DD7E00  LD        A,(IX+0)
05C0 AD      XOR      L
05C1 C0      RET      NZ
05C2 DD23    INC      IX
05C4 1B      DEC      DE
05C5 08      EX        AF,AF
05C6 06B2    LD        B,B2
05C8 2E01    LD        L,01
05CA CDE305  CALL     05E3
05CD D0      RET      NC
05CE 3ECB    LD        A,CB
05D0 B8      CP        B
05D1 CB15    RL        L
05D3 06B0    LD        B,B0
05D5 D2CA05  JP        NC,05CA
05D8 7C      LD        A,H
05D9 AD      XOR      L
05DA 67      LD        H,A
05DB 7A      LD        A,D
05DB BB01    OR        01
05E2 C9      RET
;
05E3 CDE705  CALL     05E7
05E6 D0      RET      NC
05E7 3E16    LD        A,16
05E9 3D      DEC      A
05EA 20FD    JR        NZ,-3;05E9
05EC A7      AND      A
05ED 04      INC      B
05EE C8      RET      Z
05EF 3E7F    LD        A,7F      ;test for break
05F1 DBFE    IN        A,(FE)
05F3 1F      RRA
05F4 D0      RET      NC
05F5 A9      XOR      C

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; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

05F6 E620      AND      20
05F8 28F3      JR       Z,-13;05ED
05FA 79        LD       A,C
05FB 2F        CPL
05FC 4F        LD       C,A
05FD E607      AND      07
05FF F608      OR       08
0601 D3FE      OUT      (FE),A
0603 37        SCF
0604 C9        RET
; construct file header record
0605 F1        POP      AF
0606 3A745C     LD       A,(TADDR)
0609 D6E0      SUB      E0
060B 32745C     LD       (TADDR),A
060E CD8C1C     CALL     1C8C
0611 CD3025     CALL     2530
0614 283C      JR       Z,+60;0652
0616 011100     LD       BC,0011
0619 3A745C     LD       A,(TADDR)
061C A7        AND      A
061D 2802      JR       Z,+2;0621
061F 0E22      LD       C,22
0621 F7        RST      30;make space
0622 D5        PUSH     DE
0623 DDE1      POP      IX
0625 060B      LD       B,0B
0627 3E20      LD       A,20
0629 12        LD       (DE),A
062A 13        INC      DE
062B 10FC      DJNZ     -4;0629
062D DD3601FF   LD       (IX+1),FF
; get item off the calculator stack
0631 CDF12B     CALL     2BF1
0634 21F6FF     LD       HL,FFF6
0637 0B        DEC      BC
0638 09        ADD      HL,BC
0639 03        INC      BC
063A 300F      JR       NC,+15;064B
063C 3A745C     LD       A,(TADDR)
063F A7        AND      A
0640 2002      JR       NZ,+2;0644
; invalid file name
0642 CF        RST      0B
0643 0E        DEFB     +14
0644 78        LD       A,B
0645 B1        OR       C
0646 280A      JR       Z,+10;0652
0648 010A00     LD       BC,000A
064B DDE5      PUSH     IX
064D E1        POP      HL
064E 23        INC      HL
064F EB        EX       DE,HL
0650 EDB0      LDIR
0652 DF        RST      1B

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```

0653 FEE4      CP      E4
0655 2049      JR      NZ,+73;06A0
0657 3A745C    LD      A,(TADDR)
065A FE03      CP      03
065C CA8A1C    JP      Z,1C8A
065F E7        RST     20
0660 CDB228    CALL    28B2
0663 CBF9      SET     7,C
0665 300B      JR      NC,+11;0672
0667 210000    LD      HL,0000
066A 3A745C    LD      A,(TADDR)
066D 3D        DEC     A
066E 2815      JR      Z,+21;0685
; variable not found
0670 CF        RST     08
0671 01        DEFB    +1
0672 C28A1C    JP      NZ,1C8A
0675 CD3025    CALL    2530
0678 2818      JR      Z,+24;0692
067A 23        INC     HL
067B 7E        LD      A,(HL)
067C DD770B    LD      (IX+11),A
067F 23        INC     HL
0680 7E        LD      A,(HL)
0681 DD770C    LD      (IX+12),A
0684 23        INC     HL
0685 DD710E    LD      (IX+14),C
0688 3E01      LD      A,01
068A CB71      BIT     6,C
068C 2801      JR      Z,+1;068F
068E 3C        INC     A
068F DD7700    LD      (IX+0),A
0692 EB        EX      DE,HL
0693 E7        RST     20
0694 FE29      CP      29
0696 20DA      JR      NZ,-38;0672
0698 E7        RST     20
0699 CDEE1B    CALL    1BEE
069C EB        EX      DE,HL
069D C35A07    JP      075A
;
06A0 FEAA      CP      AA
06A2 201F      JR      NZ,+31;06C3
06A4 3A745C    LD      A,(TADDR)
06A7 FE03      CP      03
06A9 CA8A1C    JP      Z,1C8A
06AC E7        RST     20
06AD CDEE1B    CALL    1BEE
06B0 DD360B00  LD      (IX+11),00;length of
06B4 DD360C1B  LD      (IX+12),1B;SCREEN$
06B8 210040    LD      HL,4000;display file
06BB DD750D    LD      (IX+13),L
06BE DD740E    LD      (IX+14),H
06C1 184D      JR      +77;0710
;

```

06C3	FEAF	CP	AF
06C5	204F	JR	NZ,+79;0716
06C7	3A745C	LD	A,(TADDR)
06CA	FE03	CP	03
06CC	CA8A1C	JP	Z,1C8A
06CF	E7	RST	20
06D0	CD4820	CALL	2048
06D3	200C	JR	NZ,+12;06E1
06D5	3A745C	LD	A,(TADDR)
06D8	A7	AND	A
06D9	CA8A1C	JP	Z,1C8A
06DC	CDE61C	CALL	1CE6
06DF	180F	JR	+15;06F0
06E1	CD821C	CALL	1C82
06E4	DF	RST	18
06E5	FE2C	CP	2C
06E7	280C	JR	Z,+12;06F5
06E9	3A745C	LD	A,(TADDR)
06EC	A7	AND	A
06ED	CA8A1C	JP	Z,1C8A
06F0	CDE61C	CALL	1CE6
06F3	1804	JR	+4;06F9
06F5	E7	RST	20
06F6	CD821C	CALL	1C82
06F9	CDEE1B	CALL	1BEE
06FC	CD991E	CALL	1E99
06FF	DD710B	LD	(IX+11),C
0702	DD700C	LD	(IX+12),B
0705	CD991E	CALL	1E99
0708	DD710D	LD	(IX+13),C
070B	DD700E	LD	(IX+14),B
070E	60	LD	H,B
070F	69	LD	L,C
0710	DD360003	LD	(IX+0),03
0714	1844	JR	+68;075A
0716	FECA	CP	CA
0718	2809	JR	Z,+9;0723
071A	CDEE1B	CALL	1BEE
071D	DD360E80	LD	(IX+14),80
0721	1817	JR	+23;073A
0723	3A745C	LD	A,(TADDR)
0726	A7	AND	A
0727	C28A1C	JP	NZ,1C8A
072A	E7	RST	20
072B	CD821C	CALL	1C82
072E	CDEE1B	CALL	1BEE
0731	CD991E	CALL	1E99
0734	DD710D	LD	(IX+13),C
0737	DD700E	LD	(IX+14),B
073A	DD360000	LD	(IX+0),00
073E	2A595C	LD	HL,(ELINE)
0741	ED5B535C	LD	DE,(PROG)
0745	37	SCF	
0746	ED52	SBC	HL,DE
0748	DD750B	LD	(IX+11),L

```

074B DD740C      LD      (IX+12),H
074E 2A4B5C      LD      HL,(VARS)
0751 ED52        SBC     HL,DE
0753 DD750F      LD      (IX+15),L
0756 DD7410      LD      (IX+16),H
0759 EB          EX      DE,HL
075A 3A745C      LD      A,(TADDR)
075D A7          AND     A
075E CA7009      JP      Z,SAVE
0761 E5          PUSH    HL;addr for loading
0762 011100      LD      BC,0011
0765 DD09        ADD     IX,BC
0767 DDE5        PUSH    IX
0769 111100      LD      DE,0011
076C AF          XOR     A
076D 37          SCF
076E CD5605      CALL    0556;load
0771 DDE1        POP     IX
0773 30F2        JR      NC,-14;0767
0775 3EFE        LD      A,FE;screen output
0777 CD0116      CALL    SELDEV
077A FD365203    LD      (IY+YSCRCT),03
077E 0E80        LD      C,80
; file type 0=prog 1=data() 2=data$() 3=code
0780 DD7E00      LD      A,(IX+0)
0783 DDBEEF      CP      (IX-17)
0786 2002        JR      NZ,+2;078A
0788 0EF6        LD      C,F6
078A FE04        CP      04
078C 30D9        JR      NC,-39;0767
078E 11C009      LD      DE,09C0;descr table
0791 C5          PUSH    BC
0792 CD0A0C      CALL    0C0A;display string(A)
0795 C1          POP     BC
0796 DDE5        PUSH    IX
0798 D1          POP     DE
0799 21F0FF      LD      HL,FFF0; -16
079C 19          ADD     HL,DE
079D 060A        LD      E,0A
079F 7E          LD      A,(HL)
07A0 3C          INC     A      ;test FF
07A1 2003        JR      NZ,+3;07A6
07A3 79          LD      A,C
07A4 80          ADD     B
07A5 4F          LD      C,A
07A6 13          INC     DE
07A7 1A          LD      A,(DE)
07A8 BE          CP      (HL);compare names
07A9 23          INC     HL
07AA 2001        JR      NZ,+1;07AD
07AC 0C          INC     C
07AD D7          RST      10;output actual name
07AE 10F6        DJNZ    -10;07A6
07B0 CB79        BIT     7,C
07B2 20B3        JR      NZ,-77;0767

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; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

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07B4 3E0D      LD      A,CR
07B6 D7        RST     10
07B7 E1        POP     HL
07B8 DD7E00    LD      A,(IX+0)
07BB FE03      CP      03
07BD 280C      JR      Z,+12;07CB if CODE
07BF 3A745C    LD      A,(TADDR)
07C2 3D        DEC     A
07C3 CA0808    JF      Z,0808
07C6 FE02      CP      02
07C8 CAB608    JF      Z,08B6
07CB E5        PUSH    HL
07CC DD6EFA    LD      L,(IX-6)
07CF DD66FB    LD      H,(IX-5)
07D2 DD5E0B    LD      E,(IX+11)
07D5 DD560C    LD      D,(IX+12)
; check length (if specified)
07D8 7C        LD      A,H
07D9 B5        OR      L
07DA 280D      JR      Z,+13;07E9
; err if desired length < actual length
; unless it is a code segment
07DC ED52      SBC     HL,DE
07DE 3826      JR      C,+38;0806
07E0 2807      JR      Z,+7;07E9
07E2 DD7E00    LD      A,(IX+0)
07E5 FE03      CP      03
07E7 201D      JR      NZ,+29;0806
07E9 E1        POP     HL
07EA 7C        LD      A,H
07EB B5        OR      L
07EC 2006      JR      NZ,+6;07F4
07EE DD6E0D    LD      L,(IX+13)
07F1 DD660E    LD      H,(IX+14)
07F4 E5        PUSH    HL
07F5 DDE1      POP     IX;addr for loading
07F7 3A745C    LD      A,(TADDR)
07FA FE02      CP      02
07FC 37        SCF
07FD 2001      JR      NZ,+1;0800
07FF A7        AND     A
0800 3EFF      LD      A,FF;data
0802 CD5605    CALL    0556;load
0805 D8        RET     C;OK
; tape loading error
0806 CF        RST     08
0807 1A        DEFB    +26
;
0808 DD5E0B    LD      E,(IX+11)
080B DD560C    LD      D,(IX+12)
080E E5        PUSH    HL
080F 7C        LD      A,H
0810 B5        OR      L
0811 2006      JR      NZ,+6;0819
0813 13        INC     DE

```

0814 13	INC	DE
0815 13	INC	DE
0816 EB	EX	DE,HL
0817 180C	JR	+12;0825
0819 DD6EFA	LD	L,(IX-6)
081C DD66FB	LD	H,(IX-5)
081F EB	EX	DE,HL
0820 37	SCF	
0821 ED52	SBC	HL,DE
0823 3809	JR	C,+9;082E
0825 110500	LD	DE,0005
0828 19	ADD	HL,DE
0829 44	LD	B,H
082A 4D	LD	C,L
082B CD051F	CALL	1F05
082E E1	POP	HL
082F DD7E00	LD	A,(IX+0)
0832 A7	AND	A
0833 283E	JR	Z,+62;0873
0835 7C	LD	A,H
0836 B5	OR	L
0837 2813	JR	Z,+19;084C
0839 2B	DEC	HL
083A 46	LD	B,(HL)
083B 2B	DEC	HL
083C 4E	LD	C,(HL)
083D 2B	DEC	HL
083E 03	INC	BC
083F 03	INC	BC
0840 03	INC	BC
0841 DD225F5C	LD	(XPTR),HL
0845 CDE819	CALL	19E8
0848 DD2A5F5C	LD	HL,(XPTR)
084C 2A595C	LD	HL,(ELINE)
084F 2B	DEC	HL
0850 DD4E0B	LD	C,(IX+11)
0853 DD460C	LD	B,(IX+12)
0856 C5	PUSH	BC
0857 03	INC	BC
0858 03	INC	BC
0859 03	INC	BC
085A DD7EFD	LD	A,(IX-3)
085D F5	PUSH	AF
085E CD5516	CALL	1655
0861 23	INC	HL
0862 F1	POP	AF
0863 77	LD	(HL),A
0864 D1	POP	DE
0865 23	INC	HL
0866 73	LD	(HL),E
0867 23	INC	HL
0868 72	LD	(HL),D
0869 23	INC	HL
086A E5	PUSH	HL
086B DDE1	POP	IX

```

086D 37          SCF
086E 3EFF        LD      A,FF
0870 C30208      JP      0802
;
0873 EB          EX      DE,HL
0874 2A595C      LD      HL,(ELINE)
0877 2B          DEC     HL
0878 DD225F5C    LD      (XPTR),HL
087C DD4E0B      LD      C,(IX+11)
087F DD460C      LD      B,(IX+12)
0882 C5          PUSH    BC
0883 CDE519      CALL    19E5
0886 C1          POP     BC
0887 E5          PUSH    HL
0888 C5          PUSH    BC
0889 CD5516      CALL    1655
088C DD2A5F5C    LD      HL,(XPTR)
0890 23          INC     HL
0891 DD4E0F      LD      C,(IX+15)
0894 DD4610      LD      B,(IX+16)
0897 09          ADD     HL,BC
0898 224B5C      LD      (VARS),HL
089B DD660E      LD      H,(IX+14)
089E 7C          LD      A,H
089F E6C0        AND     C0
08A1 200A        JR      NZ,+10;08AD
08A3 DD6E0D      LD      L,(IX+13)
08A6 22425C      LD      (NEWPPC),HL
08A9 FD360A00    LD      (IY+YNSPPC),00
08AD D1          POP     DE
08AE DDE1        POP     IX
08B0 37          SCF
08B1 3EFF        LD      A,FF
08B3 C30208      JP      0802
;
08B6 DD4E0B      LD      C,(IX+11)
08B9 DD460C      LD      B,(IX+12)
08BC C5          PUSH    BC
08BD 03          INC     BC
08BE F7          RST     30
08BF 3680        LD      (HL),80
08C1 EB          EX      DE,HL
08C2 D1          POP     DE
08C3 E5          PUSH    HL
08C4 E5          PUSH    HL
08C5 DDE1        POP     IX
08C7 37          SCF
08C8 3EFF        LD      A,FF
08CA CD0208      CALL    0802
08CD E1          POP     HL
08CE ED5B535C    LD      DE,(PROG)
08D2 7E          LD      A,(HL)
08D3 E6C0        AND     C0
08D5 2019        JR      NZ,+25;08F0
08D7 1A          LD      A,(DE)

```


08D8 13	INC	DE
08D9 BE	CP	(HL)
08DA 23	INC	HL
08DB 2002	JR	NZ,+2;08DF
08DD 1A	LD	A,(DE)
08DE BE	CP	(HL)
08DF 1B	DEC	DE
08E0 2B	DEC	HL
08E1 3008	JR	NC,+8;08EB
08E3 E5	PUSH	HL
08E4 EB	EX	DE,HL
08E5 CDB819	CALL	19B8
08E8 E1	POP	HL
08E9 18EC	JR	-20;08D7
08EB CD2C09	CALL	092C
08EE 18E2	JR	-30;08D2
08F0 7E	LD	A,(HL)
08F1 4F	LD	C,A
08F2 FE80	CP	80
08F4 C8	RET	Z
08F5 E5	PUSH	HL
08F6 2A4B5C	LD	HL,(VAR5)
08F9 7E	LD	A,(HL)
08FA FE80	CP	80
08FC 2825	JR	Z,+37;0923
08FE B9	CP	C
08FF 2808	JR	Z,+8;0909
0901 C5	PUSH	BC
0902 CDB819	CALL	19B8
0905 C1	POP	BC
0906 EB	EX	DE,HL
0907 18F0	JR	-16;08F9
0909 E6E0	AND	E0
090B FEA0	CP	A0
090D 2012	JR	NZ,+18;0921
090F D1	POP	DE
0910 D5	PUSH	DE
0911 E5	PUSH	HL
0912 23	INC	HL
0913 13	INC	DE
0914 1A	LD	A,(DE)
0915 BE	CP	(HL)
0916 2006	JR	NZ,+6;091E
0918 17	RLA	
0919 30F7	JR	NC,-9;0912
091B E1	POP	HL
091C 1803	JR	+3;0921
091E E1	POP	HL
091F 18E0	JR	-32;0901
0921 3EFF	LD	A,FF
0923 D1	POP	DE
0924 EB	EX	DE,HL
0925 3C	INC	A
0926 37	SCF	
0927 CD2C09	CALL	092C

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

092A 18C4      JR      -60;08F0
;
092C 2010      JR      NZ,+16;093E
092E 08        EX      AF,AF
092F 225F5C    LD      (XPTR),HL
0932 EB        EX      DE,HL
0933 CDE819    CALL    19B8
0936 CDE819    CALL    19E8
0939 EB        EX      DE,HL
093A 2A5F5C    LD      HL,(XPTR)
093D 08        EX      AF,AF
093E 08        EX      AF,AF
093F D5        PUSH    DE
0940 CDE819    CALL    19B8
0943 225F5C    LD      (XPTR),HL
0946 2A535C    LD      HL,(PROG)
0949 E3        EX      HL,(SP)
094A C5        PUSH    BC
094B 08        EX      AF,AF
094C 3807      JR      C,+7;0955
094E 2B        DEC     HL
094F CD5516    CALL    1655
0952 23        INC     HL
0953 1803      JR      +3;0958
0955 CD5516    CALL    1655
0958 23        INC     HL
0959 C1        POP     BC
095A D1        POP     DE
095B ED53535C  LD      (PROG),DE
095F ED5B5F5C  LD      DE,(XPTR)
0963 C5        PUSH    BC
0964 D5        PUSH    DE
0965 EB        EX      DE,HL
0966 EDB0      LDIR
0968 E1        POP     HL
0969 C1        POP     BC
096A D5        PUSH    DE
096B CDE819    CALL    19E8
096E D1        POP     DE
096F C9        RET
; save command
0970      SAVE :
0970 E5        PUSH    HL
0971 3EFD      LD      A,FD;screen output
0973 CD0116    CALL    SELDEV
0976 AF        XOR     A;'start tape'
0977 11A109    LD      DE,09A1
097A CD0A0C    CALL    0C0A
097D FDCB02EE  SET     5,(IY+YTVFLG)
0981 CDD415    CALL    INKEY;wait for key
0984 DDE5      PUSH    IX
0986 111100    LD      DE,0011;header length
0989 AF        XOR     A;tape header
098A CDC204    CALL    04C2;save
098D DDE1      POP     IX

```

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

098F 0632      LD      B,32;+50 interrupts
0991 76        HALT    ;=wait 1 second
0992 10FD      DJNZ    -3;0991
0994 DD5E0B    LD      E,(IX+11)
0997 DD560C    LD      D,(IX+12)
099A 3EFF      LD      A,FF;tape data
099C DDE1      POP     IX
099E C3C204    JP      04C2;save
;
09A1 80        DEFB    +128
09A2 53746172  DEFB    'Start tape, '
09A6 74207461
09AA 70652C20
09AE 7468656E  DEFB    'then press a'
09B2 20707265
09B6 73732061
09BA 6E79206B  DEFB    'ny key.';+bit 7
09BE 6579AE
09C1 0D        DEFB    CR
09C2 50726F67  DEFB    'Program:'      ;0
09C6 72616D3A
09CA A00D      DEFB    +32+128,CR
09CC 4E756D62  DEFB    'Number array'    ;1
09D0 65722061
09D4 72726179
09D8 3A        DEFB    ':'
09D9 A00D      DEFB    +32+128,CR
09DB 43686172  DEFB    'Character ar'    ;2
09DF 61637465
09E3 72206172
09E7 726179    DEFB    'ray:'
09EB A00D      DEFB    +32+128,CR
09ED 42797465  DEFB    'Bytes:'      ;3
09F1 733A
09F3 A0        DEFB    +32+128
; output (A) to current stream
;      PRINT:
09F4 CD030B    CALL    0B03
09F7 FE20      CP      20
09F9 D2D90A    JP      NC,0AD9
09FC FE06      CP      06
09FE 3869      JR      C,+105;0A69
0A00 FE18      CP      18
0A02 3065      JR      NC,+101;0A69
0A04 210B0A    LD      HL,0A0B
0A07 5F        LD      E,A
0A08 1600      LD      D,00
0A0A 19        ADD     HL,DE
0A0B 5E        LD      E,(HL)
0A0C 19        ADD     HL,DE
0A0D E5        PUSH    HL
0A0E C3030B    JP      0B03
;      DATA
; Lookup table for ctl chars 06-17
0A11 4E571029

```

```

0A15 54535237
0A19 504F5F5E
0A1D 5D5C5E5A
0A21 5453
; 08 cursor left
0A23 0C            INC      C
0A24 3E22          LD       A,22
0A26 B9            CP       C
0A27 2011          JR       NZ,+17;0A3A
0A29 FDCB014E      BIT       1,(IY+YFLAGS)
0A2D 2009          JR       NZ,+9;0A38
0A2F 04            INC      E
0A30 0E02          LD       C,02
0A32 3E18          LD       A,18
0A34 B8            CP       B
0A35 2003          JR       NZ,+3;0A3A
0A37 05            DEC      E
0A38 0E21          LD       C,21
0A3A C3D90D        JP       CURSOR
; 09 cursor right
0A3D 3A915C        LD       A,(PFLAG)
0A40 F5            PUSH     AF
0A41 FD365701      LD       (IY+YFFLAG),01
0A45 3E20          LD       A,20
0A47 CD650B        CALL     0B65
0A4A F1            POP      AF
0A4B 32915C        LD       (PFLAG),A
0A4E C9            RET
; 0D carriage return (ENTER)
0A4F FDCB014E      BIT       1,(IY+YFLAGS)
0A53 C2CD0E        JP       NZ,LPRINT
0A56 0E21          LD       C,21
0A58 CD550C        CALL     0C55
0A5B 05            DEC      B
0A5C C3D90D        JP       CURSOR
; 06 print comma
0A5F CD030B        CALL     0B03
0A62 79            LD       A,C
0A63 3D            DEC      A
0A64 3D            DEC      A
0A65 E610          AND      10
0A67 185A          JR       +90;0AC3
; 0A/0B/0C/0E/0F
0A69 3E3F          LD       A,3F
0A6B 186C          JR       +108;0AD9
;
0A6D 11870A        LD       DE,0A87
0A70 320F5C        LD       (5C0F),A
0A73 180B          JR       +11;0A80
; 16/17 AT/TAB
0A75 116D0A        LD       DE,0A6D
0A78 1803          JR       +3;0A7D
; 10/11/12/13/14/15 force next 'print' to 0A87
0A7A 11870A        LD       DE,0A87
0A7D 320E5C        LD       (TVDATA),A

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; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

0A80 2A515C      LD      HL,(CURCHL)
0A83 73          LD      (HL),E
0A84 23          INC     HL
0A85 72          LD      (HL),D
0A86 C9          RET
; reset output driver address
0A87 11F409      LD      DE,PRINT
0A8A CD800A      CALL    0A80
0A8D 2A0E5C      LD      HL,(TVDATA)
0A90 57          LD      D,A
0A91 7D          LD      A,L
0A92 FE16      CP      16
0A94 DA1122      JP      C,2211
0A97 2029      JR      NZ,+41;0AC2
0A99 44          LD      B,H
0A9A 4A          LD      C,D
0A9B 3E1F      LD      A,1F
0A9D 91          SUB     C
0A9E 380C      JR      C,+12;0AAC
0AA0 C602      ADD      02
0AA2 4F          LD      C,A
0AA3 FDCB014E    BIT      1,(IY+YFLAGS)
0AA7 2016      JR      NZ,+22;0ABF
0AA9 3E16      LD      A,16
0AAB 90          SUB     B
0AAC DA9F1E      JP      C,1E9F
0AAF 3C          INC     A
0AB0 47          LD      B,A
0AB1 04          INC     B
0AB2 FDCB0246    BIT      0,(IY+YTVFLG)
0AB6 C2550C      JP      NZ,0C55
0AB9 FDBE31      CP      (IY+YDFSZ)
0ABC DA860C      JP      C,0C86
0ABF C3D90D      JP      CURSOR
;
0AC2 7C          LD      A,H
0AC3 CD030B      CALL    0B03
0AC6 81          ADD      C
0AC7 3D          DEC      A
0AC8 E61F      AND      1F
0ACA C8          RET      Z
0ACB 57          LD      D,A
0ACC FDCB01C6    SET      0,(IY+YFLAGS)
0AD0 3E20      LD      A,20
0AD2 CD3B0C      CALL    0C3B
0AD5 15          DEC      D
0AD6 20F8      JR      NZ,-8;0AD0
0AD8 C9          RET
; print normal char
0AD9 CD240B      CALL    0B24
0ADC FDCB014E    BIT      1,(IY+YFLAGS)
0AE0 201A      JR      NZ,+26;0AFC
0AE2 FDCB0246    BIT      0,(IY+YTVFLG)
0AE6 2008      JR      NZ,+8;0AF0
0AE8 ED43885C    LD      (SPOSN),BC

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; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

0AEC 22845C      LD      (DFCC),HL
0AEF C9         RET
;
0AF0 ED438A5C   LD      (SPOSNL),BC
0AF4 ED43825C   LD      (ECHOE),BC
0AF8 22865C     LD      (DFCCL),HL
0AFB C9         RET
;
0AFC FD7145     LD      (IY+YFPOSN),C
0AFF 22805C     LD      (PRCC),HL
0B02 C9         RET
; get current position
; bit 1,(IY+YFLAGS) is set when using printer
; bit 0,(IY+YTVFLG) is set when printing to lower screen
0B03 FDCB014E   BIT     1,(IY+YFLAGS)
0B07 2014       JR      NZ,+20;0B1D
0B09 ED4B885C   LD      BC,(SPOSN)
0B0D 2A845C     LD      HL,(DFCC)
0B10 FDCB0246   BIT     0,(IY+YTVFLG)
0B14 C8         RET     Z
0B15 ED4B8A5C   LD      BC,(SPOSNL)
0B19 2A865C     LD      HL,(DFCCL)
0B1C C9         RET
;
0B1D FD4E45     LD      C,(IY+YFPOSN)
0B20 2A805C     LD      HL,(PRCC)
0B23 C9         RET
;
0B24 FE80       CP      80
0B26 383D       JR      C,+61;0B65
0B28 FE90       CP      90
0B2A 3026       JR      NC,+38;0B52
0B2C 47         LD      B,A
0B2D CD380B     CALL    0B38
0B30 CD030B     CALL    0B03
0B33 11925C     LD      DE,MEMBOT
0B36 1847       JR      +71;0B7F
0B38 21925C     LD      HL,MEMBOT
0B3B CD3E0B     CALL    0B3E
0B3E CB18       RR      B
0B40 9F         SBC     A
0B41 E60F       AND     0F
0B43 4F         LD      C,A
0B44 CB18       RR      B
0B46 9F         SBC     A
0B47 E6F0       AND     F0
0B49 B1         OR      C
0B4A 0E04       LD      C,04
0B4C 77         LD      (HL),A
0B4D 23         INC     HL
0B4E 0D         DEC     C
0B4F 20FB       JR      NZ,-5;0B4C
0B51 C9         RET
;
0B52 D6A5       SUB     A5

```



```

0B54 3009      JR      NC,+9;0B5F
0B56 C615      ADD      15
0B58 C5        PUSH     BC
0B59 ED4B7B5C  LD       BC,(UDG)
0B5D 180B      JR      +11;0B6A
0B5F CD100C    CALL     0C10
0B62 C3030B    JP       0B03
;
0B65 C5        PUSH     BC
0B66 ED4B365C  LD       BC,(CHARS)
0B6A EB        EX       DE,HL
0B6B 213B5C    LD       HL,FLAGS
0B6E CB86      RES      0,(HL)
0B70 FE20      CP       20
0B72 2002      JR      NZ,+2;0B76
0B74 C8C6      SET      0,(HL)
0B76 2600      LD       H,00
0B78 6F        LD       L,A
0B79 29        ADD      HL,HL
0B7A 29        ADD      HL,HL
0B7B 29        ADD      HL,HL
0B7C 09        ADD      HL,BC
0B7D C1        POP      BC
0B7E EB        EX       DE,HL
0B7F 79        LD       A,C
0B80 3D        DEC      A
0B81 3E21      LD       A,21
0B83 200E      JR      NZ,+14;0B93
0B85 05        DEC      B
0B86 4F        LD       C,A
0B87 FDCB014E  BIT      1,(IY+YFLAGS)
0B8B 2806      JR      Z,+6;0B93
0B8D D5        PUSH     DE
0B8E CDCD0E    CALL     LPRINT
0B91 D1        POP      DE
0B92 79        LD       A,C
0B93 B9        CP       C
0B94 D5        PUSH     DE
0B95 CC550C    CALL     Z,0C55;check scroll
0B98 D1        POP      DE
0B99 C5        PUSH     BC
0B9A E5        PUSH     HL
0B9B 3A915C    LD       A,(PFLAG)
0B9E 06FF      LD       B,FF
0BA0 1F        RRA
0BA1 3801      JR      C,+1;0BA4
0BA3 04        INC      B
0BA4 1F        RRA
0BA5 1F        RRA
0BA6 9F        SBC      A
0BA7 4F        LD       C,A
0BA8 3E08      LD       A,08
0BAA A7        AND      A
0BAB FDCB014E  BIT      1,(IY+YFLAGS)
0BAF 2805      JR      Z,+5;0BB6

```

```

0BB1 FDCB30CE    SET      1,(IY+YFLGS2)
0BB5 37          SCF
0BB6 EB         EX       DE,HL
0BB7 08         EX       AF,AF
0BB8 1A         LD       A,(DE)
0BB9 A0         AND      B
0BBA AE         XOR      (HL)
0BBB A9         XOR      C
0BBC 12         LD       (DE),A
0BBD 08         EX       AF,AF
0BBE 3813       JR       C,+19;0BD3
0BC0 14         INC      D
0BC1 23         INC      HL
0BC2 3D         DEC      A
0BC3 20F2       JR       NZ,-14;0BB7
0BC5 EB         EX       DE,HL
0BC6 25         DEC      H
0BC7 FDCB014E   BIT      1,(IY+YFLAGS)
0BCB CCDB0B     CALL     Z,0BDB
0BCE E1         POP      HL
0BCF C1         POP      BC
0BD0 0D         DEC      C
0BD1 23         INC      HL
0BD2 C9         RET
;
0BD3 08         EX       AF,AF
0BD4 3E20       LD       A,20
0BD6 83         ADD      E
0BD7 5F         LD       E,A
0BD8 08         EX       AF,AF
0BD9 18E6       JR       -26;0BC1
; update screen attribute
0BDB 7C         LD       A,H
0BDC 0F         RRCA
0BDD 0F         RRCA
0BDE 0F         RRCA
0BDF E603       AND      03
0BE1 F658       OR       58
0BE3 67         LD       H,A
0BE4 ED5B8F5C   LD       DE,(ATTRT)
0BE8 7E         LD       A,(HL)
0BE9 AB         XOR      E
0BEA A2         AND      D
0BEB AB         XOR      E
0BEC FDCB5776   BIT      6,(IY+YPFLAG)
0BF0 2808       JR       Z,+8;0BFA
0BF2 E6C7       AND      C7
0BF4 CB57       BIT      2,A
0BF6 2002       JR       NZ,+2;0BFA
0BF8 EE38       XOR      38
0BFA FDCB5766   BIT      4,(IY+YPFLAG)
0BFE 2808       JR       Z,+8;0C08
0C00 E6F8       AND      F8
0C02 CB6F       BIT      5,A
0C04 2002       JR       NZ,+2;0C08

```

```

0C06 EE07      XOR      07
0C08 77        LD       (HL),A
0C09 C9        RET
; display (DE)=string indexed by (A)
0C0A E5        PUSH     HL
0C0B 2600      LD       H,00
0C0D E3        EX       HL,(SP)
0C0E 1804      JR       +4;0C14
0C10 119500    LD       DE,0095
0C13 F5        PUSH     AF
0C14 CD410C    CALL     0C41
0C17 3809      JR       C,+9;0C22
0C19 3E20      LD       A,20
0C1B FDCB0146  BIT      0,(IY+YFLAGS)
0C1F CC3B0C    CALL     Z,0C3B
0C22 1A        LD       A,(DE)
0C23 E67F      AND      7F
0C25 CD3B0C    CALL     0C3B
0C28 1A        LD       A,(DE)
0C29 13        INC      DE
0C2A 87        ADD      A
0C2B 30F5      JR       NC,-11;0C22
0C2D D1        POP      DE
0C2E FE48      CP       48
0C30 2803      JR       Z,+3;0C35
0C32 FE82      CP       82
0C34 D8        RET      C
0C35 7A        LD       A,D
0C36 FE03      CP       03
0C38 D8        RET      C
0C39 3E20      LD       A,20
0C3B D5        PUSH     DE
0C3C D9        EXX
0C3D D7        RST      10
0C3E D9        EXX
0C3F D1        POP      DE
0C40 C9        RET
;
0C41 F5        PUSH     AF
0C42 EB        EX       DE,HL
0C43 3C        INC      A
0C44 CB7E      BIT      7,(HL)
0C46 23        INC      HL
0C47 28FB      JR       Z,-5;0C44
0C49 3D        DEC      A
0C4A 20F8      JR       NZ,-8;0C44
0C4C EB        EX       DE,HL
0C4D F1        POP      AF
0C4E FE20      CP       20
0C50 D8        RET      C
0C51 1A        LD       A,(DE)
0C52 D641      SUB      41
0C54 C9        RET
; scroll subroutine
0C55 FDCB014E  BIT      1,(IY+YFLAGS)

```

```

0C59 C0      RET      NZ;exit if printer
0C5A 11D90D   LD       DE,CURSOR
0C5D D5      PUSH    DE
0C5E 78      LD       A,B
0C5F FDCB0246 BIT      0,(IY+YTVFLG)
0C63 C2020D   JP      NZ,0D02
0C66 FDBE31   CP      (IY+YDFSZ)
0C69 381B     JR      C,+27;0C86
0C6B C0      RET      NZ
0C6C FDCB0266 BIT      4,(IY+YTVFLG)
0C70 2816     JR      Z,+22;0C88
0C72 FD5E2D   LD       E,(IY+YBREG)
0C75 1D      DEC      E
0C76 285A     JR      Z,+90;0CD2
0C78 3E00     LD       A,00;lower screen
0C7A CD0116   CALL    SELDEV
0C7D ED7B3F5C LD       SP,(LISTSP)
0C81 FDCB02A6 RES      4,(IY+YTVFLG)
0C85 C9      RET
; error 'out of screen'
0C86 CF      RST      08
0C87 04      DEFB     +4
;
0C88 FD3552   DEC      (IY+YSCRCT)
0C8B 2045     JR      NZ,+69;0CD2
0C8D 3E18     LD       A,18
0C8F 90      SUB      B
0C90 328C5C   LD       (SCRCT),A
0C93 2A8F5C   LD       HL,(ATTRT)
0C96 E5      PUSH    HL
0C97 3A915C   LD       A,(PFLAG)
0C9A F5      PUSH    AF
0C9B 3EFD     LD       A,FD;lower screen
0C9D CD0116   CALL    SELDEV
0CA0 AF      XOR      A
0CA1 11F80C   LD       DE,0CF8;scroll msg
0CA4 CD0A0C   CALL    0C0A
0CA7 FDCB02EE SET      5,(IY+YTVFLG)
0CAB 213B5C   LD       HL,FLAGS
0CAE CBDE     SET      3,(HL)
0CB0 CBAE     RES      5,(HL)
0CB2 D9      EXX
0CB3 CDD415   CALL    INKEY;wait for key
0CB6 D9      EXX
0CB7 FE20     CP      20;check key code
0CB9 2845     JR      Z,+69;0D00
0CBB FEE2     CP      E2
0CBD 2841     JR      Z,+65;0D00
0CBF F620     OR      20
0CC1 FE6E     CP      6E
0CC3 283B     JR      Z,+59;0D00
0CC5 3EFE     LD       A,FE
0CC7 CD0116   CALL    SELDEV
0CCA F1      POP     AF
0CCB 32915C   LD       (PFLAG),A

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```

0CCE E1      POP      HL
0CCF 228F5C   LD       (ATTRT),HL
0CD2 CDFE0D   CALL     0DFE
0CD5 FD4631   LD       B,(IY+YDFSZ)
0CD8 04       INC      B
0CD9 0E21     LD       C,21
0CDB C5       PUSH     BC
0CDC CD9B0E   CALL     0E9B
0CDF 7C       LD       A,H
0CE0 0F       RRCA
0CE1 0F       RRCA
0CE2 0F       RRCA
0CE3 E603     AND      03
0CE5 F658     OR       58
0CE7 67       LD       H,A
0CE8 11E05A   LD       DE,5AE0
0CEB 1A       LD       A,(DE)
0CEC 4E       LD       C,(HL)
0CED 0620     LD       B,20
0CEF EB       EX       DE,HL
0CF0 12       LD       (DE),A
0CF1 71       LD       (HL),C
0CF2 13       INC      DE
0CF3 23       INC      HL
0CF4 10FA     DJNZ     -6;0CF0
0CF6 C1       POP      BC
0CF7 C9       RET
;          DATA (bit 7 set on last byte)
0CF8 80       DEFB     +128
0CF9 7363726F DEFB     'scroll?'
0CFD 6C6CBF
; break - CONT repeats
0D00 CF       RST      08
0D01 0C       DEFB     +12
;
0D02 FE02     CF       02
0D04 3880     JR       C,-128;0C86
0D06 FD8631   ADD      (IY+YDFSZ)
0D09 D619     SUB      19
0D0B D0       RET      NC
0D0C ED44     NEG
0D0E C5       PUSH     BC
0D0F 47       LD       B,A
0D10 2A8F5C   LD       HL,(ATTRT)
0D13 E5       PUSH     HL
0D14 2A915C   LD       HL,(PFLAG)
0D17 E5       PUSH     HL
0D18 CD4D0D   CALL     0D4D
0D1B 78       LD       A,B
0D1C F5       PUSH     AF
0D1D 216B5C   LD       HL,DFSZ
0D20 46       LD       B,(HL)
0D21 78       LD       A,B
0D22 3C       INC      A
0D23 77       LD       (HL),A

```

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

0D24 21895C      LD      HL,5C89
0D27 BE         CP      (HL)
0D28 3803        JR      C,+3;0D2D
0D2A 34          INC     (HL)
0D2B 0618        LD      B,18
0D2D CD000E      CALL    0E00
0D30 F1          POP     AF
0D31 3D          DEC     A
0D32 20E8        JR      NZ,-24;0D1C
0D34 E1          POP     HL
0D35 FD7557      LD      (IY+YFFLAG),L
0D38 E1          POP     HL
0D39 228F5C      LD      (ATTRT),HL
0D3C ED4B885C    LD      BC,(SPOSN)
0D40 FDCB0286    RES     0,(IY+YTVFLG);screen
0D44 CDD90D      CALL    CURSOR
0D47 FDCB02C6    SET     0,(IY+YTVFLG);keyboard
0D4B C1          POP     BC
0D4C C9          RET
; reset temporary attributes
0D4D AF          XOR     A
0D4E 2A8D5C      LD      HL,(ATTRP)
0D51 FDCB0246    BIT     0,(IY+YTVFLG)
0D55 2804        JR      Z,+4;0D5B
0D57 67          LD      H,A
0D58 FD6E0E      LD      L,(IY+YBRDCR)
0D5B 228F5C      LD      (ATTRT),HL
0D5E 21915C      LD      HL,PFLAG
0D61 2002        JR      NZ,+2;0D65
0D63 7E          LD      A,(HL)
0D64 0F          RRCA
0D65 AE          XOR     (HL)
0D66 E655        AND     55
0D68 AE          XOR     (HL)
0D69 77          LD      (HL),A
0D6A C9          RET
; CLS command
0D6B CDAF0D      CALL    0DAF
0D6E 213C5C      LD      HL,TVFLAG
0D71 CB AE       RES     5,(HL)
0D73 CB C6       SET     0,(HL)
0D75 CD4D0D      CALL    0D4D
0D78 FD4631      LD      B,(IY+YDFSZ)
0D7B CD440E      CALL    0E44
0D7E 21C05A      LD      HL,5AC0
0D81 3A8D5C      LD      A,(ATTRP)
0D84 05          DEC     B
0D85 1807        JR      +7;0D8E
0D87 0E20        LD      C,20
0D89 2B          DEC     HL
0D8A 77          LD      (HL),A
0D8B 0D          DEC     C
0D8C 20FB        JR      NZ,-5;0D89
0D8E 10F7        DJNZ    -9;0D87
0D90 FD363102    LD      (IY+YDFSZ),02

```

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

0D94 3EFD      LD      A,FD
0D96 CD0116    CALL    SELDEV
; redirect output channel to 09F4
0D99 2A515C    LD      HL,(CURCHL)
0D9C 11F409    LD      DE,PRINT
0D9F A7        AND     A
0DA0 73        LD      (HL),E
0DA1 23        INC     HL
0DA2 72        LD      (HL),D
0DA3 23        INC     HL
0DA4 11A810    LD      DE,10A8
0DA7 3F        CCF
0DA8 38F6      JR      C,-10;0DA0
0DAA 012117    LD      BC,1721
0DAD 182A      JR      +42;CURSOR
;
0DAF 210000    LD      HL,0000
0DB2 227D5C    LD      (COORDX),HL
0DB5 FDCB3086  RES     0,(IY+YFLGSZ)
0DB9 CD940D    CALL    0D94
0DBC 3EFE      LD      A,FE
0DBE CD0116    CALL    SELDEV
0DC1 CD4D0D    CALL    0D4D
0DC4 0618      LD      B,18
0DC6 CD440E    CALL    0E44
0DC9 2A515C    LD      HL,(CURCHL)
0DCC 11F409    LD      DE,PRINT
0DCF 73        LD      (HL),E
0DD0 23        INC     HL
0DD1 72        LD      (HL),D
0DD2 FD365201  LD      (IY+YSCRCT),01
0DD6 012118    LD      BC,1821
;
0DD9          CURSOR:
0DD9 21005B    LD      HL,5B00
0DDC FDCB014E  BIT     1,(IY+YFLAGS);set if printer
0DE0 2012      JR      NZ,+18;0DF4
0DE2 78        LD      A,B
0DE3 FDCB0246  BIT     0,(IY+YTVFLG);set if lower screen
0DE7 2805      JR      Z,+5;0DEE
0DE9 FD8631    ADD     (IY+YDFSZ)
0DEC D618      SUB     18
0DEE C5        PUSH    BC
0DEF 47        LD      B,A
0DF0 CD9B0E    CALL    0E9B
0DF3 C1        POP     BC
0DF4 3E21      LD      A,21
0DF6 91        SUB     C
0DF7 5F        LD      E,A
0DF8 1600      LD      D,00
0DFA 19        ADD     HL,DE
0DFB C3DC0A    JP      0ADC
;
0DFE 0617      LD      B,17
0E00 CD9B0E    CALL    0E9B

```

0E03 0E08	LD	C,08
0E05 C5	PUSH	BC
0E06 E5	PUSH	HL
0E07 78	LD	A,B
0E08 E607	AND	07
0E0A 78	LD	A,B
0E0B 200C	JR	NZ,+12;0E19
0E0D EB	EX	DE,HL
0E0E 21E0F8	LD	HL,F8E0
0E11 19	ADD	HL,DE
0E12 EB	EX	DE,HL
0E13 012000	LD	BC,0020
0E16 3D	DEC	A
0E17 EDE0	LDIR	
0E19 EB	EX	DE,HL
0E1A 21E0FF	LD	HL,FFE0
0E1D 19	ADD	HL,DE
0E1E EB	EX	DE,HL
0E1F 47	LD	B,A
0E20 E607	AND	07
0E22 0F	RRCA	
0E23 0F	RRCA	
0E24 0F	RRCA	
0E25 4F	LD	C,A
0E26 78	LD	A,B
0E27 0600	LD	B,00
0E29 EDE0	LDIR	
0E2B 0607	LD	B,07
0E2D 09	ADD	HL,BC
0E2E E6F8	AND	F8
0E30 20DB	JR	NZ,-37;0E0D
0E32 E1	POP	HL
0E33 24	INC	H
0E34 C1	POP	BC
0E35 0D	DEC	C
0E36 20CD	JR	NZ,-51;0E05
0E38 CD880E	CALL	0E88
0E3B 21E0FF	LD	HL,FFE0
0E3E 19	ADD	HL,DE
0E3F EB	EX	DE,HL
0E40 EDE0	LDIR	
0E42 0601	LD	B,01
0E44 C5	PUSH	BC
0E45 CD9B0E	CALL	0E9B
0E48 0E08	LD	C,08
0E4A C5	PUSH	BC
0E4B E5	PUSH	HL
0E4C 78	LD	A,B
0E4D E607	AND	07
0E4F 0F	RRCA	
0E50 0F	RRCA	
0E51 0F	RRCA	
0E52 4F	LD	C,A
0E53 78	LD	A,B
0E54 0600	LD	B,00

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

0E56 0D      DEC      C
0E57 54      LD       D,H
0E58 5D      LD       E,L
0E59 3600    LD       (HL),00
0E5B 13      INC      DE
0E5C ED80    LDIR
0E5E 110107  LD       DE,0701
0E61 19      ADD      HL,DE
0E62 3D      DEC      A
0E63 E6F8    AND      F8
0E65 47      LD       B,A
0E66 20E5    JR       NZ,-27;0E4D
0E68 E1      POP      HL
0E69 24      INC      H
0E6A C1      POP      BC
0E6B 0D      DEC      C
0E6C 20DC    JR       NZ,-36;0E4A
0E6E CD880E  CALL     0E88
0E71 62      LD       H,D
0E72 6B      LD       L,E
0E73 13      INC      DE
0E74 3A8D5C  LD       A,(ATTRP)
0E77 FDCB0246 BIT      0,(IY+YTVFLG)
0E7B 2803    JR       Z,+3;0E80
0E7D 3A485C  LD       A,(BORDCR)
0E80 77      LD       (HL),A
0E81 0B      DEC      BC
0E82 ED80    LDIR
0E84 C1      POP      BC
0E85 0E21    LD       C,21
0E87 C9      RET
;
0E88 7C      LD       A,H
0E89 0F      RRCA
0E8A 0F      RRCA
0E8B 0F      RRCA
0E8C 3D      DEC      A
0E8D F650    OR       50
0E8F 67      LD       H,A
0E90 EB      EX       DE,HL
0E91 61      LD       H,C
0E92 6B      LD       L,B
0E93 29      ADD      HL,HL
0E94 29      ADD      HL,HL
0E95 29      ADD      HL,HL
0E96 29      ADD      HL,HL
0E97 29      ADD      HL,HL
0E98 44      LD       B,H
0E99 4D      LD       C,L
0E9A C9      RET
; calc screen address of line start
; (B)=line number where +21=top +1=bottom
0E9B 3E18    LD       A,18;+24
0E9D 90      SUB      B
0E9E 57      LD       D,A

```

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

0E9F 0F          RRCA
0EA0 0F          RRCA
0EA1 0F          RRCA
0EA2 E6E0        AND      E0
0EA4 6F          LD       L,A
0EA5 7A          LD       A,D
0EA6 E618        AND      18
0EA8 F640        OR       40
0EAA 67          LD       H,A
0EAB C9          RET
; copy command
0EAC          COPY :
0EAC F3          DI
0EAD 06B0        LD       B,B0
0EAF 210040      LD       HL,4000
0EB2 E5          PUSH     HL
0EB3 C5          PUSH     BC
0EB4 CDF40E      CALL     0EF4
0EB7 C1          POP      BC
0EB8 E1          POP      HL
0EB9 24          INC      H
0EBA 7C          LD       A,H
0EBB E607        AND      07
0EBD 200A        JR       NZ,+10;0EC9
0EBF 7D          LD       A,L
0EC0 C620        ADD      20
0EC2 6F          LD       L,A
0EC3 3F          CCF
0EC4 9F          SBC      A
0EC5 E6F8        AND      F8
0EC7 84          ADD      H
0EC8 67          LD       H,A
0EC9 10E7        DJNZ     -25;0EB2
0ECB 180D        JR       +13;0EDA
; print contents of printer buffer
0ECD          LPRINT:
0ECD F3          DI
0ECE 21005B      LD       HL,5B00
0ED1 0608        LD       B,08
0ED3 C5          PUSH     BC
0ED4 CDF40E      CALL     0EF4
0ED7 C1          POP      BC
0ED8 10F9        DJNZ     -7;0ED3
0EDA 3E04        LD       A,04
0EDC D3FB        OUT      (FB),A
0EDE FB          EI
; clear & reset printer buffer
0EDF          CLRBF :
0EDF 21005B      LD       HL,5B00
0EE2 FD7546      LD       (IY+YPRCC),L
0EE5 AF          XOR      A
0EE6 47          LD       B,A
0EE7 77          LD       (HL),A
0EE8 23          INC      HL
0EE9 10FC        DJNZ     -4;0EE7

```

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

0EEB FDCB308E  RES      1,(IY+YFLGS2)
0EEF 0E21      LD       C,21
0EF1 C3D90D    JP       CURSOR
;
0EF4 78        LD       A,B
0EF5 FE03      CP       03
0EF7 9F        SEC
0EF8 E602      AND      02
0EFA D3FB      OUT      (FB),A
0EFC 57        LD       D,A
0EFD CD541F    CALL     BREAK
0F00 380A      JR       C,+10;0F0C
0F02 3E04      LD       A,04
0F04 D3FB      OUT      (FB),A
0F06 FB        EI
0F07 CDDF0E    CALL     CLRBF
0F0A CF        RST      08
0F0B 0C        DEFB     +12
0F0C DBFB      IN       A,(FB)
0F0E 87        ADD      A
0F0F F8        RET      M
0F10 30EB      JR       NC,-21;0EFD
0F12 0E20      LD       C,20
0F14 5E        LD       E,(HL)
0F15 23        INC      HL
0F16 0608      LD       B,08
0F18 CB12      RL       D
0F1A CB13      RL       E
0F1C CB1A      RR       D
0F1E DBFB      IN       A,(FB)
0F20 1F        RRA
0F21 30FB      JR       NC,-5;0F1E
0F23 7A        LD       A,D
0F24 D3FB      OUT      (FB),A
0F26 10F0      DJNZ     -16;0F18
0F28 0D        DEC      C
0F29 20E9      JR       NZ,-23;0F14
0F2B C9        RET
; input-line editor
0F2C GETLIN:
0F2C 2A3D5C    LD       HL,(ERRSP)
0F2F E5        PUSH     HL
0F30 217F10    LD       HL,107F
0F33 E5        PUSH     HL
0F34 ED733D5C  LD       (ERRSP),SP
0F38 CDD415    CALL     INKEY;wait for key
0F3B F5        PUSH     AF
0F3C 1600      LD       D,00
0F3E FD5EFF    LD       E,(IY+YPIP);-1
0F41 21C800    LD       HL,00C8
0F44 CDB503    CALL     BEEPER;confirm keypress
0F47 F1        POP      AF
0F48 21380F    LD       HL,0F38
0F4B E5        PUSH     HL
0F4C FE18      CP       18

```

```

0F4E 3031      JR      NC,+49;0F81
0F50 FE07      CP      07
0F52 382D      JR      C,+45;0F81
0F54 FE10      CP      10
0F56 383A      JR      C,+58;0F92
0F58 010200    LD      BC,0002
0F5B 57        LD      D,A
0F5C FE16      CP      16
0F5E 380C      JR      C,+12;0F6C
0F60 03        INC     BC
0F61 FDCB377E  BIT     7,(IY+YFLAGX)
0F65 CA1E10    JP      Z,101E
0F68 CDD415    CALL    INKEY
0F6B 5F        LD      E,A
0F6C CDD415    CALL    INKEY
0F6F D5        PUSH    DE
0F70 2A5B5C    LD      HL,(KCUR)
0F73 FDCB0786  RES     0,(IY+YMODE)
0F77 CD5516    CALL    1655
0F7A C1        POP     BC
0F7B 23        INC     HL
0F7C 70        LD      (HL),B
0F7D 23        INC     HL
0F7E 71        LD      (HL),C
0F7F 180A      JR      +10;0F8B
; insert char into edit line
; by shifting (up to STKEND)
0F81 FDCB0786  RES     0,(IY+YMODE)
0F85 2A5B5C    LD      HL,(KCUR)
0F88 CD5216    CALL    1652
0F8B 12        LD      (DE),A
0F8C 13        INC     DE
0F8D ED535B5C  LD      (KCUR),DE
0F91 C9        RET
;
0F92 5F        LD      E,A
0F93 1600      LD      D,00
0F95 21990F    LD      HL,0F99
0F98 19        ADD     HL,DE
0F99 5E        LD      E,(HL)
0F9A 19        ADD     HL,DE
0F9B E5        PUSH    HL
0F9C 2A5B5C    LD      HL,(KCUR)
0F9F C9        RET
;      DATA table for editing-key codes
0FA0 09666A50
0FA4 B5707ECF
0FA8 D4
; edit key
0FA9 EDIT:
0FA9 2A495C    LD      HL,(EPPC)
0FAC FDCB376E  BIT     5,(IY+YFLAGX)
0FB0 C29710    JP      NZ,1097
0FB3 CD6E19    CALL    196E
0FB6 CD9516    CALL    1695

```

```

0FB9 7A      LD      A,D
0FBA B3      OR      E
0FBB CA9710  JP      Z,1097
0FBE E5      PUSH    HL
0FBF 23      INC     HL
0FC0 4E      LD      C,(HL)
0FC1 23      INC     HL
0FC2 46      LD      B,(HL)
0FC3 210A00  LD      HL,000A
0FC6 09      ADD     HL,BC
0FC7 44      LD      B,H
0FC8 4D      LD      C,L
0FC9 CD051F  CALL    1F05
0FCC CD9710  CALL    1097
0FCF 2A515C  LD      HL,(CURCHL)
0FD2 E3      EX      HL,(SP)
0FD3 E5      PUSH    HL
0FD4 3EFF    LD      A,FF
0FD6 CD0116  CALL    SELDEV
0FD9 E1      POP     HL
0FDA 2B      DEC     HL
0FDB FD350F  DEC     (IY+YEPPC)
0FDE CD5518  CALL    1855
0FE1 FD340F  INC     (IY+YEPPC)
0FE4 2A595C  LD      HL,(ELINE)
0FE7 23      INC     HL
0FE8 23      INC     HL
0FE9 23      INC     HL
0FEA 23      INC     HL
0FEB 225B5C  LD      (KCUR),HL
0FEE E1      POP     HL
0FEF CD1516  CALL    1615
0FF2 C9      RET
;
0FF3 FDCB376E BIT    5,(IY+YFLAGX)
0FF7 2008    JR      NZ,+8;1001
0FF9 21495C  LD      HL,EPPC
0FFC CD0F19  CALL    190F
0FFF 186D    JR      +109;106E
1001 FD360010 LD    (IY+YERRNR),10
1005 181D    JR      +29;1024
;
1007 CD3110  CALL    1031
100A 1805    JR      +5;1011
;
100C 7E      LD      A,(HL)
100D FE0D    CP      0D
100F C8      RET     Z
1010 23      INC     HL
1011 225B5C  LD      (KCUR),HL
1014 C9      RET
;
1015 CD3110  CALL    1031
1018 010100  LD      BC,0001
101B C3E819  JP      19E8

```

```

;
101E CDD415      CALL      INKEY
1021 CDD415      CALL      INKEY
1024 E1          POP       HL
1025 E1          POP       HL
1026 E1          POP       HL
1027 223D5C      LD        (ERRSP),HL
102A FDCB007E    BIT       7,(IY+YERRNR)
102E C0          RET       NZ
102F F9          LD        SP,HL
1030 C9          RET
;
1031 37          SCF
1032 CD9511      CALL      1195
1035 ED52        SBC       HL,DE
1037 19          ADD       HL,DE
1038 23          INC       HL
1039 C1          POP       BC
103A D8          RET       C
103B C5          PUSH      BC
103C 44          LD        B,H
103D 4D          LD        C,L
103E 62          LD        H,D
103F 6B          LD        L,E
1040 23          INC       HL
1041 1A          LD        A,(DE)
1042 E6F0        AND       F0
1044 FE10        CP        10
1046 2009        JR        NZ,+9;1051
1048 23          INC       HL
1049 1A          LD        A,(DE)
104A D617        SUB       17
104C CE00        ADC       00
104E 2001        JR        NZ,+1;1051
1050 23          INC       HL
1051 A7          AND       A
1052 ED42        SBC       HL,BC
1054 09          ADD       HL,BC
1055 EB          EX        DE,HL
1056 38E6        JR        C,-26;103E
1058 C9          RET
;
1059 FDCB376E    BIT       5,(IY+YFLAGX)
105D C0          RET       NZ
105E 2A495C      LD        HL,(EPPC)
1061 CD6E19      CALL      196E
1064 EB          EX        DE,HL
1065 CD9516      CALL      1695
1068 214A5C      LD        HL,5C4A
106B CD1C19      CALL      191C
106E CD9517      CALL      1795
1071 3E00        LD        A,00
1073 C30116      JP        SELDEV
;
1076 FDCB377E    BIT       7,(IY+YFLAGX)

```

```

107A 28A8      JR      Z,-88;1024
107C C3810F    JF      0F81
;
107F FDCE3066  BIT     4,(IY+YFLGS2)
1083 28A1      JR      Z,-95;1026
1085 FD3600FF  LD      (IY+YERRNR),FF
1089 1600      LD      D,00
108B FD5EFE    LD      E,(IY+YRASP);-2
108E 21901A    LD      HL,1A90
1091 CDB503    CALL    BEEPER;buzz
1094 C3300F    JF      0F30
;
1097 E5        PUSH    HL
1098 CD9011    CALL    1190
109B 2B        DEC     HL
109C CDE519    CALL    19E5
109F 225B5C    LD      (KCUR),HL
10A2 FD360700  LD      (IY+YMODE),00
10A6 E1        POP     HL
10A7 C9        RET
; get input key
10A8 FDCB025E  BIT     3,(IY+YTVFLG)
10AC C41D11    CALL    NZ,111D
10AF A7        AND     A
10B0 FDCB016E  BIT     5,(IY+YFLAGS);anything pressed?
10B4 C8        RET     Z
10B5 3A085C    LD      A,(LASTK);key code
10B8 FDCB01AE  RES     5,(IY+YFLAGS)
10BC F5        PUSH    AF
10BD FDCB026E  BIT     5,(IY+YTVFLG)
10C1 C46E0D    CALL    NZ,0D6E
10C4 F1        POP     AF
10C5 FE20      CP      20
10C7 3052      JR      NC,+82;111B
10C9 FE10      CP      10
10CB 302D      JR      NC,+45;10FA
10CD FE06      CP      06
10CF 300A      JR      NC,+10;10DB
10D1 47        LD      B,A
10D2 E601      AND     01
10D4 4F        LD      C,A
10D5 78        LD      A,B
10D6 1F        RRA
10D7 C612      ADD     12
10D9 182A      JR      +42;1105
10DB 2009      JR      NZ,+9;10E6
; caps lock
10DD 216A5C    LD      HL,FLAGS2
10E0 3E08      LD      A,08
10E2 AE        XOR     (HL) ;flip bit 3
10E3 77        LD      (HL),A ;Caps lock flag
10E4 180E      JR      +14;10F4
;
10E6 FE0E      CP      0E
10E8 D8        RET     C

```

```

10E9 D60D      SUB      0D
10EB 21415C    LD       HL,MODE
10EE BE       CP       (HL)
10EF 77       LD       (HL),A
10F0 2002     JR       NZ,+2;10F4
10F2 3600     LD       (HL),00
10F4 FDCB02DE SET      3,(IY+YTVFLG)
10F8 BF       CP       A
10F9 C9       RET
;
10FA 47       LD       B,A
10FB E607     AND      07
10FD 4F       LD       C,A
10FE 3E10     LD       A,10
1100 CB58     BIT      3,B
1102 2001     JR       NZ,+1;1105
1104 3C       INC      A
1105 FD71D3    LD       (IY+YKDATA),C;-45
1108 110D11    LD       DE,110D
110B 1806     JR       +6;1113
110D 3A0D5C    LD       A,(KDATA)
1110 11A810    LD       DE,10A8
1113 2A4F5C    LD       HL,(CHANS)
1116 23       INC      HL
1117 23       INC      HL
1118 73       LD       (HL),E
1119 23       INC      HL
111A 72       LD       (HL),D
111B 37       SCF
111C C9       RET
;
111D CD4D0D    CALL     0D4D
1120 FDCB029E RES      3,(IY+YTVFLG)
1124 FDCB02AE RES      5,(IY+YTVFLG)
1128 2A8A5C    LD       HL,(SPOSNL)
112B E5       PUSH     HL
112C 2A3D5C    LD       HL,(ERRSP)
112F E5       PUSH     HL
1130 216711    LD       HL,1167
1133 E5       PUSH     HL
1134 ED733D5C  LD       (ERRSP),SP
1138 2A825C    LD       HL,(ECHOE)
113B E5       PUSH     HL
113C 37       SCF
113D CD9511    CALL     1195
1140 EB       EX       DE,HL
1141 CD7D18    CALL     187D
1144 EB       EX       DE,HL
1145 CDE118    CALL     18E1
1148 2A8A5C    LD       HL,(SPOSNL)
114B E3       EX       HL,(SP)
114C EB       EX       DE,HL
114D CD4D0D    CALL     0D4D
1150 3A8B5C    LD       A,(5C8B)
1153 92       SUB      D

```


; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

1154 3826      JR      C,+38;117C
1156 2006      JR      NZ,+6;115E
1158 7B        LD      A,E
1159 FD9650    SUB     (IY+YSFOSL)
115C 301E      JR      NC,+30;117C
115E 3E20      LD      A,20
1160 D5        PUSH    DE
1161 CDF409    CALL    PRINT
1164 D1        POP     DE
1165 18E9      JR      -23;1150
1167 1600      LD      D,00
1169 FD5EFE    LD      E,(IY+YRASP);-2
116C 21901A    LD      HL,1A90
116F CDE503    CALL    BEEPER
1172 FD3600FF  LD      (IY+YERRNR),FF
1176 ED5B8A5C  LD      DE,(SPOSNL)
117A 1802      JR      +2;117E
117C D1        POP     DE
117D E1        POP     HL
117E E1        POP     HL
117F 223D5C    LD      (ERRSP),HL
1182 C1        POP     BC
1183 D5        PUSH    DE
1184 CDD90D    CALL    CURSOR
1187 E1        POP     HL
1188 22825C    LD      (ECHOE),HL
118B FD362600  LD      (IY+YXPTR+1),00
118F C9        RET
;
1190 2A615C    LD      HL,(WORKSP)
1193 2B        DEC     HL
1194 A7        AND     A
1195 ED5B595C  LD      DE,(ELINE)
1199 FDCB376E  BIT     5,(IY+YFLAGX)
119D C8        RET     Z
119E ED5B615C  LD      DE,(WORKSP)
11A2 D8        RET     C
11A3 2A635C    LD      HL,(STKBOT)
11A6 C9        RET
;
11A7 7E        LD      A,(HL)
11A8 FE0E      CP      0E
11AA 010600    LD      BC,0006
11AD CCE819    CALL    Z,19E8
11B0 7E        LD      A,(HL)
11B1 23        INC     HL
11B2 FE0D      CP      0D
11B4 20F1      JR      NZ,-15;11A7
11B6 C9        RET
; NEW command
11B7 F3        DI
11B8 3EFF      LD      A,FF
11BA ED5BB25C  LD      DE,(RAMTOP)
11BE D9        EXX     ;save some variables
11BF ED4BB45C  LD      BC,(PRAMT)

```

```

11C3 ED5B385C    LD      DE,(RASP)
11C7 2A7B5C     LD      HL,(UDG)
11CA D9         EXX
; power on reset leads here
11CB 47         LD      E,A
11CC 3E07       LD      A,07      ;white
11CE D3FE       OUT     (FE),A    ;border
11D0 3E3F       LD      A,3F      ;point Interrupt
11D2 ED47       LD      I,A       ;DMA into ROM
11D4 00         NOP
11D5 00         NOP
11D6 00         NOP
11D7 00         NOP
11D8 00         NOP
11D9 00         NOP
11DA 62         LD      H,D       ;RAM 'test'
11DB 6B         LD      L,E
11DC 3602       LD      (HL),02
11DE 2B         DEC     HL
11DF BC         CP      H
11E0 20FA       JR      NZ,-6;11DC
11E2 A7         AND     A
11E3 ED52       SBC     HL,DE
11E5 19         ADD     HL,DE
11E6 23         INC     HL
11E7 3006       JR      NC,+6;11EF
11E9 35         DEC     (HL)
11EA 2803       JR      Z,+3;11EF
11EC 35         DEC     (HL)
11ED 28F3       JR      Z,-13;11E2
11EF 2B         DEC     HL
; retrieve saved variables in case of NEW
11F0 D9         EXX
11F1 ED43B45C   LD      (PRAMT),BC
11F5 ED53385C   LD      (RASP),DE
11F9 227B5C     LD      (UDG),HL
11FC D9         EXX
11FD 04         INC     B
11FE 2819       JR      Z,+25;1219 skip if NEW
1200 22B45C     LD      (PRAMT),HL
1203 11AF3E     LD      DE,3EAF ;UDG area
1206 01A800     LD      BC,00A8 ;copy A-U
1209 EB         EX      DE,HL
120A EDB8       LDDR
120C EB         EX      DE,HL
120D 23         INC     HL
120E 227B5C     LD      (UDG),HL
1211 2B         DEC     HL
; initialise other variables
1212 014000     LD      BC,0040
1215 ED43385C   LD      (RASP),BC
1219 22B25C     LD      (RAMTOP),HL
121C 21003C     LD      HL,3C00;char map
121F 22365C     LD      (CHARS),HL
1222 2AB25C     LD      HL,(RAMTOP)

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; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

1225 363E      LD      (HL),3E
1227 2E        DEC     HL
1228 F9        LD      SP,HL
1229 2E        DEC     HL
122A 2E        DEC     HL
122B 223D5C    LD      (ERRSP),HL
122E ED56      IM      1      ;int=RST 38
1230 FD213A5C  LD      IY,ERRNR;fixed value assumed
1234 FE        EI
1235 21B65C    LD      HL,5CB6
1238 224F5C    LD      (CHANS),HL
123B 11AF15    LD      DE,15AF;default channels
123E 011500    LD      BC,0015
1241 EB        EX      DE,HL
1242 EDB0      LDIR
1244 EB        EX      DE,HL
1245 2E        DEC     HL
1246 22575C    LD      (DATADD),HL
1249 23        INC     HL
; make program space logically empty
124A 22535C    LD      (PROG),HL
124D 224B5C    LD      (VARS),HL
1250 3680      LD      (HL),80
1252 23        INC     HL
1253 22595C    LD      (ELINE),HL
1256 360D      LD      (HL),0D
1258 23        INC     HL
1259 3680      LD      (HL),80
125B 23        INC     HL
125C 22615C    LD      (WORKSP),HL
125F 22635C    LD      (STKBOT),HL
1262 22655C    LD      (STKEND),HL
1265 3E38      LD      A,38
1267 328D5C    LD      (ATTRP),A
126A 328F5C    LD      (ATTRT),A
126D 32485C    LD      (BORDCR),A
1270 212305    LD      HL,0523
1273 22095C    LD      (REPDEL),HL
1276 FD35C6    DEC     (IY+YKSTATE);-58
1279 FD35CA    DEC     (IY+YKSTATE+4);-54
127C 21C615    LD      HL,15C6
127F 11105C    LD      DE,STRMS
1282 010E00    LD      BC,000E
1285 EDB0      LDIR
1287 FDCB01CE   SET     1,(IY+YFLAGS)
128B CDDF0E    CALL    CLREBF;clear print buffer
128E FD363102  LD      (IY+YDFSZ),02
1292 CD6B0D    CALL    0D6B
1295 AF        XOR     A
1296 113815    LD      DE,1538
1299 CD0A0C    CALL    0C0A
129C FDCB02EE  SET     5,(IY+YTVFLG)
12A0 1807      JR      +7;12A9
; get input line
12A2 FD363102  LD      (IY+YDFSZ),02

```

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

12A6 CD9517      CALL      1795
12A9 CDB016      CALL      16B0
12AC 3E00      LD      A,00
12AE CD0116      CALL      SELDEV
12B1 CD2C0F      CALL      GETLIN
12B4 CD171B      CALL      1B17
12B7 FDCB007E    BIT      7,(IY+YERRNR)
12BB 2012      JR      NZ,+1B;12CF
12BD FDCB3066    BIT      4,(IY+YFLGS2)
12C1 2840      JR      Z,+64;1303
12C3 2A595C      LD      HL,(ELINE)
12C6 CDA711      CALL      11A7
12C9 FD3600FF    LD      (IY+YERRNR),FF
12CD 18DD      JR      -35;12AC
; see if line num present
12CF 2A595C      LD      HL,(ELINE)
12D2 225D5C      LD      (CHADD),HL
12D5 CDFE19      CALL      19FB
12D8 78      LD      A,B
12D9 B1      OR      C
12DA C25D15      JP      NZ,ADDLIN
; no line num so direct Basic command
12DD DF      RST      1B
12DE FE0D      CP      0D
12E0 28C0      JR      Z,-64;12A2
12E2 FDCB3046    BIT      0,(IY+YFLGS2)
12E6 C4AF0D      CALL      NZ,0DAF
12E9 CD6E0D      CALL      0D6E
12EC 3E19      LD      A,19
12EE FD964F      SUB      (IY+YSPOSN+1)
12F1 328C5C      LD      (SCRCT),A
12F4 FDCB01FE    SET      7,(IY+YFLAGS)
12F8 FD3600FF    LD      (IY+YERRNR),FF
12FC FD360A01    LD      (IY+YNSPPC),01
1300 CD8A1B      CALL      1B8A
1303 76      HALT
1304 FDCB01AE    RES      5,(IY+YFLAGS)
1308 FDCB304E    BIT      1,(IY+YFLGS2)
130C C4CD0E      CALL      NZ,LPRINT
130F 3A3A5C      LD      A,(ERRNR)
1312 3C      INC      A
1313 F5      PUSH    AF
1314 210000      LD      HL,0000
1317 FD7437      LD      (IY+YFLAGX),H
131A FD7426      LD      (IY+YXPTR+1),H
131D 220B5C      LD      (DEFADD),HL
1320 210100      LD      HL,0001
1323 22165C      LD      (5C16),HL
1326 CDB016      CALL      16B0
1329 FDCB37AE    RES      5,(IY+YFLAGX)
132D CD6E0D      CALL      0D6E
1330 FDCB02EE    SET      5,(IY+YTVFLG)
1334 F1      POP      AF
1335 47      LD      B,A
1336 FE0A      CP      0A

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```

1338 3802      JR      C,+2;133C
133A C607      ADD      07
133C CDEF15    CALL     15EF
133F 3E20      LD       A,20
1341 D7        RST      10
1342 78        LD       A,B
1343 119113    LD       DE,1391
1346 CD0A0C    CALL     0C0A
1349 AF        XOR      A
134A 113615    LD       DE,1536
134D CD0A0C    CALL     0C0A
1350 ED4B455C  LD       BC,(PPC)
1354 CD1B1A    CALL     1A1B
1357 3E3A      LD       A,3A
1359 D7        RST      10
135A FD4E0D    LD       C,(IY+YSUBPC)
135D 0600      LD       B,00
135F CD1B1A    CALL     1A1B
1362 CD9710    CALL     1097
1365 3A3A5C    LD       A,(ERRNR)
1368 3C        INC      A
1369 281B      JR       Z,+27;1386
136B FE09      CP       09
136D 2804      JR       Z,+4;1373
136F FE15      CP       15
1371 2003      JR       NZ,+3;1376
1373 FD340D    INC      (IY+YSUBPC)
1376 010300    LD       BC,0003
1379 11705C    LD       DE,0SPPC
137C 21445C    LD       HL,NSPPC
137F CB7E      BIT      7,(HL)
1381 2801      JR       Z,+1;1384
1383 09        ADD      HL,BC
1384 EDB8      LDDR
1386 FD360AFF  LD       (IY+YNSPPC),FF
138A FDCB019E  RES      3,(IY+YFLAGS)
138E C3AC12    JP       12AC
;      DATA (coding omitted)
; message index shown in each case
; last char in each message has bit 7 set
1391 80        ;flag byte
1392 4FCB      ;-01 'OK'
1394 4E455854  ;+00 'NEXT without FOR'
1398 20776974
139C 686F7574
13A0 20464FD2
13A4 56617269  ;+01 'Variable not found'
13A8 61626C65
13AC 206E6F74
13B0 20666F75
13B4 6EE4
13B6 53756273  ;+02 'Subscript wrong'
13BA 63726970
13BE 74207772
13C2 6F6EE7

```

```

13C5 4F757420      ;+03 'Out of memory'
13C9 6F66206D
13CD 656D6F72
13D1 F9
13D2 4F757420      ;+04 'Out of screen'
13D6 6F662073
13DA 63726565
13DE EE
13DF 4E756D62      ;+05 'Number too big'
13E3 65722074
13E7 6F6F2062
13EB 69E7
13ED 52455455      ;+06 'RETURN without GOSUB'
13F1 524E2077
13F5 6974686F
13F9 75742047
13FD 4F5355C2
1401 456E6420      ;+07 'End of file'
1405 6F662066
1409 696CE5
140C 53544F50      ;+08 'STOP statement'
1410 20737461
1414 74656D65
1418 6EF4
141A 496E7661      ;+09 'Invalid argument'
141E 6C696420
1422 61726775
1426 6D656EF4
142A 496E7465      ;+10 'Integer out of range'
142E 67657220
1432 6F757420
1436 6F662072
143A 616E67E5
143E 4E6F6E73      ;+11 'Nonsense in BASIC'
1442 656E7365
1446 20696E20
144A 42415349
144E C3
144F 42524541      ;+12 'BREAK - CONT repeats'
1453 4B202D20
1457 434F4E54
145B 20726570
145F 656174F3
1463 4F757420      ;+13 'Out of DATA'
1467 6F662044
146B 4154C1
146E 496E7661      ;+14 'Invalid file name'
1472 6C696420
1476 66696C65
147A 206E616D
147E E5
147F 4E6F2072      ;+15 'No room for line'
1483 6F6F6D20
1487 666F7220
148B 6C696EE5

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```

148F 53544F50      ;+16 'STOP in INPUT'
1493 20696E20
1497 494E5055
149B D4
149C 464F5220      ;+17 'FOR without NEXT'
14A0 77697468
14A4 6F757420
14A8 4E4558D4
14AC 496E7661      ;+18 'Invalid I/O device'
14B0 6C696420
14B4 492F4F20
14B8 64657669
14BC 63E5
14BE 496E7661      ;+19 'Invalid colour'
14C2 6C696420
14C6 636F6C6F
14CA 75F2
14CC 42524541      ;+20 'BREAK into program'
14D0 4E20696E
14D4 746F2070
14D8 726F6772
14DC 61ED
14DE 52414D54      ;+21 'RAMTOP no good'
14E2 4F50206E
14E6 6F20676F
14EA 6FE4
14EC 53746174      ;+22 'Statement lost'
14F0 656D656E
14F4 74206C6F
14F8 73F4
14FA 496E7661      ;+23 'Invalid stream'
14FE 6C696420
1502 73747265
1506 61ED
1508 464E2077      ;+24 'FN without DEF'
150C 6974686F
1510 75742044
1514 45C6
1516 50617261      ;+25 'Parameter error'
151A 6D657465
151E 72206572
1522 726FF2
1525 54617065      ;+26 'Tape loading error'
1529 206C6F61
152D 64696E67
1531 20657272
1535 6FF2
1537 2CA0      ;+27 comma space
1539 7F203139      ;+28 copyright space '1982 S'
153D 38322053      ;...
1541 696E636C      ;... 'inclair Research Ltd'
1545 61697220
1549 52657365
154D 61726368
1551 204C74E4

```

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

; error 'no room for line'

```
1555 3E10      LD      A,+15+1
1557 010000      LD      BC,0000
155A C31313      JP      1313
; add Basic line into program
155D      ADDLIN:
155D ED43495C      LD      (EPFC),BC
1561 2A5D5C      LD      HL,(CHADD)
1564 EB      EX      DE,HL
1565 215515      LD      HL,1555
1568 E5      PUSH      HL
1569 2A615C      LD      HL,(WORKSP)
156C 37      SCF
156D ED52      SBC      HL,DE
156F E5      PUSH      HL
1570 60      LD      H,B
1571 69      LD      L,C
1572 CD6E19      CALL      196E
1575 2006      JR      NZ,+6;157D
1577 CDB819      CALL      19B8
157A CDE819      CALL      19E8
157D C1      POP      BC
157E 79      LD      A,C
157F 3D      DEC      A
1580 B0      OR      B
1581 2828      JR      Z,+40;15AB
1583 C5      PUSH      BC
1584 03      INC      BC
1585 03      INC      BC
1586 03      INC      BC
1587 03      INC      BC
1588 2B      DEC      HL
1589 ED5B535C      LD      DE,(PROG)
158D D5      PUSH      DE
158E CD5516      CALL      1655
1591 E1      POP      HL
1592 22535C      LD      (PROG),HL
1595 C1      POP      BC
1596 C5      PUSH      BC
1597 13      INC      DE
1598 2A615C      LD      HL,(WORKSP)
159B 2B      DEC      HL
159C 2B      DEC      HL
159D EDB8      LDDR
159F 2A495C      LD      HL,(EPFC)
15A2 EB      EX      DE,HL
15A3 C1      POP      BC
15A4 70      LD      (HL),B
15A5 2B      DEC      HL
15A6 71      LD      (HL),C
15A7 2B      DEC      HL
15A8 73      LD      (HL),E
15A9 2B      DEC      HL
15AA 72      LD      (HL),D
15AB F1      POP      AF
```



```

15AC C3A212      JP      12A2
; initial STRMS settings
15AF F409A810    DEFW    09F4,10A8
15B3 4B          DEFB    'K'
15B4 F409C415    DEFW    09F4,15C4
15B8 53          DEFB    'S'
15B9 810FC415    DEFW    0F81,15C4
15BD 52          DEFB    'R'
15BE F409C415    DEFW    09F4,15C4
15C2 50          DEFB    'P'
15C3 80          DEFB    +128
; error 'invalid I/O device'
15C4 CF          RST      08
15C5 12          DEFB    +18
; initial CHANS settings
15C6 0100        DEFW    +01;'K'
15C8 0600        DEFW    +06;'S'
15CA 0B00        DEFW    +11;'R'
15CC 0100        DEFW    +01;'K'
15CE 0100        DEFW    +01;'K'
15D0 0600        DEFW    +06;'S'
15D2 1000        DEFW    +16;'P'
; wait for a key to be pressed
15D4      INKEY :
15D4 FDCB026E    BIT      5,(IY+YTVFLG)
15D8 2004        JR      NZ,+4;15DE
15DA FDCB02DE    SET      3,(IY+YTVFLG)
15DE CDE615      CALL     SLCTIP
15E1 D8          RET      C
15E2 28FA        JR      Z,-6;15DE
; error 'end of file'
15E4 CF          RST      08
15E5 07          DEFB    +7
;
15E6      SLCTIP:
15E6 D9          EXX
15E7 E5          PUSH     HL
15E8 2A515C      LD       HL,(CURCHL)
15EB 23          INC      HL
15EC 23          INC      HL
15ED 1808        JR      +8;15F7
15EF 1E30        LD       E,30
15F1 83          ADD      E
15F2 D9          EXX
;
15F3      SLCTOP:
15F3 E5          PUSH     HL
15F4 2A515C      LD       HL,(CURCHL)
15F7 5E          LD       E,(HL)
15F8 23          INC      HL
15F9 56          LD       D,(HL)
15FA EB          EX       DE,HL
15FB CD2C16      CALL     162C
15FE E1          POP      HL
15FF D9          EXX

```

```

1600 C9            RET
;**** select device (A) for current stream
; -3,-2,-1 reserved for system use
; User can OPEN£ or CLOSE£ 0 to 15
1601        SELDEV:
1601 87            ADD        A
1602 C616          ADD        16
1604 6F            LD         L,A
1605 265C          LD         H,5C
1607 5E            LD         E,(HL)
1608 23            INC        HL
1609 56            LD         D,(HL)
160A 7A            LD         A,D
160B B3            OR         E
160C 2002          JR         NZ,+2;1610
; error 'invalid stream'
160E CF            RST        08
160F 17            DEFB       +23
;
1610 1E            DEC        DE
1611 2A4F5C        LD         HL,(CHANS)
1614 19            ADD        HL,DE
1615 22515C        LD         (CURCHL),HL
1618 FDCB30A6      RES        4,(IY+YFLGS2)
161C 23            INC        HL
161D 23            INC        HL
161E 23            INC        HL
161F 23            INC        HL
1620 4E            LD         C,(HL)
1621 212D16        LD         HL,162D
1624 CDDC16        CALL       16DC
1627 D0            RET        NC
1628 1600          LD         D,00
162A 5E            LD         E,(HL)
162B 19            ADD        HL,DE
162C E9            JP         (HL)
; Offset table for OPEN£ file name
162D 4B06          DEFB       'K',+06 ;1634
162F 5312          DEFB       'S',+18 ;1642
1631 501B          DEFB       'P',+27 ;164D
1633 00            DEFB       0;end
; open 'K'
1634 FDCB02C6      SET        0,(IY+YTVFLG)
1638 FDCB01AE      RES        5,(IY+YFLAGS)
163C FDCB30E6      SET        4,(IY+YFLGS2)
1640 1804          JR         +4;1646
; open 'S'
1642 FDCB0286      RES        0,(IY+YTVFLG)
1646 FDCB018E      RES        1,(IY+YFLAGS)
164A C34D0D        JP         0D4D
; open 'P'
164D FDCB01CE      SET        1,(IY+YFLAGS)
1651 C9            RET
;
1652 010100        LD         BC,0001 ;one space

```

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; make space: BC=bytes required at HL=address

```

1655 E5      PUSH    HL
1656 CD051F   CALL    1F05
1659 E1      POP     HL
165A CD6416   CALL    1664
165D 2A655C   LD      HL,(STKEND)
1660 EB      EX      DE,HL
1661 EDB8     LDDR
1663 C9      RET
; adjust pointers
1664 F5      PUSH    AF
1665 E5      PUSH    HL
1666 214B5C   LD      HL,VAR5
1669 3E0E     LD      A,0E
166B 5E      LD      E,(HL)
166C 23      INC     HL
166D 56      LD      D,(HL)
166E E3      EX      HL,(SP)
166F A7      AND     A
1670 ED52     SBC     HL,DE
1672 19      ADD     HL,DE
1673 E3      EX      HL,(SP)
1674 3009     JR      NC,+9;167F
1676 D5      PUSH    DE
1677 EB      EX      DE,HL
1678 09      ADD     HL,BC
1679 EB      EX      DE,HL
167A 72      LD      (HL),D
167B 2B      DEC     HL
167C 73      LD      (HL),E
167D 23      INC     HL
167E D1      POP     DE
167F 23      INC     HL
1680 3D      DEC     A
1681 20EB     JR      NZ,-24;166B
1683 EB      EX      DE,HL
1684 D1      POP     DE
1685 F1      POP     AF
1686 A7      AND     A
1687 ED52     SBC     HL,DE
1689 44      LD      B,H
168A 4D      LD      C,L
168B 03      INC     BC
168C 19      ADD     HL,DE
168D EB      EX      DE,HL
168E C9      RET
;
168F 00      NOP
1690 00      NOP
1691 EB      EX      DE,HL
1692 118F16   LD      DE,168F
1695 7E      LD      A,(HL)
1696 E6C0     AND     C0
1698 20F7     JR      NZ,-9;1691
169A 56      LD      D,(HL)

```

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

169B 23      INC      HL
169C 5E      LD        E,(HL)
169D C9      RET
;
169E 2A635C  LD        HL,(STKBOT)
16A1 2B      DEC      HL
16A2 CD5516  CALL      1655
16A5 23      INC      HL
16A6 23      INC      HL
16A7 C1      POP      BC
16A8 ED43615C LD        (WORKSP),BC
16AC C1      POP      BC
16AD EB      EX        DE,HL
16AE 23      INC      HL
16AF C9      RET
; reset all work areas
16B0 2A595C  LD        HL,(ELINE)
16B3 360D    LD        (HL),0D
16B5 225B5C  LD        (KCUR),HL
16B8 23      INC      HL
16B9 3680    LD        (HL),80
16BB 23      INC      HL
16BC 22615C  LD        (WORKSP),HL
16BF 2A615C  LD        HL,(WORKSP)
16C2 22635C  LD        (STKBOT),HL
; reset some work areas
16C5 2A635C  LD        HL,(STKBOT)
16C8 22655C  LD        (STKEND),HL
16CB E5      PUSH     HL
16CC 21925C  LD        HL,MEMBOT
16CF 22685C  LD        (MEM),HL
16D2 E1      POP      HL
16D3 C9      RET
;
16D4 ED5B595C LD        DE,(ELINE)
16D8 C3E519  JP        19E5
; table lookup subroutine
16DB 23      INC      HL
16DC 7E      LD        A,(HL)
16DD A7      AND      A
16DE C8      RET      Z
16DF B9      CP      C
16E0 23      INC      HL
16E1 20F8    JR        NZ,-8;16DB
16E3 37      SCF
16E4 C9      RET
; CLOSE £ command
16E5 CD1E17  CALL      171E
16E8 CD0117  CALL      1701
16EB 010000  LD        BC,0000
16EE 11E2A3  LD        DE,A3E2
16F1 EB      EX        DE,HL
16F2 19      ADD      HL,DE
16F3 3807    JR        C,+7;16FC
16F5 01D415  LD        BC,INKEY

```

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```

16F8 09      ADD      HL,BC
16F9 4E      LD       C,(HL)
16FA 23      INC      HL
16FB 46      LD       B,(HL)
16FC EB      EX       DE,HL
16FD 71      LD       (HL),C
16FE 23      INC      HL
16FF 70      LD       (HL),B
1700 C9      RET
;
1701 E5      PUSH     HL
1702 2A4F5C   LD       HL,(CHANS)
1705 09      ADD      HL,BC
1706 23      INC      HL
1707 23      INC      HL
1708 23      INC      HL
1709 4E      LD       C,(HL)
170A EB      EX       DE,HL
170B 211617   LD       HL,1716
170E CDDC16   CALL     16DC
1711 4E      LD       C,(HL)
1712 0600     LD       B,00
1714 09      ADD      HL,BC
1715 E9      JP       (HL)
; Offset table for CLOSEf
1716 4B05     DEFB     'K',+05;171C
1718 5303     DEFB     'S',+03;171C
171A 5001     DEFB     'P',+01;171C
; Note: missing end marker on this table
;
171C E1      POP      HL
171D C9      RET
;
171E CD941E   CALL     1E94
1721 FE10     CP       10
1723 3802     JR       C,+2;1727
1725 CF      RST      08
1726 17      DEFB     +23
1727 C603     ADD      03
1729 07      RLCA
172A 21105C   LD       HL,STRMS
172D 4F      LD       C,A
172E 0600     LD       B,00
1730 09      ADD      HL,BC
1731 4E      LD       C,(HL)
1732 23      INC      HL
1733 46      LD       B,(HL)
1734 2B      DEC      HL
1735 C9      RET
; OPENf command
1736 EF      RST      28
1737 01      DEFB     +1
1738 38      DEFB     +56;fp exit
1739 CD1E17   CALL     171E
173C 78      LD       A,B

```

```

173D B1      OR      C
173E 2816    JR      Z,+22;1756
1740 EB      EX      DE,HL
1741 2A4F5C  LD      HL,(CHANS)
1744 09      ADD     HL,BC
1745 23      INC     HL
1746 23      INC     HL
1747 23      INC     HL
1748 7E      LD      A,(HL)
1749 EB      EX      DE,HL
174A FE4B    CP      4B      ;'K'
174C 2808    JR      Z,+8;1756
174E FE53    CP      53      ;'S'
1750 2804    JR      Z,+4;1756
1752 FE50    CP      50      ;'P'
1754 20CF    JR      NZ,-49;1725
1756 CD5D17  CALL    175D
1759 73      LD      (HL),E
175A 23      INC     HL
175B 72      LD      (HL),D
175C C9      RET
;
175D E5      PUSH    HL
175E CDF12B  CALL    2EF1
1761 78      LD      A,B
1762 B1      OR      C
1763 2002    JR      NZ,+2;1767
1765 CF      RST     08
1766 0E      DEFB    +14
1767 C5      PUSH    BC
1768 1A      LD      A,(DE)
1769 E6DF    AND     DF
176B 4F      LD      C,A
176C 217A17  LD      HL,177A
176F CDDC16  CALL    16DC
1772 30F1    JR      NC,-15;1765
1774 4E      LD      C,(HL)
1775 0600    LD      B,00
1777 09      ADD     HL,BC
1778 C1      POP     BC
1779 E9      JP      (HL)
; Offset table for OPEN£
177A 4B06    DEFB    'K',+06;1781
177C 5308    DEFB    'S',+08;1785
177E 500A    DEFB    'P',+10;1789
1780 00      DEFB    0;end
; 'K'
1781 1E01    LD      E,01
1783 1806    JR      +6;178B
; 'S'
1785 1E06    LD      E,06
1787 1802    JR      +2;178B
; 'P'
1789 1E10    LD      E,10
178B 0B      DEC     BC

```

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```

178C 78      LD      A,B
178D B1      OR      C
178E 20D5    JR      NZ,-43;1765
1790 57      LD      D,A
1791 E1      POP     HL
1792 C9      RET
; default error for FORMAT & CAT commands
1793 1890    JR      -112;1725
;
1795 ED733F5C LD      (LISTSP),SP
1799 FD360210 LD      (IY+YTVFLG),10
179D CDAF0D   CALL    0DAF
17A0 FDCB02C6 SET     0,(IY+YTVFLG)
17A4 FD4631   LD      B,(IY+YDFSZ)
17A7 CD440E   CALL    0E44
17AA FDCB0286 RES     0,(IY+YTVFLG)
17AE FDCB30C6 SET     0,(IY+YFLGS2)
17B2 2A495C   LD      HL,(EPPC)
17B5 ED5B6C5C LD      DE,(STOP)
17B9 A7      AND     A
17BA ED52     SBC     HL,DE
17BC 19      ADD     HL,DE
17BD 3822     JR      C,+34;17E1
17BF D5      PUSH    DE
17C0 CD6E19   CALL    196E
17C3 11C002   LD      DE,02C0
17C6 EB      EX      DE,HL
17C7 ED52     SBC     HL,DE
17C9 E3      EX      HL,(SP)
17CA CD6E19   CALL    196E
17CD C1      POP     BC
17CE C5      PUSH    BC
17CF CDB819   CALL    19B8
17D2 C1      POP     BC
17D3 09      ADD     HL,BC
17D4 380E     JR      C,+14;17E4
17D6 EB      EX      DE,HL
17D7 56      LD      D,(HL)
17D8 23      INC     HL
17D9 5E      LD      E,(HL)
17DA 2B      DEC     HL
17DB ED536C5C LD      (STOP),DE
17DF 18ED     JR      -19;17CE
17E1 226C5C   LD      (STOP),HL
17E4 2A6C5C   LD      HL,(STOP)
17E7 CD6E19   CALL    196E
17EA 2801     JR      Z,+1;17ED
17EC EB      EX      DE,HL
17ED CD3318   CALL    1833
17F0 FDCB02A6 RES     4,(IY+YTVFLG)
17F4 C9      RET
; LLIST command
17F5 3E03     LD      A,03      ;printer
17F7 1802     JR      +2;17FB
; LIST command

```

17F9 3E02	LD	A,02	;screen
17FE FD360200	LD	(IY+YTVFLG),00	
17FF CD3025	CALL	2530	;immediate?
1802 C40116	CALL	NZ,SELDEV	;if so,select.
1805 DF	RST	18	;check if new
1806 CD7020	CALL	2070	;device reqd.
1809 3814	JR	C,+20;181F	
180B DF	RST	18	
180C FE3B	CP	3B	;semicolon
180E 2804	JR	Z,+4;1814	
1810 FE2C	CP	2C	;comma
1812 2006	JR	NZ,+6;181A	
1814 E7	RST	20	
1815 CD821C	CALL	1C82	
1818 1808	JR	+8;1822	
181A CDE61C	CALL	1CE6	
181D 1803	JR	+3;1822	
181F CDDE1C	CALL	1CDE	
1822 CDEE1B	CALL	1BEE	
1825 CD991E	CALL	1E99	
1828 78	LD	A,B	
1829 E63F	AND	3F	
182B 67	LD	H,A	
182C 69	LD	L,C	
182D 22495C	LD	(EPPC),HL	
1830 CD6E19	CALL	196E	;find prog line
1833 1E01	LD	E,01	
1835 CD5518	CALL	1855	
1838 D7	RST	10	
1839 FDCB0266	BIT	4,(IY+YTVFLG)	
183D 28F6	JR	Z,-10;1835	
183F 3A6B5C	LD	A,(DFSZ)	
1842 FD964F	SUB	(IY+YSPOSN+1)	
1845 20EE	JR	NZ,-18;1835	
1847 AB	XOR	E	
1848 C8	RET	Z	
1849 E5	PUSH	HL	
184A D5	PUSH	DE	
184B 216C5C	LD	HL,STOP	
184E CD0F19	CALL	190F	
1851 D1	POP	DE	
1852 E1	POP	HL	
1853 18E0	JR	-32;1835	
1855 ED4B495C	LD	BC,(EPPC)	
1859 CD8019	CALL	1980	
185C 163E	LD	D,3E	
185E 2805	JR	Z,+5;1865	
1860 110000	LD	DE,0000	
1863 CB13	RL	E	
1865 FD732D	LD	(IY+YBREG),E	
1868 7E	LD	A,(HL)	
1869 FE40	CP	40	
186B C1	POP	BC	
186C D0	RET	NC	
186D C5	PUSH	BC	

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```

; convert & print line number
186E CD281A      CALL      1A28
1871 23          INC        HL
1872 23          INC        HL
1873 23          INC        HL
1874 FDCB0186    RES        0,(IY+YFLAGS)
1878 7A          LD         A,D
1879 A7          AND        A
187A 2805        JR         Z,+5;1881
187C D7          RST        10
187D FDCB01C6    SET        0,(IY+YFLAGS)
1881 D5          PUSH      DE
1882 EB          EX         DE,HL
1883 FDCB3096    RES        2,(IY+YFLGS2)
1887 213B5C      LD         HL,FLAGS
188A CB96        RES        2,(HL)
188C FDCB376E    BIT        5,(IY+YFLAGX)
1890 2802        JR         Z,+2;1894
1892 CBD6        SET        2,(HL)
1894 2A5F5C      LD         HL,(XPTR)
1897 A7          AND        A
1898 ED52        SBC        HL,DE
189A 2005        JR         NZ,+5;18A1
189C 3E3F        LD         A,3F
189E CDC118      CALL      18C1
18A1 CDE118      CALL      18E1
18A4 EB          EX         DE,HL
18A5 7E          LD         A,(HL)
18A6 CDB618      CALL      18B6
18A9 23          INC        HL
18AA FE0D        CP         0D
18AC 2806        JR         Z,+6;18B4
18AE EB          EX         DE,HL
18AF CD3719      CALL      1937
18B2 18E0        JR         -32;1894
18B4 D1          POP        DE
18B5 C9          RET
;
18B6 FE0E        CP         0E
18B8 C0          RET        NZ
18B9 23          INC        HL
18BA 23          INC        HL
18BB 23          INC        HL
18BC 23          INC        HL
18BD 23          INC        HL
18BE 23          INC        HL
18BF 7E          LD         A,(HL)
18C0 C9          RET
;
18C1 D9          EXX
18C2 2A8F5C      LD         HL,(ATTRT)
18C5 E5          PUSH      HL
18C6 CBBC        RES        7,H
18C8 CBFD        SET        7,L
18CA 228F5C      LD         (ATTRT),HL

```

```

18CD 21915C    LD      HL,PFLAG
18D0 56        LD      D,(HL)
18D1 D5        PUSH    DE
18D2 3600      LD      (HL),00
18D4 CDF409    CALL    PRINT
18D7 E1        POP     HL
18D8 FD7457    LD      (IY+YFLAG),H
18DB E1        POP     HL
18DC 228F5C    LD      (ATTRT),HL
18DF D9        EXX
18E0 C9        RET
;
18E1 2A5B5C    LD      HL,(KCUR)
18E4 A7        AND     A
18E5 ED52      SBC     HL,DE
18E7 C0        RET     NZ
18E8 3A415C    LD      A,(MODE)
18EB CB07      RLC     A
18ED 2804      JR      Z,+4;18F3
18EF C643      ADD     43
18F1 1816      JR      +22;1909
18F3 213B5C    LD      HL,FLAGS
18F6 CB9E      RES     3,(HL)
18F8 3E4B      LD      A,4B
18FA CB56      BIT     2,(HL)
18FC 280B      JR      Z,+11;1909
18FE CBDE      SET     3,(HL)
1900 3C        INC     A
1901 FDCB305E  BIT     3,(IY+YFLAG2)
1905 2802      JR      Z,+2;1909
1907 3E43      LD      A,43
1909 D5        PUSH    DE
190A CDC118    CALL    18C1
190D D1        POP     DE
190E C9        RET
;
190F 5E        LD      E,(HL)
1910 23        INC     HL
1911 56        LD      D,(HL)
1912 E5        PUSH    HL
1913 EB        EX      DE,HL
1914 23        INC     HL
1915 CD6E19    CALL    196E
1918 CD9516    CALL    1695
191B E1        POP     HL
191C FDCB376E  BIT     5,(IY+YFLAGX)
1920 C0        RET     NZ
1921 72        LD      (HL),D
1922 2B        DEC     HL
1923 73        LD      (HL),E
1924 C9        RET
;
1925 7B        LD      A,E
1926 A7        AND     A
1927 F8        RET     M

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; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

1928 180D      JR      +13;1937
; count number of times BC goes into HL
192A AF        XOR      A
192B 09        ADD      HL,BC
192C 3C        INC      A
192D 38FC      JR      C,-4;192B
192F ED42      SBC      HL,BC
1931 3D        DEC      A
1932 28F1      JR      Z,-15;1925
1934 C3EF15    JP      15EF
;
1937 CD1B2D    CALL     2D1B
193A 3030      JR      NC,+48;196C
193C FE21      CP      21
193E 382C      JR      C,+44;196C
1940 FDCB0196  RES      2,(IY+YFLAGS)
1944 FECB      CP      CB
1946 2824      JR      Z,+36;196C
1948 FE3A      CP      3A
194A 200E      JR      NZ,+14;195A
194C FDCB376E  BIT      5,(IY+YFLAGX)
1950 2016      JR      NZ,+22;1968
1952 FDCB3056  BIT      2,(IY+YFLGS2)
1956 2814      JR      Z,+20;196C
1958 180E      JR      +14;1968
195A FE22      CP      22
195C 200A      JR      NZ,+10;1968
195E F5        PUSH     AF
195F 3A6A5C    LD      A,(FLAGS2)
1962 EE04      XOR      04
1964 326A5C    LD      (FLAGS2),A
1967 F1        POP      AF
1968 FDCB01D6  SET      2,(IY+YFLAGS)
196C D7        RST      10
196D C9        RET
; search program for BC=line number
196E E5        PUSH     HL
196F 2A535C    LD      HL,(PROG)
1972 54        LD      D,H
1973 5D        LD      E,L
1974 C1        POP      BC
1975 CD8019    CALL     1980
1978 D0        RET      NC;when > or =
1979 C5        PUSH     BC
197A CDB819    CALL     19B8
197D EB        EX      DE,HL
197E 18F4      JR      -12;1974
;
1980 7E        LD      A,(HL)
1981 B8        CP      B
1982 C0        RET      NZ
1983 23        INC      HL
1984 7E        LD      A,(HL)
1985 2B        DEC      HL
1986 B9        CP      C

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; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

1987 C9          RET
;
1988 23          INC      HL
1989 23          INC      HL
198A 23          INC      HL
198B 225D5C      LD        (CHADD),HL
198E 0E00        LD        C,00
1990 15          DEC      D
1991 C8          RET      Z
1992 E7          RST      20
1993 BB          CP        E
1994 2004        JR        NZ,+4;199A
1996 A7          AND      A
1997 C9          RET
;
1998 23          INC      HL
1999 7E          LD        A,(HL)
199A CDB618      CALL     18B6
199D 225D5C      LD        (CHADD),HL
19A0 FE22        CP        22
19A2 2001        JR        NZ,+1;19A5
19A4 0D          DEC      C
19A5 FE3A        CP        3A      ;colon
19A7 2804        JR        Z,+4;19AD
19A9 FECB        CP        CB      ;THEN
19AB 2004        JR        NZ,+4;19B1
19AD CB41        BIT      0,C
19AF 28DF        JR        Z,-33;1990
19B1 FE0D        CP        0D
19B3 20E3        JR        NZ,-29;1998
19B5 15          DEC      D
19B6 37          SCF
19B7 C9          RET
; calc length of item (variable,prog line etc)
; (HL)=item address. Exit with (DE)=next item
19B8 E5          PUSH     HL
19B9 7E          LD        A,(HL)
19BA FE40        CP        40
19BC 3817        JR        C,+23;19D5
19BE CB6F        BIT      5,A
19C0 2814        JR        Z,+20;19D6
19C2 87          ADD      A
19C3 FAC719      JP        M,19C7
19C6 3F          CCF
19C7 010500      LD        BC,0005
19CA 3002        JR        NC,+2;19CE
19CC 0E12        LD        C,12
19CE 17          RLA
19CF 23          INC      HL
19D0 7E          LD        A,(HL)
19D1 30FB        JR        NC,-5;19CE
19D3 1806        JR        +6;19DB
19D5 23          INC      HL
19D6 23          INC      HL
19D7 4E          LD        C,(HL)

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; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

19D8 23      INC      HL
19D9 46      LD       E,(HL)
19DA 23      INC      HL
19DB 09      ADD      HL,BC
19DC D1      POP      DE
19DD A7      AND      A
19DE ED52    SBC      HL,DE
19E0 44      LD       E,H
19E1 4D      LD       C,L
19E2 19      ADD      HL,DE
19E3 EB      EX       DE,HL
19E4 C9      RET
;
19E5 CDDD19  CALL     19DD
19E8 C5      PUSH     BC
19E9 78      LD       A,B
19EA 2F      CPL
19EB 47      LD       E,A
19EC 79      LD       A,C
19ED 2F      CPL
19EE 4F      LD       C,A
19EF 03      INC      BC
19F0 CD6416  CALL     1664
19F3 EB      EX       DE,HL
19F4 E1      POP      HL
19F5 19      ADD      HL,DE
19F6 D5      PUSH     DE
19F7 EDB0    LDIR
19F9 E1      POP      HL
19FA C9      RET
; get first char of edit line (line num?)
19FB 2A595C  LD       HL,(ELINE)
19FE 2B      DEC      HL
19FF 225D5C  LD       (CHADD),HL
1A02 E7      RST      20
1A03 21925C  LD       HL,MEMBOT
1A06 22655C  LD       (STKEND),HL
1A09 CD3B2D  CALL     2D3B
1A0C CDA22D  CALL     2DA2
1A0F 3804    JR       C,+4;1A15
1A11 21F0D8  LD       HL,D8F0
1A14 09      ADD      HL,BC
1A15 DA8A1C  JP       C,1C8A
1A18 C3C516  JP       16C5
; line printing routine
1A1B D5      PUSH     DE
1A1C E5      PUSH     HL
1A1D AF      XOR      A
1A1E CB78    BIT      7,B
1A20 2020    JR       NZ,+32;1A42
1A22 60      LD       H,B
1A23 69      LD       L,C
1A24 1EFF    LD       E,FF
1A26 1808    JR       +8;1A30
; (HL)=value to print

```

```

1A28 D5      PUSH    DE
1A29 56      LD      D,(HL)
1A2A 23      INC     HL
1A2B 5E      LD      E,(HL)
1A2C E5      PUSH    HL
1A2D EB      EX      DE,HL
1A2E 1E20    LD      E,20
; HL=16 bit value to print
1A30 0118FC  LD      BC,FC18
1A33 CD2A19  CALL    192A
1A36 019CFF  LD      BC,FF9C
1A39 CD2A19  CALL    192A
1A3C 0EF6    LD      C,F6
1A3E CD2A19  CALL    192A
1A41 7D      LD      A,L
1A42 CDEF15  CALL    15EF
1A45 E1      POP     HL
1A46 D1      POP     DE
1A47 C9      RET
;      DATA (coding omitted) see 1B4A
; Offset table for commands (self offset)
1A48 B1CBB0BF ;DEF-FN CAT FORMAT MOVE
1A4C C4AFB493 ;ERASE OPEN£ CLOSE£ MERGE
1A50 91929598 ;VERIFY BEEP CIRCLE INK
1A54 98989898 ;PAPER FLASH BRIGHT INVERSE
1A58 98987F81 ;OVER OUT LPRINT LLIST
1A5C 2E6C6E70 ;STOP READ DATA RESTORE
1A60 4894563F ;NEW BORDER CONTINUE DIM
1A64 412B171F ;REM FOR GOTO GOSUB
1A68 3777440F ;INPUT LOAD LIST LET
1A6C 592B432D ;PAUSE NEXT POKE PRINT
1A70 513A6D42 ;PLOT RUN SAVE RANDOMIZE
1A74 0D495C44 ;IF CLS DRAW CLEAR
1A78 155D    ;RETURN COPY
; command syntax table indexed
; by command offset in previous table
1A7A 013D02  ;      LET
1A7D 0600671E ;1E67  GOTO
1A81 06CB05  ;1CF0  IF
1A84 F01C
1A86 0600ED1E ;1EED  GOSUB
1A8A 00EE1C   ;1CEE  STOP
1A8D 00231F   ;1F23  RETURN
1A90 043D06CC ;1D03  FOR
1A94 0605031D
1A98 0400AB1D ;1DAB  NEXT
1A9C 05CD1F   ;1FCD  PRINT
1A9F 058920   ;2089  INPUT
1AA2 05022C   ;2C02  DIM
1AA5 05B21B   ;1BB2  REM
1AA8 00B711   ;11B7  NEW
1AAB 03A11E   ;1EA1  RUN
1AAE 05F917   ;17F9  LIST
1AB1 0800801E ;1E80  POKE
1AB5 034F1E   ;1E4F  RANDOMIZE

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1AB8 005F1E      ;1E5F  CONTINUE
1ABB 03AC1E      ;1EAC  CLEAR
1ABE 006B0D      ;0D6B  CLS
1AC1 0900DC22    ;22DC  PLOT
1AC5 06003A1F    ;1F3A  PAUSE
1AC9 05ED1D      ;1DED  READ
1ACC 05271E      ;1E27  DATA
1ACF 03421E      ;1E42  RESTORE
1AD2 09058223    ;2382  DRAW
1AD6 00AC0E      ;0EAC  COPY
1AD9 05C91F      ;1FC9  LPRINT
1ADC 05F517      ;17F5  LLIST
1ADF 0B          ;      SAVE
1AE0 0B          ;      LOAD
1AE1 0B          ;      VERIFY
1AE2 0B          ;      MERGE
1AE3 0800F803    ;03F8  BEEP
1AE7 09052023    ;2320  CIRCLE
1AEB 07          ;      INK
1AEC 07          ;      PAPER
1AED 07          ;      FLASH
1AEE 07          ;      BRIGHT
1AEF 07          ;      INVERSE
1AF0 07          ;      OVER
1AF1 08007A1E    ;1E7A  OUT
1AF5 06009422    ;2294  BORDER
1AF9 05601F      ;1F60  DEF FN
1AFC 062C0A00    ;1736  OPEN£
1B00 3617
1B02 0600E516    ;16E5  CLOSE£
1B06 0A009317    ;1793  FORMAT
1B0A 0A2C0A00    ;1793  MOVE
1B0E 9317
1B10 0A009317    ;1793  ERASE
1B14 009317      ;1793  CAT
;      coding resumes ...
;      INTERPRETER
; performs syntax check and
; controls program execution
1B17 FDCE01BE    RES      7,(IY+YFLAGS)
1B1B CDFB19      CALL     19FB
1B1E AF          XOR      A
1B1F 32475C      LD       (SUBPPC),A
1B22 3D          DEC      A
1B23 323A5C      LD       (ERRNR),A
1B26 1801        JR       +1;1B29
1B28 E7          RST      20
1B29 CDBF16      CALL     16BF
1B2C FD340D      INC      (IY+YSUBPC)
1B2F FA8A1C      JP       M,1C8A
1B32 DF          RST      18
1B33 0600        LD       B,00
1B35 FE0D        CP       CR
1B37 287A        JR       Z,+122;1BB3
1B39 FE3A        CP       3A      ;colon

```

```

1B3B 28EB      JR      Z,-21;1B28
1B3D 21761B    LD      HL,1B76
1B40 E5        PUSH    HL
1B41 4F        LD      C,A
1B42 E7        RST     20
1B43 79        LD      A,C
1B44 D6CE      SUB     CE
1B46 DA8A1C    JP      C,1C8A
1B49 4F        LD      C,A
1B4A 21481A    LD      HL,1A48;offset table
1B4D 09        ADD     HL,BC
1B4E 4E        LD      C,(HL);syntax table entry
1B4F 09        ADD     HL,BC
1B50 1803      JR      +3;1B55
1B52 2A745C    LD      HL,(TADDR)
1B55 7E        LD      A,(HL)
1B56 23        INC     HL
1B57 22745C    LD      (TADDR),HL
1B5A 01521B    LD      BC,1B52
1B5D C5        PUSH    BC
1B5E 4F        LD      C,A
1B5F FE20      CP      20
1B61 300C      JR      NC,+12;1B6F
1B63 21011C    LD      HL,1C01
1B66 0600      LD      B,00
1B68 09        ADD     HL,BC
1B69 4E        LD      C,(HL)
1B6A 09        ADD     HL,BC
1B6B E5        PUSH    HL
1B6C DF        RST     18
1B6D 05        DEC     B
1B6E C9        RET
;
1B6F DF        RST     18
1B70 B9        CP      C
1B71 C28A1C    JP      NZ,1C8A
1B74 E7        RST     20
1B75 C9        RET
;
1B76 CD541F    CALL    BREAK
1B79 3802      JR      C,+2;1B7D
1B7B CF        RST     08
1B7C 14        DEFB    +20;break
;
1B7D FDCB0A7E  BIT     7,(IY+YNSPPC)
1B81 2071      JR      NZ,+113;1BF4
1B83 2A425C    LD      HL,(NEWPPC)
1B86 CB7C      BIT     7,H
1B88 2814      JR      Z,+20;1B9E
1B8A 21FEFF    LD      HL,FFFE
1B8D 22455C    LD      (PPC),HL
1B90 2A615C    LD      HL,(WORKSP)
1B93 2B        DEC     HL
1B94 ED5B595C  LD      DE,(ELINE)
1B98 1B        DEC     DE

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```

1B99 3A445C      LD      A,(NSPFC)
1B9C 1833        JR      +51;1BD1
1B9E CD6E19      CALL    196E
1BA1 3A445C      LD      A,(NSPFC)
1BA4 2819        JR      Z,+25;1BBF
1BA6 A7          AND     A
1BA7 2043        JR      NZ,+67;1BEC
1BA9 47          LD      E,A
1BAA 7E          LD      A,(HL)
1BAB E6C0        AND     C0
1BAD 78          LD      A,B
1BAE 280F        JR      Z,+15;1BBF
1BB0 CF          RST     08
1BB1 FF          DEFB    +255;ok
;
;      REM command
1BB2 C1          POP     BC;discard
;
1BB3 CD3025      CALL    2530
1BB6 C8          RET     Z
1BB7 2A555C      LD      HL,(NXTLIN)
1BBA 3EC0        LD      A,C0
1BBC A6          AND     (HL)
1BBD C0          RET     NZ
1BBE AF          XOR     A
;
1BBF FE01        CP      01
1BC1 CE00        ADC     00
1BC3 56          LD      D,(HL)
1BC4 23          INC     HL
1BC5 5E          LD      E,(HL)
1BC6 ED53455C    LD      (PFC),DE
1BCA 23          INC     HL
1BCB 5E          LD      E,(HL)
1BCC 23          INC     HL
1BCD 56          LD      D,(HL)
1BCE EB          EX      DE,HL
1BCF 19          ADD     HL,DE
1BD0 23          INC     HL
;
1BD1 22555C      LD      (NXTLIN),HL
1BD4 EB          EX      DE,HL
1BD5 225D5C      LD      (CHADD),HL
1BD8 57          LD      D,A
1BD9 1E00        LD      E,00
1BDB FD360AFF    LD      (IY+YNSPFC),FF
1BDF 15          DEC     D
1BE0 FD720D      LD      (IY+YSUBPC),D
1BE3 CA281B      JP      Z,1B28
1BE6 14          INC     D
1BE7 CD8B19      CALL    198B
1BEA 2808        JR      Z,+8;1BF4
1BEC CF          RST     08
1BED 16          DEFB    +22;stt lost
;
1BEE CD3025      CALL    2530

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```

1BF1 C0      RET      NZ
1BF2 C1      POP      BC
1BF3 C1      POP      BC
1BF4 DF      RST      18
1BF5 FE0D    CP       CR
1BF7 28BA    JR       Z,-70;1B83
1BF9 FE3A    CP       3A      ;colon
1BFB CA281B  JP       Z,1B28
1BFE C38A1C  JP       1C8A
; command class lookup table
1C01 0F ;+00 1C10
1C02 1D ;+01 1C1F
1C03 4B ;+02 1C4E
1C04 09 ;+03 1C0D
1C05 67 ;+04 1C6C
1C06 0B ;+05 1C11
1C07 7B ;+06 1C82
1C08 8E ;+07 1C96
1C09 71 ;+08 1C7A
1C0A B4 ;+09 1CBE
1C0B 81 ;+10 1C8C
1C0C CF ;+11 1CDB
; class +03
1C0D CDDE1C  CALL     1CDE
; class +00
1C10 BF      CP       A
; class +05
1C11 C1      POP      BC
1C12 CCEE1B  CALL     Z,1BEE
1C15 EB      EX       DE,HL
;
1C16 2A745C  LD        HL,(TADDR)
1C19 4E      LD        C,(HL)
1C1A 23      INC       HL
1C1B 46      LD        B,(HL)
1C1C EB      EX       DE,HL
1C1D C5      PUSH     BC
1C1E C9      RET
; class +01
1C1F CDB228  CALL     28B2
1C22 FD363700 LD      (IY+YFLAGX),00
1C26 3008    JR       NC,+8;1C30
1C28 FDCB37CE SET     1,(IY+YFLAGX)
1C2C 2018    JR       NZ,+24;1C46
1C2E CF      RST      08
1C2F 01      DEFB     +1;variable not found
1C30 CC9629  CALL     Z,2996
1C33 FDCB0176 BIT     6,(IY+YFLAGS)
1C37 200D    JR       NZ,+13;1C46
1C39 AF      XOR      A
1C3A CD3025  CALL     2530
1C3D C4F12B  CALL     NZ,2BF1
1C40 21715C  LD        HL,FLAGX
1C43 B6      OR       (HL)
1C44 77      LD        (HL),A

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```

1C45 EB      EX      DE,HL
1C46 ED43725C LD      (STRLEN),BC
1C4A 224D5C   LD      (DEST),HL
1C4D C9      RET
; class +02
1C4E C1      POP     BC
1C4F CD561C   CALL    1C56
1C52 CDEE1B   CALL    1BEE
1C55 C9      RET
;
1C56 3A3B5C   LD      A,(FLAGS)
1C59 F5      PUSH    AF
1C5A CDFB24   CALL    24FB
1C5D F1      POP     AF
1C5E FD5601   LD      D,(IY+YFLAGS)
1C61 AA      XOR     D
1C62 E640     AND     40
1C64 2024     JR      NZ,+36;1C8A
1C66 CB7A     BIT     7,D
1C68 C2FF2A   JP      NZ,2AFF
1C6B C9      RET
; class +04
1C6C CDB228   CALL    28B2
1C6F F5      PUSH    AF
1C70 79      LD      A,C
1C71 F69F     OR      9F
1C73 3C      INC     A
1C74 2014     JR      NZ,+20;1C8A
1C76 F1      POP     AF
1C77 18A9     JR      -87;1C22
1C79 E7      RST     20
; class +08
1C7A CD821C   CALL    1C82
1C7D FE2C     CP      2C
1C7F 2009     JR      NZ,+9;1C8A
1C81 E7      RST     20
; class +06
1C82 CDFB24   CALL    24FB
1C85 FDCB0176 BIT     6,(IY+YFLAGS)
1C89 C0      RET     NZ
; => error 'nonsense in Basic'
1C8A CF      RST     08
1C8B 0B      DEFB    +11
; class +10
1C8C CDFB24   CALL    24FB
1C8F FDCB0176 BIT     6,(IY+YFLAGS)
1C93 C8      RET     Z
1C94 18F4     JR      -12;1C8A
; class +07
1C96 FDCB017E BIT     7,(IY+YFLAGS)
1C9A FDCB0286 RES     0,(IY+YTVFLG)
1C9E C44D0D   CALL    NZ,0D4D
1CA1 F1      POP     AF
1CA2 3A745C   LD      A,(TADDR)
1CA5 D613     SUB     13

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```

1CA7 CDFC21      CALL      21FC
1CAA CDEE1B      CALL      1BEE
1CAD 2A8F5C      LD        HL,(ATTRT)
1CE0 228D5C      LD        (ATTRP),HL
1CE3 21915C      LD        HL,PFLAG
1CB6 7E          LD        A,(HL)
1CB7 07          RLCA
1CB8 AE          XOR        (HL)
1CB9 E6AA        AND        AA
1CBB AE          XOR        (HL)
1CBC 77          LD        (HL),A
1CBD C9          RET
; class +09
1CBE CD3025      CALL      2530
1CC1 2813        JR        Z,+19;1CD6
1CC3 FDCB0286    RES        0,(IY+YTVFLG)
1CC7 CD4D0D      CALL      0D4D
1CCA 21905C      LD        HL,MASKT
1CCD 7E          LD        A,(HL)
1CCE F6F8        OR         F8
1CD0 77          LD        (HL),A
1CD1 FDCB57B6    RES        6,(IY+YFFLAG)
1CD5 DF          RST        18
1CD6 CDE221      CALL      21E2
1CD9 189F        JR        -97;1C7A
1CDB C30506      JP         0605
; class 0B tape handling
1CDE FE0D        CP         CR
1CE0 2804        JR        Z,+4;1CE6
1CE2 FE3A        CP         3A
1CE4 209C        JR        NZ,-100;1C82
1CE6 CD3025      CALL      2530
1CE9 C8          RET        Z
1CEA EF          RST        28
1CEB A0          DEFB      +160
1CEC 38          DEFB      +56;fp exit
1CED C9          RET
;          STOP command
1CEE CF          RST        08
1CEF 08          DEFB      +8
;          IF command
1CF0 C1          POP        BC
1CF1 CD3025      CALL      2530
1CF4 280A        JR        Z,+10;1D00
1CF6 EF          RST        28
1CF7 02          DEFB      +2;delete
1CF8 38          DEFB      +56;fp exit
1CF9 EB          EX         DE,HL
1CFA CDE934      CALL      34E9
1CFD DAB31B      JP         C,1BB3
1D00 C3291B      JP         1B29
;          FOR command
1D03 FECD        CP         CD
1D05 2009        JR        NZ,+9;1D10
1D07 E7          RST        20

```

1D08 CD821C	CALL	1C82
1D0B CDEE1B	CALL	1BEE
1D0E 1806	JR	+6;1D16
1D10 CDEE1B	CALL	1BEE
1D13 EF	RST	28
1D14 A1	DEFB	+161
1D15 38	DEFB	+56;fp exit
1D16 EF	RST	28
1D17 C0	DEFB	+192;store 0
1D18 02	DEFB	+2;delete
1D19 01	DEFB	+1;exchg
1D1A E0	DEFB	+224;get 0
1D1B 01	DEFB	+1;exchg
1D1C 38	DEFB	+56;fp exit
1D1D CDFF2A	CALL	2AFF
1D20 22685C	LD	(MEM),HL
1D23 2B	DEC	HL
1D24 7E	LD	A,(HL)
1D25 CBFE	SET	7,(HL)
1D27 010600	LD	BC,0006
1D2A 09	ADD	HL,BC
1D2B 07	RLCA	
1D2C 3806	JR	C,+6;1D34
1D2E 0E0D	LD	C,0D
1D30 CD5516	CALL	1655
1D33 23	INC	HL
1D34 E5	PUSH	HL
1D35 EF	RST	28
1D36 02	DEFB	+2;delete
1D37 02	DEFB	+2;delete
1D38 38	DEFB	+56;fp exit
1D39 E1	POP	HL
1D3A EB	EX	DE,HL
1D3B 0E0A	LD	C,0A
1D3D EDB0	LDIR	
1D3F 2A455C	LD	HL,(PPC)
1D42 EB	EX	DE,HL
1D43 73	LD	(HL),E
1D44 23	INC	HL
1D45 72	LD	(HL),D
1D46 FD560D	LD	D,(IY+YSUBPC)
1D49 14	INC	D
1D4A 23	INC	HL
1D4B 72	LD	(HL),D
1D4C CDDA1D	CALL	1DDA
1D4F D0	RET	NC
1D50 FD4638	LD	B,(IY+YSTRLN)
1D53 2A455C	LD	HL,(PPC)
1D56 22425C	LD	(NEWPPC),HL
1D59 3A475C	LD	A,(SUBPPC)
1D5C ED44	NEG	
1D5E 57	LD	D,A
1D5F 2A5D5C	LD	HL,(CHADD)
1D62 1EF3	LD	E,F3
1D64 C5	PUSH	BC

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1D65 ED4B555C   LD      BC,(NXTLIN)
1D69 CD861D     CALL    1D86
1D6C ED43555C   LD      (NXTLIN),BC
1D70 C1         POP     BC
1D71 3811       JR      C,+17;1D84
1D73 E7         RST     20
1D74 F620       OR      20
1D76 B8         CP      B
1D77 2803       JR      Z,+3;1D7C
1D79 E7         RST     20
1D7A 18E8       JR      -24;1D64
1D7C E7         RST     20
1D7D 3E01       LD      A,01
1D7F 92         SUB     D
1D80 32445C     LD      (NSPFC),A
1D83 C9         RET
;
1D84 CF         RST     08
1D85 11         DEFB    +17
1D86 7E         LD      A,(HL)
1D87 FE3A       CP      3A
1D89 2818       JR      Z,+24;1DA3
1D8B 23         INC     HL
1D8C 7E         LD      A,(HL)
1D8D E6C0       AND     C0
1D8F 37         SCF
1D90 C0         RET     NZ
1D91 46         LD      E,(HL)
1D92 23         INC     HL
1D93 4E         LD      C,(HL)
1D94 ED43425C   LD      (NEWFFC),BC
1D98 23         INC     HL
1D99 4E         LD      C,(HL)
1D9A 23         INC     HL
1D9B 46         LD      E,(HL)
1D9C E5         PUSH    HL
1D9D 09         ADD     HL,BC
1D9E 44         LD      E,H
1D9F 4D         LD      C,L
1DA0 E1         POP     HL
1DA1 1600       LD      D,00
1DA3 C5         PUSH    EC
1DA4 CD8E19     CALL    198E
1DA7 C1         POP     EC
1DA8 D0         RET     NC
1DA9 18E0       JR      -32;1D8E
;
;      NEXT command
1DAB FDCB374E   BIT     1,(IY+YFLAGX)
1DAF C22E1C     JP      NZ,1C2E
1DB2 2A4D5C     LD      HL,(DEST)
1DB5 CB7E       BIT     7,(HL)
1DB7 281F       JR      Z,+31;1DD8
1DB9 23         INC     HL
1DBA 22685C     LD      (MEM),HL
1DBD EF         RST     28

```

```

1DBE E0      DEFB      +224;get 0
1DBF E2      DEFB      +226;get 2
1DC0 0F      DEFB      +15;add
1DC1 C0      DEFB      +192;store 0
1DC2 02      DEFB      +2;delete
1DC3 38      DEFB      +56;fp exit
1DC4 CDDA1D  CALL      1DDA
1DC7 D8      RET
1DC8 2A685C  LD         HL,(MEM)
1DCB 110F00  LD         DE,000F
1DCE 19      ADD        HL,DE
1DCF 5E      LD         E,(HL)
1DD0 23      INC        HL
1DD1 56      LD         D,(HL)
1DD2 23      INC        HL
1DD3 66      LD         H,(HL)
1DD4 EB      EX         DE,HL
1DD5 C3731E  JP         1E73
;
1DD8 CF      RST        08
1DD9 00      DEFB      +0;NEXT without FOR
;
1DDA EF      RST        28
1DDB E1      DEFB      +225;get 1
1DDC E0      DEFB      +224;get 0
1DDD E2      DEFB      +226;get 2
1DDE 36      DEFB      +54;a<0
1DDF 00      DEFB      +0;j true
1DE0 02      DEFB      +2
1DE1 01      DEFB      +1;exchg
1DE2 03      DEFB      +3;subtract
1DE3 37      DEFB      +55;a>0
1DE4 00      DEFB      +0;j true
1DE5 04      DEFB      +4
1DE6 38      DEFB      +56;fp exit
1DE7 A7      AND        A;exit with NC
1DE8 C9      RET
; function list
1DE9 38      DEFB      +56;fp exit
1DEA 37      SCF        ;exit with C
1DEB C9      RET
;
1DEC E7      RST        20
; READ command
1DED CD1F1C  CALL      1C1F
1DF0 CD3025  CALL      2530
1DF3 2829    JR         Z,+41;1E1E
1DF5 DF      RST        18
1DF6 225F5C  LD         (XPTR),HL
1DF9 2A575C  LD         HL,(DATADD)
1DFC 7E      LD         A,(HL)
1DFD FE2C    CP         2C
1DFF 2809    JR         Z,+9;1E0A
1E01 1EE4    LD         E,E4
1E03 CD861D  CALL      1D86

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```

1E06 3002      JR      NC,+2;1E0A
1E08 CF        RST      08
1E09 0D        DEFB     +13;out of DATA
;
1E0A CD7700     CALL     0077
1E0D CD561C     CALL     1C56
1E10 DF        RST      18
1E11 22575C     LD       (DATADD),HL
1E14 2A5F5C     LD       HL,(XPTR)
1E17 FD362600   LD       (IY+YXPTR+1),00
1E1B CD7800     CALL     0078
1E1E DF        RST      18
1E1F FE2C       CP       2C
1E21 28C9       JR       Z,-55;1DEC
1E23 CDEE1B     CALL     1BEE
1E26 C9        RET
;      DATA command
1E27 CD3025     CALL     2530
1E2A 200B       JR       NZ,+11;1E37
1E2C CDFB24     CALL     24FB
1E2F FE2C       CP       2C
1E31 C4EE1B     CALL     NZ,1BEE
1E34 E7         RST      20
1E35 18F5       JR       -11;1E2C
;
1E37 3EE4       LD       A,E4
1E39 47         LD       B,A
1E3A EDB9       CPDR
1E3C 110002     LD       DE,0200
1E3F C38B19     JP       198E
;      RESTORE command
1E42 CD991E     CALL     1E99
1E45 60         LD       H,B
1E46 69         LD       L,C
1E47 CD6E19     CALL     196E
1E4A 2B         DEC      HL
1E4B 22575C     LD       (DATADD),HL
1E4E C9        RET
;      RANDOMIZE command
1E4F CD991E     CALL     1E99
1E52 78         LD       A,B
1E53 B1         OR       C
1E54 2004       JR       NZ,+4;1E5A
1E56 ED4B785C   LD       BC,(FRAMES)
1E5A ED43765C   LD       (SEED),BC
1E5E C9        RET
;      CONTINUE command
1E5F 2A6E5C     LD       HL,(OLDPPC)
1E62 FD5636     LD       D,(IY+YOSPPC)
1E65 180C       JR       +12;1E73
;      GO TO command
1E67 CD991E     CALL     1E99
1E6A 60         LD       H,B
1E6B 69         LD       L,C
1E6C 1600       LD       D,00

```


; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

1E6E 7C          LD      A,H
1E6F FEF0        CP      F0
1E71 302C        JR      NC,+44;1E9F
1E73 22425C      LD      (NEWPPC),HL
1E76 FD720A      LD      (IY+YNSPPC),D
1E79 C9          RET
;      OUT command
1E7A CD851E      CALL    1E85
1E7D ED79        OUT     (C),A
1E7F C9          RET
;      POKE command
1E80 CD851E      CALL    1E85
1E83 02          LD      (BC),A
1E84 C9          RET
;
1E85 CDD52D      CALL    2DD5
1E88 3815        JR      C,+21;1E9F
1E8A 2802        JR      Z,+2;1E8E
1E8C ED44        NEG
1E8E F5          PUSH    AF
1E8F CD991E      CALL    1E99
1E92 F1          POP     AF
1E93 C9          RET
;
1E94 CDD52D      CALL    2DD5
1E97 1803        JR      +3;1E9C
1E99 CDA22D      CALL    2DA2
1E9C 3801        JR      C,+1;1E9F
1E9E C8          RET     Z
1E9F CF          RST     08
1EA0 0A          DEFB    +10
;      RUN command
1EA1 CD671E      CALL    1E67
1EA4 010000      LD      BC,0000
1EA7 CD451E      CALL    1E45
1EAA 1803        JR      +3;1EAF
;      CLEAR command
1EAC CD991E      CALL    1E99
1EAF 78          LD      A,B
1EB0 B1          OR      C
1EB1 2004        JR      NZ,+4;1EB7
1EB3 ED4BB25C    LD      BC,(RAMTOP)
1EB7 C5          PUSH    BC
1EB8 ED5B4B5C    LD      DE,(VARS)
1EBC 2A595C      LD      HL,(ELINE)
1EBF 2B          DEC     HL
1EC0 CDE519      CALL    19E5
1EC3 CD6B0D      CALL    0D6B
1EC6 2A655C      LD      HL,(STKEND)
1EC9 113200      LD      DE,0032
1ECC 19          ADD     HL,DE
1ECD D1          POP     DE
1ECE ED52        SBC     HL,DE
1ED0 3008        JR      NC,+8;1EDA
1ED2 2AB45C      LD      HL,(PRAMT)

```

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

1ED5 A7      AND      A
1ED6 ED52    SBC      HL,DE
1ED8 3002    JR       NC,+2;1EDC
1EDA CF      RST      08
1EDB 15      DEFB     +21
1EDC EB      EX       DE,HL
1EDD 22B25C  LD       (RAMTOP),HL
1EE0 D1      POP      DE
1EE1 C1      POP      BC
1EE2 363E    LD       (HL),3E
1EE4 2B      DEC      HL
1EE5 F9      LD       SP,HL
1EE6 C5      PUSH     BC
1EE7 ED73D5C LD       (ERRSP),SP
1EEB EB      EX       DE,HL
1EEC E9      JP       (HL)
;           GOSUB command
1EED D1      POP      DE
1EEE FD660D  LD       H,(IY+YSUBFC)
1EF1 24      INC      H
1EF2 E3      EX       HL,(SP)
1EF3 33      INC      SP
1EF4 ED4B455C LD      BC,(PFC)
1EF8 C5      PUSH     BC
1EF9 E5      PUSH     HL
1EFA ED73D5C LD       (ERRSP),SP
1EFE D5      PUSH     DE
1EFF CD671E  CALL     1E67
1F02 011400  LD       BC,0014
1F05 2A655C  LD       HL,(STKEND)
1F08 09      ADD      HL,BC
1F09 380A    JR       C,+10;1F15
1F0B EB      EX       DE,HL
1F0C 215000  LD       HL,0050
1F0F 19      ADD      HL,DE
1F10 3803    JR       C,+3;1F15
1F12 ED72    SBC      HL,SP
1F14 D8      RET      C
1F15 2E03    LD       L,03
1F17 C35500  JP       0055
; returns BC=memory bytes in use
; can be called from Basic by USR +7962
1F1A 010000  LD       BC,0000
1F1D CD051F  CALL     1F05
1F20 44      LD       B,H
1F21 4D      LD       C,L
1F22 C9      RET
;           RETURN command
1F23 C1      POP      BC
1F24 E1      POP      HL
1F25 D1      POP      DE
1F26 7A      LD       A,D
1F27 FE3E    CP       3E
1F29 280B    JR       Z,+11;1F36
1F2B 3B      DEC      SP      ;???

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; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

1F2C E3      EX      HL,(SP)
1F2D EB      EX      DE,HL
1F2E ED73D5C LD      (ERRSP),SP
1F32 C5      PUSH    BC
1F33 C3731E   JP      1E73
;
1F36 D5      PUSH    DE
1F37 E5      PUSH    HL
; error 'return without gosub'
1F38 CF      RST      08
1F39 06      DEFB     +6
;
; PAUSE command
1F3A CD991E   CALL    1E99
1F3D 76      HALT
1F3E 0B      DEC      BC
1F3F 78      LD      A,B
1F40 B1      OR       C
1F41 280C     JR      Z,+12;1F4F
1F43 78      LD      A,B
1F44 A1      AND      C
1F45 3C      INC      A
1F46 2001     JR      NZ,+1;1F49
1F48 03      INC      BC
; test if key pressed
1F49 FDCB016E BIT     5,(IY+YFLAGS)
1F4D 28EE     JR      Z,-18;1F3D
1F4F FDCB01AE RES     5,(IY+YFLAGS)
1F53 C9      RET
; subroutine to test for Break key
; returns NC if Break (shift+space)
1F54 BREAK ;
1F54 3E7F     LD      A,7F
1F56 DBFE     IN      A,(FE)
1F58 1F      RRA
1F59 D8      RET      C
1F5A 3EFE     LD      A,FE
1F5C DBFE     IN      A,(FE)
1F5E 1F      RRA
1F5F C9      RET
;
; DEF FN command
1F60 CD3025   CALL    2530
1F63 2805     JR      Z,+5;1F6A
1F65 3ECE     LD      A,CE
1F67 C3391E   JP      1E39
;
1F6A FDCB01F6 SET     6,(IY+YFLAGS)
1F6E CD8D2C   CALL    2C8D
1F71 3016     JR      NC,+22;1F89
1F73 E7      RST      20
1F74 FE24     CP      '$'
1F76 2005     JR      NZ,+5;1F7D
1F78 FDCB01B6 RES     6,(IY+YFLAGS)
1F7C E7      RST      20
1F7D FE28     CP      '('
1F7F 203C     JR      NZ,+60;1FBD

```

```

1F81 E7      RST      20
1F82 FE29    CP       ')'
1F84 2820    JR        Z,+32;1FA6
1F86 CD8D2C  CALL     2C8D
1F89 D28A1C  JP       NC,1C8A
1F8C EB      EX       DE,HL
1F8D E7      RST      20
1F8E FE24    CP       '$'
1F90 2002    JR        NZ,+2;1F94
1F92 EB      EX       DE,HL
1F93 E7      RST      20
1F94 EB      EX       DE,HL
1F95 010600  LD        BC,0006
1F98 CD5516  CALL     1655
1F9B 23      INC      HL
1F9C 23      INC      HL
1F9D 360E    LD        (HL),0E
1F9F FE2C    CP       2C;comma
1FA1 2003    JR        NZ,+3;1FA6
1FA3 E7      RST      20
1FA4 18E0    JR        -32;1F86
1FA6 FE29    CP       ')'
1FA8 2013    JR        NZ,+19;1FBD
1FAA E7      RST      20
1FAB FE3D    CP       '='
1FAD 200E    JR        NZ,+14;1FBD
1FAF E7      RST      20
1FB0 3A3B5C  LD        A,(FLAGS)
1FB3 F5      PUSH     AF
1FB4 CDFB24  CALL     24FB
1FB7 F1      POP      AF
1FB8 FDAE01  XOR       (IY+YFLAGS)
1FBB E640    AND      40
1FBD C28A1C  JP       NZ,1C8A
1FC0 CDEE1B  CALL     1BEE
1FC3 CD3025  CALL     2530
1FC6 E1      POP      HL
1FC7 C8      RET      Z
1FC8 E9      JP       (HL)
;          LPRINT command
1FC9 3E03    LD        A,03;printer
1FCB 1802    JR        +2;1FCF
;          PRINT command
1FCD 3E02    LD        A,02;screen
1FCF CD3025  CALL     2530
1FD2 C40116  CALL     NZ,SELDEV
1FD5 CD4D0D  CALL     0D4D
1FD8 CDDF1F  CALL     1FDF
1FDB CDEE1B  CALL     1BEE
1FDE C9      RET
; get char to print
1FDF DF      RST      18
1FE0 CD4520  CALL     2045
1FE3 280D    JR        Z,+13;1FF2
1FE5 CD4E20  CALL     204E

```

```

1FE8 28FB      JR      Z,-5;1FE5
1FEA CD4C1F    CALL    1FFC
1FED CD4E20    CALL    204E
1FF0 28F3      JR      Z,-13;1FE5
1FF2 FE29      CP      ')'
1FF4 C8        RET     Z
1FF5 CDC31F    CALL    1FC3
1FF8 3E0D      LD      A,CR
1FFA D7        RST     10
1FFB C9        RET
;
1FFC DF        RST     18
1FFD FEAC      CP      AC;'AT' token
1FFF 200D      JR      NZ,+13;200E
2001 CD791C    CALL    1C79
2004 CDC31F    CALL    1FC3
2007 CD0723    CALL    2307
200A 3E16      LD      A,16;'AT' control
200C 1810      JR      +16;201E
200E FEAD      CP      AD;'TAB' token
2010 2012      JR      NZ,+18;2024
2012 E7        RST     20
2013 CD821C    CALL    1C82
2016 CDC31F    CALL    1FC3
2019 CD991E    CALL    1E99
201C 3E17      LD      A,17;'TAB' control
201E D7        RST     10
201F 79        LD      A,C
2020 D7        RST     10
2021 78        LD      A,B
2022 D7        RST     10
2023 C9        RET
;
2024 CDF221    CALL    21F2
2027 D0        RET     NC
2028 CD7020    CALL    2070
202B D0        RET     NC
202C CDFB24    CALL    24FB
202F CDC31F    CALL    1FC3
2032 FDCB0176  BIT     6,(IY+YFLAGS)
2036 CCF12B    CALL    Z,2BF1
2039 C2E32D    JP      NZ,2DE3
203C 78        LD      A,B
203D B1        OR      C
203E 0B        DEC     BC
203F C8        RET     Z
2040 1A        LD      A,(DE)
2041 13        INC     DE
2042 D7        RST     10
2043 18F7      JR      -9;203C
2045 FE29      CP      ')'
2047 C8        RET     Z
2048 FE0D      CP      CR
204A C8        RET     Z
204B FE3A      CP      3A;colon

```

```

204D C9          RET
;
204E DF          RST      18
204F FE3B        CP       3B;semicolon
2051 2814        JR       Z,+20;2067
2053 FE2C        CP       2C;comma
2055 200A        JR       NZ,+10;2061
2057 CD3025      CALL     2530
205A 280B        JR       Z,+11;2067
205C 3E06        LD       A,06;print comma
205E D7          RST      10
205F 1806        JR       +6;2067
2061 FE27        CP       27;apostrophe
2063 C0          RET      NZ
2064 CDF51F      CALL     1FF5
2067 E7          RST      20
2068 CD4520      CALL     2045
206B 2001        JR       NZ,+1;206E
206D C1          POP      BC
206E BF          CP       A
206F C9          RET
;
2070 FE23        CP       23
2072 37          SCF
2073 C0          RET      NZ
2074 E7          RST      20
2075 CD821C      CALL     1C82
2078 A7          AND      A
2079 CDC31F      CALL     1FC3
207C CD941E      CALL     1E94
207F FE10        CP       10
2081 D20E16      JP       NC,160E
2084 CD0116      CALL     SELDEV
2087 A7          AND      A
2088 C9          RET
;
      INPUT command
2089 CD3025      CALL     2530
208C 2808        JR       Z,+8;2096
208E 3E01        LD       A,01
2090 CD0116      CALL     SELDEV
2093 CD6E0D      CALL     0D6E
2096 FD360201    LD       (IY+YTVFLG),01
209A CDC120      CALL     20C1
209D CDEE1B      CALL     1BEE
20A0 ED4B885C    LD       BC,(SPOSN)
20A4 3A6B5C      LD       A,(DFSZ)
20A7 B8          CP       B
20A8 3803        JR       C,+3;20AD
20AA 0E21        LD       C,21
20AC 47          LD       B,A
20AD ED43885C    LD       (SPOSN),BC
20B1 3E19        LD       A,19
20B3 90          SUB      B
20B4 328C5C      LD       (SCRCT),A
20B7 FDCB0286    RES      0,(IY+YTVFLG)

```

```

20BE CDD90D    CALL    CURSOR
20BE C36E0D    JP      0D6E
;
20C1 CD4E20    CALL    204E
20C4 28FE      JR      Z,-5;20C1
20C6 FE28      CP      '('
20C8 200E      JR      NZ,+14;20D8
20CA E7        RST     20
20CB CDDF1F    CALL    1FDF
20CE DF        RST     18
20CF FE29      CP      ')'
20D1 C28A1C    JP      NZ,1C8A
20D4 E7        RST     20
20D5 C3B221    JP      21B2
;
20D8 FECA      CP      CA;'LINE' token
20DA 2011      JR      NZ,+17;20ED
20DC E7        RST     20
20DD CD1F1C    CALL    1C1F
20E0 FDCB37FE  SET     7,(IY+YFLAGX)
20E4 FDCB0176  BIT     6,(IY+YFLAGS)
20E8 C28A1C    JP      NZ,1C8A
20EB 180D      JR      +13;20FA
;
20ED CD8D2C    CALL    2C8D
20F0 D2AF21    JP      NC,21AF
20F3 CD1F1C    CALL    1C1F
20F6 FDCB37BE  RES     7,(IY+YFLAGX)
20FA CD3025    CALL    2530
20FD CAB221    JP      Z,21B2
2100 CDBF16    CALL    16BF
2103 21715C    LD      HL,FLAGX
2106 CBB6      RES     6,(HL)
2108 CBEE      SET     5,(HL)
210A 010100    LD      BC,0001
210D CB7E      BIT     7,(HL)
210F 200E      JR      NZ,+11;211C
2111 3A3B5C    LD      A,(FLAGS)
2114 E640      AND     40
2116 2002      JR      NZ,+2;211A
2118 0E03      LD      C,03
211A B6        OR      (HL)
211E 77        LD      (HL),A
211C F7        RST     30
211D 360D      LD      (HL),0D
211F 79        LD      A,C
2120 0F        RRCA
2121 0F        RRCA
2122 3005      JR      NC,+5;2129
2124 3E22      LD      A,22
2126 12        LD      (DE),A
2127 2B        DEC     HL
2128 77        LD      (HL),A
2129 225B5C    LD      (KCUR),HL
212C FDCB377E  BIT     7,(IY+YFLAGX)

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```

2130 202C      JR      NZ,+44;215E
2132 2A5D5C    LD      HL,(CHADD)
2135 E5        PUSH    HL
2136 2A3D5C    LD      HL,(ERRSP)
2139 E5        PUSH    HL
213A 213A21    LD      HL,213A
213D E5        PUSH    HL
213E FDCB3066  BIT      4,(IY+YFLGS2)
2142 2804      JR      Z,+4;2148
2144 ED733D5C  LD      (ERRSP),SP
2148 2A615C    LD      HL,(WORKSP)
214B CDA711    CALL    11A7
214E FD3600FF  LD      (IY+YERRNR),FF
2152 CD2C0F    CALL    GETLIN
2155 FDCB01BE  RES      7,(IY+YFLAGS)
2159 CDB921    CALL    21B9
215C 1803      JR      +3;2161
215E CD2C0F    CALL    GETLIN
2161 FD362200  LD      (IY+YKCUR+1),00
2165 CDD621    CALL    21D6
2168 200A      JR      NZ,+10;2174
216A CD1D11    CALL    111D
216D ED4B825C  LD      BC,(ECHOE)
2171 CDD90D    CALL    CURSOR
2174 21715C    LD      HL,FLAGX
2177 CBAE      RES      5,(HL)
2179 CB7E      BIT      7,(HL)
217B CBBE      RES      7,(HL)
217D 201C      JR      NZ,+28;219B
217F E1        POP      HL
2180 E1        POP      HL
2181 223D5C    LD      (ERRSP),HL
2184 E1        POP      HL
2185 225F5C    LD      (XPTR),HL
2188 FDCB01FE  SET      7,(IY+YFLAGS)
218C CDB921    CALL    21B9
218F 2A5F5C    LD      HL,(XPTR)
2192 FD362600  LD      (IY+XPTR+1),00
2196 225D5C    LD      (CHADD),HL
2199 1817      JR      +23;21B2
;
219B 2A635C    LD      HL,(STKBOT)
219E ED5B615C  LD      DE,(WORKSP)
21A2 37        SCF
21A3 ED52      SBC      HL,DE
21A5 44        LD      B,H
21A6 4D        LD      C,L
21A7 CDB22A    CALL    2AB2
21AA CDFF2A    CALL    2AFF
21AD 1803      JR      +3;21B2
21AF CDFC1F    CALL    1FFC
21B2 CD4E20    CALL    204E
21B5 CAC120    JP      Z,20C1
21B8 C9        RET
;

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```

21B9 2A615C      LD      HL,(WORKSP)
21BC 225D5C      LD      (CHADD),HL
21BF DF         RST      18
21C0 FEE2       CP      E2;'STOP' token
21C2 280C       JR      Z,+12;21D0
21C4 3A715C     LD      A,(FLAGX)
21C7 CD591C     CALL    1C59
21CA DF         RST      18
21CB FE0D       CP      CR
21CD C8         RET      Z
21CE CF         RST      08
21CF 0B         DEFB     +11;nonsense
21D0 CD3025     CALL    2530
21D3 C8         RET      Z
21D4 CF         RST      08
21D5 10         DEFB     +16;STOP in INPUT
; test current channel for 'K'
21D6 2A515C     LD      HL,(CURCHL)
21D9 23         INC      HL
21DA 23         INC      HL
21DB 23         INC      HL
21DC 23         INC      HL
21DD 7E         LD      A,(HL)
21DE FE4B       CP      'K'
21E0 C9         RET
;
21E1 E7         RST      20
21E2 CDF221     CALL    21F2
21E5 D8         RET      C
21E6 DF         RST      18
21E7 FE2C       CP      2C;comma
21E9 28F6       JR      Z,-10;21E1
21EB FE3B       CP      3B;semicolon
21ED 28F2       JR      Z,-14;21E1
21EF C38A1C     JP      1C8A;nonsense
;
21F2 FED9       CP      D9;'INK'...
21F4 D8         RET      C
21F5 FEDF       CP      DF;...'OVER'+1
21F7 3F         CCF
21F8 D8         RET      C
21F9 F5         PUSH     AF
21FA E7         RST      20
21FB F1         POP      AF
21FC D6C9       SUB      C9;makes ctrl char
21FE F5         PUSH     AF
21FF CD821C     CALL    1C82
2202 F1         POP      AF
2203 A7         AND      A
2204 CDC31F     CALL    1FC3
2207 F5         PUSH     AF
2208 CD941E     CALL    1E94
220B 57         LD      D,A
220C F1         POP      AF
220D D7         RST      10

```

220E 7A	LD	A,D
220F D7	RST	10
2210 C9	RET	
;		
2211 D611	SUB	11
2213 CE00	ADC	00
2215 281D	JR	Z,+29;2234
2217 D602	SUB	02
2219 CE00	ADC	00
221B 2856	JR	Z,+86;2273
221D FE01	CP	01
221F 7A	LD	A,D
2220 0601	LD	B,01
2222 2004	JR	NZ,+4;2228
2224 07	RLCA	
2225 07	RLCA	
2226 0604	LD	B,04
2228 4F	LD	C,A
2229 7A	LD	A,D
222A FE02	CP	02
222C 3016	JR	NC,+22;2244
222E 79	LD	A,C
222F 21915C	LD	HL,PFLAG
2232 1838	JR	+56;226C
2234 7A	LD	A,D
2235 0607	LD	E,07
2237 3805	JR	C,+5;223E
2239 07	RLCA	
223A 07	RLCA	
223B 07	RLCA	
223C 0638	LD	B,38
223E 4F	LD	C,A
223F 7A	LD	A,D
2240 FE0A	CP	0A
2242 3802	JR	C,+2;2246
2244 CF	RST	08
2245 13	DEFB	+19;inv colour
2246 218F5C	LD	HL,ATTR
2249 FE08	CP	08
224B 380B	JR	C,+11;2258
224D 7E	LD	A,(HL)
224E 2807	JR	Z,+7;2257
2250 B0	OR	B
2251 2F	CPL	
2252 E624	AND	24
2254 2801	JR	Z,+1;2257
2256 78	LD	A,B
2257 4F	LD	C,A
2258 79	LD	A,C
2259 CD6C22	CALL	226C
225C 3E07	LD	A,07
225E BA	CP	D
225F 9F	SBC	A
2260 CD6C22	CALL	226C
2263 07	RLCA	

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```

2264 07      RLCA
2265 E650    AND      50
2267 47      LD       B,A
2268 3E08    LD       A,08
226A BA      CP       D
226B 9F      SBC      A
226C AE      XOR      (HL)
226D A0      AND      B
226E AE      XOR      (HL)
226F 77      LD       (HL),A
2270 23      INC      HL
2271 78      LD       A,B
2272 C9      RET
;
2273 9F      SBC      A
2274 7A      LD       A,D
2275 0F      RRCA
2276 0680    LD       B,80
2278 2003    JR       NZ,+3;227D
227A 0F      RRCA
227B 0640    LD       B,40
227D 4F      LD       C,A
227E 7A      LD       A,D
227F FE08    CP       08
2281 2804    JR       Z,+4;2287
2283 FE02    CP       02
2285 30BD    JR       NC,-67;2244
2287 79      LD       A,C
2288 218F5C  LD       HL,ATTRT
228B CD6C22  CALL     226C
228E 79      LD       A,C
228F 0F      RRCA
2290 0F      RRCA
2291 0F      RRCA
2292 18D8    JR       -40;226C
;
2294 CD941E  CALL     1E94
2297 FE08    CP       08
2299 30A9    JR       NC,-87;2244
229B D3FE    OUT      (FE),A
229D 07      RLCA
229E 07      RLCA
229F 07      RLCA
22A0 CB6F    BIT      5,A
22A2 2002    JR       NZ,+2;22A6
22A4 EE07    XOR      07
22A6 32485C  LD       (BORDCR),A
22A9 C9      RET
;
22AA 3EAF    LD       A,AF
22AC 90      SUB      B
22AD DAF924  JP       C,24F9
22B0 47      LD       B,A
22B1 A7      AND      A
22B2 1F      RRA

```

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

22B3 37      SCF
22B4 1F      RRA
22B5 A7      AND      A
22B6 1F      RRA
22B7 A8      XOR      B
22B8 E6F8    AND      FB
22BA A8      XOR      B
22BB 67      LD      H,A
22BC 79      LD      A,C
22BD 07      RLCA
22BE 07      RLCA
22BF 07      RLCA
22C0 A8      XOR      B
22C1 E6C7    AND      C7
22C3 A8      XOR      B
22C4 07      RLCA
22C5 07      RLCA
22C6 6F      LD      L,A
22C7 79      LD      A,C
22C8 E607    AND      07
22CA C9      RET
;
22CB CD0723  CALL     2307
22CE CDAA22  CALL     22AA
22D1 47      LD      B,A
22D2 04      INC     B
22D3 7E      LD      A,(HL)
22D4 07      RLCA
22D5 10FD    DJNZ    -3;22D4
22D7 E601    AND     01
22D9 C3282D  JP      2D28
;          PLOT command
22DC CD0723  CALL     2307
22DF CDE522  CALL     22E5
22E2 C34D0D  JP      0D4D
; plot point at E=row C=column
22E5 ED437D5C LD      (COORDX),BC
22E9 CDAA22  CALL     22AA
22EC 47      LD      B,A
22ED 04      INC     B
22EE 3EFE    LD      A,FE
22F0 0F      RRCA
22F1 10FD    DJNZ    -3;22F0
22F3 47      LD      B,A
22F4 7E      LD      A,(HL)
22F5 FD4E57  LD      C,(IY+YPFLAG)
22F8 CB41    BIT     0,C
22FA 2001    JR      NZ,+1;22FD
22FC A0      AND     B
22FD CB51    BIT     2,C
22FF 2002    JR      NZ,+2;2303
2301 A8      XOR     B
2302 2F      CPL
2303 77      LD      (HL),A
2304 C3DB0B  JP      0BDB

```

```

;
2307 CD1423      CALL      2314
230A 47          LD        B,A
230B C5          PUSH     BC
230C CD1423      CALL      2314
230F 59          LD        E,C
2310 C1          POP      BC
2311 51          LD        D,C
2312 4F          LD        C,A
2313 C9          RET
;
2314 CDD52D      CALL      2DD5
2317 DAF924      JP        C,24F9
231A 0E01      LD        C,01
231C C8          RET       Z
231D 0EFF      LD        C,FF
231F C9          RET
;      CIRCLE command
2320 DF          RST       18
2321 FE2C      CP        2C;comma
2323 C28A1C      JP        NZ,1C8A
2326 E7          RST       20
2327 CD821C      CALL      1C82
232A CDEE1B      CALL      1BEE
232D EF          RST       28
232E 2A          DEFB     +42;ABS
232F 3D          DEFB     +61;restack
2330 38          DEFB     +56;fp exit
2331 7E          LD        A,(HL)
2332 FE81      CP        81
2334 3005      JR        NC,+5;233B
2336 EF          RST       28
2337 02          DEFB     +2;delete
2338 38          DEFB     +56;fp exit
2339 18A1      JR        -95;22DC
;
233B EF          RST       28
233C A3          DEFB     +163
233D 38          DEFB     +56;fp exit
233E 3683      LD        (HL),83
2340 EF          RST       28
2341 C5          DEFB     +197;store 5
2342 02          DEFB     +2;delete
2343 38          DEFB     +56;fp exit
2344 CD7D24      CALL      247D
2347 C5          PUSH     BC
2348 EF          RST       28
2349 31          DEFB     +49;copy
234A E1          DEFB     +225;get 1
234B 04          DEFB     +4;multiply
234C 38          DEFB     +56;fp exit
234D 7E          LD        A,(HL)
234E FE80      CP        80
2350 3008      JR        NC,+8;235A
2352 EF          RST       28

```

```

2353 02      DEFB      +2;delete
2354 02      DEFB      +2;delete
2355 38      DEFB      +56;fp exit
2356 C1      POP       BC
2357 C3DC22  JP        22DC
;
235A EF      RST       28
235B C2      DEFB      +194;store 2
235C 01      DEFB      +1;exchg
235D C0      DEFB      +192;store 0
235E 02      DEFB      +2;delete
235F 03      DEFB      +3;subtract
2360 01      DEFB      +1;exchg
2361 E0      DEFB      +224;get 0
2362 0F      DEFB      +15;add
2363 C0      DEFB      +192;store 0
2364 01      DEFB      +1;exchg
2365 31      DEFB      +49;copy
2366 E0      DEFB      +224;get 0
2367 01      DEFB      +1;exchg
2368 31      DEFB      +49;copy
2369 E0      DEFB      +224;get 0
236A A0      DEFB      +160
236B C1      DEFB      +193;store 1
236C 02      DEFB      +2;delete
236D 38      DEFB      +56;fp exit
236E FD3462  INC       (IY+YMEMBT+10)
2371 CD941E  CALL      1E94
2374 6F      LD        L,A
2375 E5      PUSH      HL
2376 CD941E  CALL      1E94
2379 E1      POP       HL
237A 67      LD        H,A
237B 227D5C  LD        (COORDX),HL
237E C1      POP       BC
237F C32024  JP        2420
;      DRAW command
2382 DF      RST       18
2383 FE2C    CP        2C
2385 2806    JR        Z,+6;238D
2387 CDEE1B  CALL      1BEE
238A C37724  JP        2477
;
238D E7      RST       20
238E CD821C  CALL      1C82
2391 CDEE1B  CALL      1BEE
2394 EF      RST       28
2395 C5      DEFB      +197;store 5
2396 A2      DEFB      +162
2397 04      DEFB      +4;multiply
2398 1F      DEFB      +31;SIN
2399 31      DEFB      +49;copy
239A 30      DEFB      +48;NOT
239B 30      DEFB      +48;NOT
239C 00      DEFB      +0;j true

```

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

239D 06      DEFB      +6
239E 02      DEFB      +2;delete
239F 38      DEFB      +56;fp exit
23A0 C37724  JP        2477
; function list
23A3 C0      DEFB      +192;store 0
23A4 02      DEFB      +2;delete
23A5 C1      DEFB      +193;store 1
23A6 02      DEFB      +2;delete
23A7 31      DEFB      +49;copy
23A8 2A      DEFB      +42;ABS
23A9 E1      DEFB      +225;get 1
23AA 01      DEFB      +1;exchg
23AB E1      DEFB      +225;get 1
23AC 2A      DEFB      +42;ABS
23AD 0F      DEFB      +15;add
23AE E0      DEFB      +224;get 0
23AF 05      DEFB      +5;divide
23B0 2A      DEFB      +42;ABS
23B1 E0      DEFB      +224;get 0
23B2 01      DEFB      +1;exchg
23B3 3D      DEFB      +61;restack
23B4 38      DEFB      +56;fp exit
23B5 7E      LD        A,(HL)
23B6 FE81    CP        81
23B8 3007    JR        NC,+7;23C1
;
23BA EF      RST       28
23BB 02      DEFB      +2;delete
23BC 02      DEFB      +2;delete
23BD 38      DEFB      +56;fp exit
23BE C37724  JP        2477
;
23C1 CD7D24  CALL      247D
23C4 C5      PUSH      BC
23C5 EF      RST       28
23C6 02      DEFB      +2;delete
23C7 E1      DEFB      +225;get 1
23C8 01      DEFB      +1;exchg
23C9 05      DEFB      +5;divide
23CA C1      DEFB      +193;store 1
23CB 02      DEFB      +2;delete
23CC 01      DEFB      +1;exchg
23CD 31      DEFB      +49;copy
23CE E1      DEFB      +225;get 1
23CF 04      DEFB      +4;multiply
23D0 C2      DEFB      +194;store 2
23D1 02      DEFB      +2;delete
23D2 01      DEFB      +1;exchg
23D3 31      DEFB      +49;copy
23D4 E1      DEFB      +225;get 1
23D5 04      DEFB      +4;multiply
23D6 E2      DEFB      +226;get 2
23D7 E5      DEFB      +229;get 5
23D8 E0      DEFB      +224;get 0

```

23D9 03	DEFB	+3;subtract
23DA A2	DEFB	+162
23DB 04	DEFB	+4;multiply
23DC 31	DEFB	+49;copy
23DD 1F	DEFB	+31;SIN
23DE C5	DEFB	+197;store 5
23DF 02	DEFB	+2;delete
23E0 20	DEFB	+32;COS
23E1 C0	DEFB	+192;store 0
23E2 02	DEFB	+2;delete
23E3 C2	DEFB	+194;store 2
23E4 02	DEFB	+2;delete
23E5 C1	DEFB	+193;store 1
23E6 E5	DEFB	+229;get 5
23E7 04	DEFB	+4;multiply
23E8 E0	DEFB	+224;get 0
23E9 E2	DEFB	+226;get 2
23EA 04	DEFB	+4;multiply
23EB 0F	DEFB	+15;add
23EC E1	DEFB	+225;get 1
23ED 01	DEFB	+1;exchg
23EE C1	DEFB	+193;store 1
23EF 02	DEFB	+2;delete
23F0 E0	DEFB	+224;get 0
23F1 04	DEFB	+4;multiply
23F2 E2	DEFB	+226;get 2
23F3 E5	DEFB	+229;get 5
23F4 04	DEFB	+4;multiply
23F5 03	DEFB	+3;subtract
23F6 C2	DEFB	+194;store 2
23F7 2A	DEFB	+42;ABS
23F8 E1	DEFB	+225;get 1
23F9 2A	DEFB	+42;ABS
23FA 0F	DEFB	+15;add
23FB 02	DEFB	+2;delete
23FC 38	DEFB	+56;fp exit
23FD 1A	LD	A,(DE)
23FE FE81	CP	81
2400 C1	POP	BC
2401 DA7724	JP	C,2477
;		
2404 C5	PUSH	BC
2405 EF	RST	28
2406 01	DEFB	+1;exchg
2407 38	DEFB	+56;fp exit
2408 3A7D5C	LD	A,(COORDX)
240B CD282D	CALL	2D28
240E EF	RST	28
240F C0	DEFB	+192;store 0
2410 0F	DEFB	+15;add
2411 01	DEFB	+1;exchg
2412 38	DEFB	+56;fp exit
2413 3A7E5C	LD	A,(COORDY)
2416 CD282D	CALL	2D28
2419 EF	RST	28


```

241A C5      DEFB      +197;store 5
241B 0F      DEFB      +15;add
241C E0      DEFB      +224;get 0
241D E5      DEFB      +229;get 5
241E 38      DEFB      +56;fp exit
241F C1      POP       BC
;
2420 05      DEC       B
2421 283C    JR        Z,+60;245F
2423 1814    JR        +20;2439
2425 EF      RST       28
2426 E1      DEFB      +225;get 1
2427 31      DEFB      +49;copy
2428 E3      DEFB      +227;get 3
2429 04      DEFB      +4;multiply
242A E2      DEFB      +226;get 2
242B E4      DEFB      +228;get 4
242C 04      DEFB      +4;multiply
242D 03      DEFB      +3;subtract
242E C1      DEFB      +193;store 1
242F 02      DEFB      +2;delete
2430 E4      DEFB      +228;get 4
2431 04      DEFB      +4;multiply
2432 E2      DEFB      +226;get 2
2433 E3      DEFB      +227;get 3
2434 04      DEFB      +4;multiply
2435 0F      DEFB      +15;add
2436 C2      DEFB      +194;store 2
2437 02      DEFB      +2;delete
2438 38      DEFB      +56;fp exit
;
2439 C5      PUSH      BC
243A EF      RST       28
243B C0      DEFB      +192;store 0
243C 02      DEFB      +2;delete
243D E1      DEFB      +225;get 1
243E 0F      DEFB      +15;add
243F 31      DEFB      +49;copy
2440 38      DEFB      +56;fp exit
2441 3A7D5C  LD        A,(COORDX)
2444 CD282D  CALL      2D28
2447 EF      RST       28
2448 03      DEFB      +3;subtract
2449 E0      DEFB      +224;get 0
244A E2      DEFB      +226;get 2
244B 0F      DEFB      +15;add
244C C0      DEFB      +192;store 0
244D 01      DEFB      +1;exchg
244E E0      DEFB      +224;get 0
244F 38      DEFB      +56;fp exit
2450 3A7E5C  LD        A,(COORDY)
2453 CD282D  CALL      2D28
2456 EF      RST       28
2457 03      DEFB      +3;subtract
2458 38      DEFB      +56;fp exit

```

```

2459 CDB724    CALL    24B7
245C C1        POP     EC
245D 10C6      DJNZ    -58;2425
;
245F EF        RST     28
2460 02        DEFB    +2;delete
2461 02        DEFB    +2;delete
2462 01        DEFB    +1;exchg
2463 38        DEFB    +56;fp exit
2464 3A7D5C    LD      A,(COORDX)
2467 CD282D    CALL    2D28
246A EF        RST     28
246B 03        DEFB    +3;subtract
246C 01        DEFB    +1;exchg
246D 38        DEFB    +56;fp exit
246E 3A7E5C    LD      A,(COORDY)
2471 CD282D    CALL    2D28
2474 EF        RST     28
2475 03        DEFB    +3;subtract
2476 38        DEFB    +56;fp exit
2477 CDB724    CALL    24B7
247A C34D0D    JP      0D4D
;
247D EF        RST     28
247E 31        DEFB    +49;copy
247F 28        DEFB    +40;SQR
2480 34        DEFB    +52;literal
2481 3200      DEFB    +50,+0
2483 01        DEFB    +1;exchg
2484 05        DEFB    +5;divide
2485 E5        DEFB    +229;get 5
2486 01        DEFB    +1;exchg
2487 05        DEFB    +5;divide
2488 2A        DEFB    +42;ABS
2489 38        DEFB    +56;fp exit
248A CDD52D    CALL    2DD5
248D 3806      JR      C,+6;2495
248F E6FC      AND     FC
2491 C604      ADD     04
2493 3002      JR      NC,+2;2497
;
2495 3EFC      LD      A,FC
2497 F5        PUSH    AF
2498 CD282D    CALL    2D28
249B EF        RST     28
249C E5        DEFB    +229;get 5
249D 01        DEFB    +1;exchg
249E 05        DEFB    +5;divide
249F 31        DEFB    +49;copy
24A0 1F        DEFB    +31;SIN
24A1 C4        DEFB    +196;store 4
24A2 02        DEFB    +2;delete
24A3 31        DEFB    +49;copy
24A4 A2        DEFB    +162
24A5 04        DEFB    +4;multiply

```

```

24A6 1F      DEFB      +31;SIN
24A7 C1      DEFB      +193;store 1
24A8 01      DEFB      +1;exchg
24A9 C0      DEFB      +192;store 0
24AA 02      DEFB      +2;delete
24AB 31      DEFB      +49;copy
24AC 04      DEFB      +4;multiply
24AD 31      DEFB      +49;copy
24AE 0F      DEFB      +15;add
24AF A1      DEFB      +161
24B0 03      DEFB      +3;subtract
24B1 1B      DEFB      +27;negate
24B2 C3      DEFB      +195;store 3
24B3 02      DEFB      +2;delete
24B4 38      DEFB      +56;fp exit
24B5 C1      POP       BC
24B6 C9      RET
;
24B7 CD0723  CALL      2307
24BA 79      LD        A,C
24BB B8      CP        B
24BC 3006    JR        NC,+6;24C4
24BE 69      LD        L,C
24BF D5      PUSH      DE
24C0 AF      XOR       A
24C1 5F      LD        E,A
24C2 1807    JR        +7;24CB
24C4 B1      OR        C
24C5 C8      RET       Z
24C6 68      LD        L,B
24C7 41      LD        B,C
24C8 D5      PUSH      DE
24C9 1600    LD        D,00
24CB 60      LD        H,B
24CC 78      LD        A,B
24CD 1F      RRA
24CE 85      ADD       L
24CF 3803    JR        C,+3;24D4
24D1 BC      CP        H
24D2 3807    JR        C,+7;24DB
24D4 94      SUB       H
24D5 4F      LD        C,A
24D6 D9      EXX
24D7 C1      POP       BC
24D8 C5      PUSH      BC
24D9 1804    JR        +4;24DF
24DB 4F      LD        C,A
24DC D5      PUSH      DE
24DD D9      EXX
24DE C1      POP       BC
24DF 2A7D5C  LD        HL,(COORDX)
24E2 78      LD        A,B
24E3 84      ADD       H
24E4 47      LD        B,A
24E5 79      LD        A,C

```

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

24E6 3C      INC      A
24E7 85      ADD      L
24E8 380D    JR       C,+13;24F7
24EA 280D    JR       Z,+13;24F9
24EC 3D      DEC      A
24ED 4F      LD       C,A
24EE CDE522  CALL     22E5
24F1 D9      EXX
24F2 79      LD       A,C
24F3 10D9    DJNZ     -39;24CE
24F5 D1      POP      DE
24F6 C9      RET
;
24F7 28F3    JR       Z,-13;24EC
24F9 CF      RST      08
24FA 0A      DEFB     +10;int out of range
; evaluate expressions
24FB DF      RST      18
24FC 0600    LD       B,00
24FE C5      PUSH     BC
24FF 4F      LD       C,A
2500 219625  LD       HL,2596
2503 CDDC16  CALL     16DC
2506 79      LD       A,C
2507 D28426  JP       NC,2684
250A 0600    LD       B,00
250C 4E      LD       C,(HL)
250D 09      ADD      HL,BC
250E E9      JP       (HL)
; check for matching quotes
250F CD7400  CALL     0074
2512 03      INC      BC
2513 FE0D    CP       CR
2515 CA8A1C  JP       Z,1C8A;nonsense
2518 FE22    CP       22;quote
251A 20F3    JR       NZ,-13;250F
251C CD7400  CALL     0074
251F FE22    CP       22;quote
2521 C9      RET
; check for bracketed params
2522 E7      RST      20
2523 FE28    CP       '('
2525 2006    JR       NZ,+6;252D
2527 CD791C  CALL     1C79
252A DF      RST      18
252B FE29    CP       ')'
252D C28A1C  JP       NZ,1C8A;nonsense
; test for syntax mode or RUN mode
2530 FDCB017E BIT      7,(IY+YFLAGS)
2534 C9      RET
;      SCREEN$
2535 CD0723  CALL     2307
2538 2A365C  LD       HL,(CHARS)
253B 110001  LD       DE,0100
253E 19      ADD      HL,DE

```

```

253F 79      LD      A,C
2540 0F      RRCA
2541 0F      RRCA
2542 0F      RRCA
2543 E6E0    AND     E0
2545 A8      XOR     B
2546 5F      LD      E,A
2547 79      LD      A,C
2548 E618    AND     18
254A EE40    XOR     40
254C 57      LD      D,A
254D 0660    LD      B,60
254F C5      PUSH    BC
2550 D5      PUSH    DE
2551 E5      PUSH    HL
2552 1A      LD      A,(DE)
2553 AE      XOR     (HL)
2554 2804    JR      Z,+4;255A
2556 3C      INC     A
2557 201A    JR      NZ,+26;2573
2559 3D      DEC     A
255A 4F      LD      C,A
255B 0607    LD      B,07
255D 14      INC     D
255E 23      INC     HL
255F 1A      LD      A,(DE)
2560 AE      XOR     (HL)
2561 A9      XOR     C
2562 200F    JR      NZ,+15;2573
2564 10F7    DJNZ    -9;255D
2566 C1      POP     BC
2567 C1      POP     BC
2568 C1      POP     BC
2569 3E80    LD      A,80
256B 90      SUB     B
256C 010100  LD      BC,0001
256F F7      RST     30
2570 12      LD      (DE),A
2571 180A    JR      +10;257D
2573 E1      POP     HL
2574 110800  LD      DE,0008
2577 19      ADD     HL,DE
2578 D1      POP     DE
2579 C1      POP     BC
257A 10D3    DJNZ    -45;254F
257C 48      LD      C,B
257D C3B22A  JP      2AB2
;
2580 CD0723  CALL    2307
2583 79      LD      A,C
2584 0F      RRCA
2585 0F      RRCA
2586 0F      RRCA
2587 4F      LD      C,A
2588 E6E0    AND     E0

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; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

258A A8      XOR      B
258B 6F      LD       L,A
258C 79      LD       A,C
258D E603    AND      03
258F EE58    XOR      58
2591 67      LD       H,A
2592 7E      LD       A,(HL)
2593 C3282D  JP      2D28
;          DATA (coding omitted)
; special function offset table
2596 221C    ;25B3 quote
2598 284F    ;25E8 left paren
259A 2EF2    ;268D period/decimal point
259C 2B12    ;25AF plus
259E A856    ;25F5 FN
25A0 A557    ;25F8 RND
25A2 A784    ;2627 PI
25A4 A68F    ;2634 INKEY$
25A6 C4E6    ;268D BIN
25A8 AABF    ;2668 SCREEN$
25AA ABC7    ;2672 ATTR
25AC A9CE    ;267B POINT
25AE 00      ;end
;          plus
25AF E7      RST      20
25B0 C3FF24  JP      24FF
;          quote
25B3 DF      RST      18
25B4 23      INC      HL
25B5 E5      PUSH     HL
25B6 010000  LD       BC,0000
25B9 CD0F25  CALL     250F
25BC 201B    JR       NZ,+27;25D9
25BE CD0F25  CALL     250F
25C1 28FB    JR       Z,-5;25BE
25C3 CD3025  CALL     2530
25C6 2811    JR       Z,+17;25D9
25C8 F7      RST      30
25C9 E1      POP      HL
25CA D5      PUSH     DE
25CB 7E      LD       A,(HL)
25CC 23      INC      HL
25CD 12      LD       (DE),A
25CE 13      INC      DE
25CF FE22    CP       22
25D1 20F8    JR       NZ,-8;25CB
25D3 7E      LD       A,(HL)
25D4 23      INC      HL
25D5 FE22    CP       22
25D7 28F2    JR       Z,-14;25CB
25D9 0B      DEC      BC
25DA D1      POP      DE
25DB 213B5C  LD       HL,FLAGS
25DE CBB6    RES      6,(HL)
25E0 CB7E    BIT      7,(HL)

```

; MoI(C)1983 DISASSEMBLY of Sinclair ZX Spectrum ROM

```

25E2 C4B22A      CALL    NZ,2AB2
25E5 C31227      JP      2712
;      left paren
25E8 E7          RST      20
25E9 CDFB24      CALL    24FB
25EC FE29        CP      ')'
25EE C28A1C      JP      NZ,1C8A;nonsense
25F1 E7          RST      20
25F2 C31227      JP      2712
;      'FN'
25F5 C3BD27      JP      27BD
;      'RND'
25F8 CD3025      CALL    2530
25FB 2828        JR      Z,+40;2625
25FD ED4B765C    LD      BC,(SEED)
2601 CD2B2D      CALL    2D2B
2604 EF          RST      28
2605 A1          DEFB     +161
2606 0F          DEFB     +15;add
2607 34          DEFB     +52;literal
2608 3716        DEFB     +55,+22
260A 04          DEFB     +4;multiply
260B 34          DEFB     +52;literal
260C 80410000    DEFB     +128,+65,+0,+0
2610 80          DEFB     +128
2611 32          DEFB     +50;a MOD b
2612 02          DEFB     +2;delete
2613 A1          DEFB     +161
2614 03          DEFB     +3;subtract
2615 31          DEFB     +49;copy
2616 38          DEFB     +56;fp exit
2617 CDA22D      CALL    2DA2
261A ED43765C    LD      (SEED),BC
261E 7E          LD      A,(HL)
261F A7          AND      A
2620 2803        JR      Z,+3;2625
2622 D610        SUB      10
2624 77          LD      (HL),A
2625 1809        JR      +9;2630
;      'PI'
2627 CD3025      CALL    2530
262A 2804        JR      Z,+4;2630
262C EF          RST      28
262D A3          DEFB     +163
262E 38          DEFB     +56;fp exit
262F 34          INC      (HL)
2630 E7          RST      20
2631 C3C326      JP      26C3
;      'INKEY$'
2634 015A10      LD      BC,105A
2637 E7          RST      20
2638 FE23        CP      23;hash
263A CA0D27      JP      Z,270D
263D 213B5C      LD      HL,FLAGS
2640 CBB6        RES      6,(HL)

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```

2642 CB7E      BIT      7,(HL)
2644 281F      JR       Z,+31;2665
2646 CD8E02    CALL     028E
2649 0E00      LD       C,00
264B 2013      JR       NZ,+19;2660
264D CD1E03    CALL     031E
2650 300E      JR       NC,+14;2660
2652 15        DEC      D
2653 5F        LD       E,A
2654 CD3303    CALL     0333
2657 F5        PUSH     AF
2658 010100    LD       BC,0001
265B F7        RST      30
265C F1        POP      AF
265D 12        LD       (DE),A
265E 0E01      LD       C,01
2660 0600      LD       B,00
2662 CDB22A    CALL     2AB2
2665 C31227    JP       2712
;      'SCREEN$'
2668 CD2225    CALL     2522
266B C43525    CALL     NZ,2535
266E E7        RST      20
266F C3DB25    JP       25DB
;      'ATTR'
2672 CD2225    CALL     2522
2675 C48025    CALL     NZ,2580
2678 E7        RST      20
2679 1848      JR       +72;26C3
;      'POINT'
267B CD2225    CALL     2522
267E C4CB22    CALL     NZ,22CB
2681 E7        RST      20
2682 183F      JR       +63;26C3
;
2684 CD882C    CALL     2C88
2687 3056      JR       NC,+86;26DF
2689 FE41      CP       'A'
268B 303C      JR       NC,+60;26C9
;      'BIN'
268D CD3025    CALL     2530
2690 2023      JR       NZ,+35;26B5
2692 CD9B2C    CALL     2C9B
2695 DF        RST      18
2696 010600    LD       BC,0006
2699 CD5516    CALL     1655
269C 23        INC      HL
269D 360E      LD       (HL),0E
269F 23        INC      HL
26A0 EB        EX       DE,HL
26A1 2A655C    LD       HL,(STKEND)
26A4 0E05      LD       C,05
26A6 A7        AND      A
26A7 ED42      SBC      HL,BC
26A9 22655C    LD       (STKEND),HL

```


; MoI(C)1983 ,DISASSEMBLY of Sinclair ZX Spectrum ROM

```

26AC EDB0      LDIR
26AE EB        EX      DE,HL
26AF 2B        DEC     HL
26B0 CD7700    CALL    0077
26B3 180E      JR      +14;26C3
;
26B5 DF        RST     1B
26B6 23        INC     HL
26B7 7E        LD      A,(HL)
26B8 FE0E      CP      0E;number flag
26BA 20FA      JR      NZ,-6;26B6
26BC 23        INC     HL
26BD CDB433    CALL    33B4
26C0 225D5C    LD      (CHADD),HL
26C3 FDCB01F6  SET     6,(IY+YFLAGS)
26C7 1814      JR      +20;26DD
;      get variable
26C9 CDB228    CALL    28B2
26CC DA2E1C    JP      C,1C2E
26CF CC9629    CALL    Z,2996
26D2 3A3B5C    LD      A,(FLAGS)
26D5 FEC0      CP      C0
26D7 3804      JR      C,+4;26DD
26D9 23        INC     HL
26DA CDB433    CALL    33B4
26DD 1833      JR      +51;2712
26DF 01DB09    LD      BC,09DB
26E2 FE2D      CP      2D
26E4 2827      JR      Z,+39;270D
26E6 011810    LD      BC,1018 ;
26EF DA8A1C    JP      C,1C8A
26F2 01F004    LD      BC,04F0
26F5 FE14      CP      14
26F7 2814      JR      Z,+20;270D
26F9 D28A1C    JP      NC,1C8A
26FC 0610      LD      B,10
26FE C6DC      ADD     DC
2700 4F        LD      C,A
2701 FEDF      CP      DF
2703 3002      JR      NC,+2;2707
2705 CBB1      RES     6,C
2707 FEEE      CP      EE
2709 3802      JR      C,+2;270D
270B CBB9      RES     7,C
270D C5        PUSH    BC
270E E7        RST     20
270F C3FF24    JP      24FF
;
2712 DF        RST     1B
2713 FE28      CP      '( '
2715 200C      JR      NZ,+12;2723
2717 FDCB0176  BIT     6,(IY+YFLAGS)
271B 2017      JR      NZ,+23;2734
271D CD522A    CALL    2A52
2720 E7        RST     20

```

```

2721 18F0      JR      -16;2713
;
2723 0600      LD      B,00
2725 4F        LD      C,A
2726 219527    LD      HL,2795
2729 CDDC16    CALL    16DC
272C 3006      JR      NC,+6;2734
272E 4E        LD      C,(HL)
272F 21ED26    LD      HL,26ED
2732 09        ADD     HL,EC
2733 46        LD      B,(HL)
2734 D1        POP     DE
2735 7A        LD      A,D
2736 B8        CP      B
2737 383A      JR      C,+58;2773
2739 A7        AND     A
273A CA1800    JP      Z,0018
273D C5        PUSH    BC
273E 213B5C    LD      HL,FLAGS
2741 7B        LD      A,E
2742 FEED      CP      ED
2744 2006      JR      NZ,+6;274C
2746 CB76      BIT     6,(HL)
2748 2002      JR      NZ,+2;274C
274A 1E99      LD      E,99
274C D5        PUSH    DE
274D CD3025    CALL    2530
2750 2809      JR      Z,+9;275B
2752 7B        LD      A,E
2753 E63F      AND     3F
2755 47        LD      B,A
2756 EF        RST     28
2757 3B        DEFB    +59;use B reg
2758 3B        DEFB    +56;fp exit
2759 1809      JR      +9;2764
;
275B 7B        LD      A,E
275C FDAE01    XOR     (IY+YFLAGS)
275F E640      AND     40
2761 C28A1C    JP      NZ,1C8A
2764 D1        POP     DE
2765 213B5C    LD      HL,FLAGS
2768 CBF6      SET     6,(HL)
276A CB7B      BIT     7,E
276C 2002      JR      NZ,+2;2770
276E CBB6      RES     6,(HL)
2770 C1        POP     BC
2771 18C1      JR      -63;2734
;
2773 D5        PUSH    DE
2774 79        LD      A,C
2775 FDCB0176   BIT     6,(IY+YFLAGS)
2779 2015      JR      NZ,+21;2790
277B E63F      AND     3F
277D C608      ADD     08

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```

277F 4F      LD      C,A
2780 FE10    CP      10
2782 2004    JR      NZ,+4;2788
2784 CBF1    SET     6,C
2786 1808    JR      +8;2790
2788 38D7    JR      C,-41;2761
278A FE17    CP      17
278C 2802    JR      Z,+2;2790
278E CBF9    SET     7,C
2790 C5      PUSH    BC
2791 E7      RST     20
2792 C3FF24  JP      24FF
;      DATA      (coding omitted)
; operator translation table
2795 2BCF    ;plus
2797 2DC3    ;minus
2799 2AC4    ;asterisk
279B 2FC5    ;slash
279D 5EC6    ;up arrow
279F 3DCE    ;equal
27A1 3ECC    ;greater than
27A3 3CCD    ;less than
27A5 C7C9    ;less or equal
27A7 C8CA    ;greater or equal
27A9 C9CB    ;not equal
27AB C5C7    ;OR
27AD C6C8    ;AND
27AF 00      ;end
; operator priority table
27B0 0608080A ;
27B4 02030505 ;
27B8 05050505 ;
27BC 06      ;
;      FN functions
27BD CD3025  CALL    2530
27C0 2035    JR      NZ,+53;27F7
27C2 E7      RST     20
27C3 CD8D2C  CALL    2C8D
27C6 D28A1C  JP      NC,1C8A
27C9 E7      RST     20
27CA FE24    CP      '$'
27CC F5      PUSH    AF
27CD 2001    JR      NZ,+1;27D0
27CF E7      RST     20
27D0 FE28    CP      '('
27D2 2012    JR      NZ,+18;27E6
27D4 E7      RST     20
27D5 FE29    CP      ')'
27D7 2810    JR      Z,+16;27E9
27D9 CDFB24  CALL    24FB
27DC DF      RST     18
27DD FE2C    CP      2C;comma
27DF 2003    JR      NZ,+3;27E4
27E1 E7      RST     20
27E2 18F5    JR      -11;27D9

```

```

;
27E4 FE29      CP      ' ) '
27E6 C28A1C    JF      NZ,1C8A
27E9 E7        RST     20
27EA 213B5C    LD      HL,FLAGS
27ED CBB6      RES     6,(HL)
27EF F1        POP     AF
27F0 2802      JR      Z,+2;27F4
27F2 CBF6      SET     6,(HL)
27F4 C31227    JP      2712
;
27F7 E7        RST     20
27F8 E6DF      AND     DF
27FA 47        LD      B,A
27FB E7        RST     20
27FC D624      SUB     24
27FE 4F        LD      C,A
27FF 2001      JR      NZ,+1;2802
2801 E7        RST     20
2802 E7        RST     20
2803 E5        PUSH    HL
2804 2A535C    LD      HL,(PROG)
2807 2B        DEC     HL
2808 11CE00    LD      DE,00CE
280B C5        PUSH    BC
280C CD861D    CALL    1D86
280F C1        POP     BC
2810 3002      JR      NC,+2;2814
2812 CF        RST     08
2813 18        DEFB    +24;FN without DEF
;
2814 E5        PUSH    HL
2815 CDAB28    CALL    28AB
2818 E6DF      AND     DF
281A B8        CP      B
281B 2008      JR      NZ,+8;2825
281D CDAB28    CALL    28AB
2820 D624      SUB     24
2822 B9        CP      C
2823 280C      JR      Z,+12;2831
2825 E1        POP     HL
2826 2B        DEC     HL
2827 110002    LD      DE,0200
282A C5        PUSH    BC
282B CD8B19    CALL    198B
282E C1        POP     BC
282F 18D7      JR      -41;2808
;
2831 A7        AND     A
2832 CCAB28    CALL    Z,28AB
2835 D1        POP     DE
2836 D1        POP     DE
2837 ED535D5C  LD      (CHADD),DE
283B CDAB28    CALL    28AB
283E E5        PUSH    HL

```

```

283F FE29      CP      ')'
2841 2842      JR      Z,+66;2885
2843 23        INC     HL
2844 7E        LD      A,(HL)
2845 FE0E      CP      0E;number flag
2847 1640      LD      D,40
2849 2807      JR      Z,+7;2852
284B 2B        DEC     HL
284C CDAB28    CALL    28AB
284F 23        INC     HL
2850 1600      LD      D,00
2852 23        INC     HL
2853 E5        PUSH    HL
2854 D5        PUSH    DE
2855 CDFB24    CALL    24FB
2858 F1        POP     AF
2859 FDAE01    XOR      (IY+YFLAGS)
285C E640      AND      40
285E 202B      JR      NZ,+43;288B
2860 E1        POP     HL
2861 EB        EX      DE,HL
2862 2A655C    LD      HL,(STKEND)
2865 010500    LD      BC,0005
2868 ED42      SEC      HL,BC
286A 22655C    LD      (STKEND),HL
286D EDB0      LDIR
286F EB        EX      DE,HL
2870 2B        DEC     HL
2871 CDAB28    CALL    28AB
2874 FE29      CP      ')'
2876 280D      JR      Z,+13;2885
2878 E5        PUSH    HL
2879 DF        RST      18
287A FE2C      CP      2C;comma
287C 200D      JR      NZ,+13;288B
287E E7        RST      20
287F E1        POP     HL
2880 CDAB28    CALL    28AB
2883 18BE      JR      -66;2843
;
2885 E5        PUSH    HL
2886 DF        RST      18
2887 FE29      CP      ')'
2889 2802      JR      Z,+2;288D
288B CF        RST      08
288C 19        DEFB     +25;param error
;
288D D1        POP     DE
288E EB        EX      DE,HL
288F 225D5C    LD      (CHADD),HL
2892 2A0B5C    LD      HL,(DEFADD)
2895 E3        EX      HL,(SP)
2896 220B5C    LD      (DEFADD),HL
2899 D5        PUSH    DE
289A E7        RST      20

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```

2898 E7      RST      20
289C CDFB24   CALL     24FB
289F E1      POP      HL
28A0 225D5C   LD       (CHADD),HL
28A3 E1      POP      HL
28A4 220B5C   LD       (DEFADD),HL
28A7 E7      RST      20
28A8 C31227   JP       2712
;
28AB 23      INC      HL
28AC 7E      LD       A,(HL)
28AD FE21     CP       21
28AF 38FA     JR       C,-6;28AB
28B1 C9      RET
; search for a variable
28B2 FDCB01F6 SET      6,(IY+YFLAGS)
28B6 DF      RST      18
28B7 CD8D2C   CALL     2C8D
28BA D28A1C   JP       NC,1C8A
28BD E5      PUSH     HL
28BE E61F     AND      1F
28C0 4F      LD       C,A
28C1 E7      RST      20
28C2 E5      PUSH     HL
28C3 FE28     CP       '( '
28C5 2828     JR       Z,+40;28EF
28C7 CBF1     SET      6,C
28C9 FE24     CP       '$'
28CB 2811     JR       Z,+17;28DE
28CD CBE9     SET      5,C
28CF CD882C   CALL     2C88
28D2 300F     JR       NC,+15;28E3
28D4 CD882C   CALL     2C88
28D7 3016     JR       NC,+22;28EF
28D9 CBB1     RES      6,C
28DB E7      RST      20
28DC 18F6     JR       -10;28D4
;
28DE E7      RST      20
28DF FDCB01B6 RES      6,(IY+YFLAGS)
28E3 3A0C5C   LD       A,(5C0C)
28E6 A7      AND      A
28E7 2806     JR       Z,+6;28EF
28E9 CD3025   CALL     2530
28EC C25129   JP       NZ,2951
28EF 41      LD       B,C
28F0 CD3025   CALL     2530
28F3 2008     JR       NZ,+8;28FD
28F5 79      LD       A,C
28F6 E6E0     AND      E0
28F8 CBFF     SET      7,A
28FA 4F      LD       C,A
28FB 1837     JR       +55;2934
;
28FD 2A4B5C   LD       HL,(VARS)

```

```

2900 7E      LD      A,(HL)
2901 E67F    AND     7F
2903 282D    JR      Z,+45;2932
2905 B9      CP      C
2906 2022    JR      NZ,+34;292A
2908 17      RLA
2909 87      ADD     A
290A F23F29  JP      F,293F
290D 3830    JR      C,+48;293F
290F D1      POP     DE
2910 D5      PUSH    DE
2911 E5      PUSH    HL
2912 23      INC     HL
2913 1A      LD      A,(DE)
2914 13      INC     DE
2915 FE20    CP      20;space
2917 28FA    JR      Z,-6;2913
2919 F620    OR      20
291B BE      CP      (HL)
291C 28F4    JR      Z,-12;2912
291E F680    OR      80
2920 BE      CP      (HL)
2921 2006    JR      NZ,+6;2929
2923 1A      LD      A,(DE)
2924 CD882C  CALL    2C88
2927 3015    JR      NC,+21;293E
2929 E1      POP     HL
292A C5      PUSH    BC
292B CDB819  CALL    19B8
292E EB      EX      DE,HL
292F C1      POP     BC
2930 18CE    JR      -50;2900
;
2932 CBF8    SET     7,B
2934 D1      POP     DE
2935 DF      RST     18
2936 FE28    CP      '( '
2938 2809    JR      Z,+9;2943
293A CBE8    SET     5,B
293C 180D    JR      +13;294B
;
293E D1      POP     DE
293F D1      POP     DE
2940 D1      POP     DE
2941 E5      PUSH    HL
2942 DF      RST     18
2943 CD882C  CALL    2C88
2946 3003    JR      NC,+3;294B
2948 E7      RST     20
2949 18F8    JR      -8;2943
;
294B E1      POP     HL
294C CB10    RL      B
294E CB70    BIT     6,B
2950 C9      RET

```

```

;
2951 2A0B5C      LD      HL,(DEFADD)
2954 7E          LD      A,(HL)
2955 FE29        CP      ')'
2957 CAEF28      JP      Z,28EF
295A 7E          LD      A,(HL)
295B F660        OR      60
295D 47          LD      B,A
295E 23          INC     HL
295F 7E          LD      A,(HL)
2960 FE0E        CP      0E;number flag
2962 2807        JR      Z,+7;296B
2964 2B          DEC     HL
2965 CDAB28      CALL    28AB
2968 23          INC     HL
2969 CBA8        RES     5,B
296B 78          LD      A,B
296C B9          CP      C
296D 2812        JR      Z,+18;2981
296F 23          INC     HL
2970 23          INC     HL
2971 23          INC     HL
2972 23          INC     HL
2973 23          INC     HL
2974 CDAB28      CALL    28AB
2977 FE29        CP      ')'
2979 CAEF28      JP      Z,28EF
297C CDAB28      CALL    28AB
297F 18D9        JR      -39;295A
;
2981 CB69        BIT     5,C
2983 200C        JR      NZ,+12;2991
2985 23          INC     HL
2986 ED5B655C    LD      DE,(STKEND)
298A CDC033      CALL    33C0
298D EB          EX      DE,HL
298E 22655C      LD      (STKEND),HL
2991 D1          POP     DE
2992 D1          POP     DE
2993 AF          XOR     A
2994 3C          INC     A
2995 C9          RET
; array variables
2996 AF          XOR     A
2997 47          LD      B,A
2998 CB79        BIT     7,C
299A 204B        JR      NZ,+75;29E7
299C CB7E        BIT     7,(HL)
299E 200E        JR      NZ,+14;29AE
29A0 3C          INC     A
29A1 23          INC     HL
29A2 4E          LD      C,(HL)
29A3 23          INC     HL
29A4 46          LD      B,(HL)
29A5 23          INC     HL

```


29A6 EB	EX	DE,HL
29A7 CDB22A	CALL	2AB2
29AA DF	RST	18
29AB C3492A	JP	2A49
;		
29AE 23	INC	HL
29AF 23	INC	HL
29B0 23	INC	HL
29B1 46	LD	B,(HL)
29B2 CB71	BIT	6,C
29B4 280A	JR	Z,+10;29C0
29B6 05	DEC	B
29B7 28E8	JR	Z,-24;29A1
29B9 EB	EX	DE,HL
29BA DF	RST	18
29BB FE28	CP	'('
29BD 2061	JR	NZ,+97;2A20
29BF EB	EX	DE,HL
29C0 EB	EX	DE,HL
29C1 1824	JR	+36;29E7
;		
29C3 E5	PUSH	HL
29C4 DF	RST	18
29C5 E1	POP	HL
29C6 FE2C	CP	2C;comma
29C8 2820	JR	Z,+32;29EA
29CA CB79	BIT	7,C
29CC 2852	JR	Z,+82;2A20
29CE CB71	BIT	6,C
29D0 2006	JR	NZ,+6;29D8
29D2 FE29	CP	')'
29D4 203C	JR	NZ,+60;2A12
29D6 E7	RST	20
29D7 C9	RET	
;		
29D8 FE29	CP	')'
29DA 286C	JR	Z,+108;2A48
29DC FECC	CP	CC;'TO' token
29DE 2032	JR	NZ,+50;2A12
29E0 DF	RST	18
29E1 2B	DEC	HL
29E2 225D5C	LD	(CHADD),HL
29E5 185E	JR	+94;2A45
;		
29E7 210000	LD	HL,0000
29EA E5	PUSH	HL
29EB E7	RST	20
29EC E1	POP	HL
29ED 79	LD	A,C
29EE FEC0	CP	C0
29F0 2009	JR	NZ,+9;29FB
29F2 DF	RST	18
29F3 FE29	CP	')'
29F5 2851	JR	Z,+81;2A48
29F7 FECC	CP	CC;'TO'

```

29F9 28E5      JR      Z,-27;29E0
29FB C5        PUSH    BC
29FC E5        PUSH    HL
29FD CDEE2A    CALL    2AEE
2A00 E3        EX      HL,(SP)
2A01 EB        EX      DE,HL
2A02 CDCC2A    CALL    2ACC
2A05 3819      JR      C,+25;2A20
2A07 0B        DEC     BC
2A08 CDF42A    CALL    2AF4
2A0B 09        ADD     HL,BC
2A0C D1        POP     DE
2A0D C1        POP     BC
2A0E 10B3      DJNZ    -77;29C3
;
2A10 CB79      BIT     7,C
2A12 2066      JR      NZ,+102;2A7A
2A14 E5        PUSH    HL
2A15 CB71      BIT     6,C
2A17 2013      JR      NZ,+19;2A2C
2A19 42        LD      B,D
2A1A 4B        LD      C,E
2A1B DF        RST     18
2A1C FE29      CP      ')'
2A1E 2802      JR      Z,+2;2A22
2A20 CF        RST     08
2A21 02        DEFB    +2;subscript wrong
;
2A22 E7        RST     20
2A23 E1        POP     HL
2A24 110500    LD      DE,0005
2A27 CDF42A    CALL    2AF4
2A2A 09        ADD     HL,BC
2A2B C9        RET
;
2A2C CDEE2A    CALL    2AEE
2A2F E3        EX      HL,(SP)
2A30 CDF42A    CALL    2AF4
2A33 C1        POP     BC
2A34 09        ADD     HL,BC
2A35 23        INC     HL
2A36 42        LD      B,D
2A37 4B        LD      C,E
2A38 EB        EX      DE,HL
2A39 CDB12A    CALL    2AB1
2A3C DF        RST     18
2A3D FE29      CP      ')'
2A3F 2807      JR      Z,+7;2A48
2A41 FE2C      CP      2C;comma
2A43 20DB      JR      NZ,-37;2A20
2A45 CD522A    CALL    2A52
2A48 E7        RST     20
2A49 FE28      CP      '('
2A4B 28F8      JR      Z,-8;2A45
2A4D FDCB01B6  RES     6,(IY+YFLAGS)

```

```

2A51 C9      RET
;
2A52 CD3025  CALL    2530
2A55 C4F12B  CALL    NZ,2BF1
2A58 E7      RST     20
2A59 FE29    CP      ')'
2A5B 2850    JR      Z,+80;2AAD
2A5D D5      PUSH    DE
2A5E AF      XOR     A
2A5F F5      PUSH    AF
2A60 C5      PUSH    BC
2A61 110100  LD      DE,0001
2A64 DF      RST     18
2A65 E1      POP     HL
2A66 FECC    CP      CC;'TO'
2A68 2817    JR      Z,+23;2A81
2A6A F1      POP     AF
2A6B CDCD2A  CALL    2ACD
2A6E F5      PUSH    AF
2A6F 50      LD      D,B
2A70 59      LD      E,C
2A71 E5      PUSH    HL
2A72 DF      RST     18
2A73 E1      POP     HL
2A74 FECC    CP      CC;'TO'
2A76 2809    JR      Z,+9;2A81
2A78 FE29    CP      ')'
2A7A C28A1C  JP      NZ,1C8A
2A7D 62      LD      H,D
2A7E 6B      LD      L,E
2A7F 1813    JR      +19;2A94
;
2A81 E5      PUSH    HL
2A82 E7      RST     20
2A83 E1      POP     HL
2A84 FE29    CP      ')'
2A86 280C    JR      Z,+12;2A94
2A88 F1      POP     AF
2A89 CDCD2A  CALL    2ACD
2A8C F5      PUSH    AF
2A8D DF      RST     18
2A8E 60      LD      H,B
2A8F 69      LD      L,C
2A90 FE29    CP      ')'
2A92 20E6    JR      NZ,-26;2A7A
2A94 F1      POP     AF
2A95 E3      EX      HL,(SP)
2A96 19      ADD     HL,DE
2A97 2B      DEC     HL
2A98 E3      EX      HL,(SP)
2A99 A7      AND     A
2A9A ED52    SBC     HL,DE
2A9C 010000  LD      BC,0000
2A9F 3807    JR      C,+7;2AAB
2AA1 23      INC     HL

```

```

2AA2 A7            AND        A
2AA3 FA202A       JF        M,2A20
2AA6 44           LD        B,H
2AA7 4D           LD        C,L
2AA8 D1           POP       DE
2AA9 FDCB01B6     RES       6,(IY+YFLAGS)
2AAD CD3025       CALL      2530
2AB0 C8           RET       Z
; place item on calc stack
2AB1 AF           XOR        A
2AB2 FDCB01B6     RES       6,(IY+YFLAGS)
2AB6 C5           PUSH      BC
2AB7 CDA933       CALL      33A9
2ABA C1           POP       BC
2ABB 2A655C       LD        HL,(STKEND)
2ABE 77           LD        (HL),A
2ABF 23           INC       HL
2AC0 73           LD        (HL),E
2AC1 23           INC       HL
2AC2 72           LD        (HL),D
2AC3 23           INC       HL
2AC4 71           LD        (HL),C
2AC5 23           INC       HL
2AC6 70           LD        (HL),B
2AC7 23           INC       HL
2AC8 22655C       LD        (STKEND),HL
2ACB C9           RET
;
2ACC AF           XOR        A
2ACD D5           PUSH      DE
2ACE E5           PUSH      HL
2ACF F5           PUSH      AF
2AD0 CD821C       CALL      1C82
2AD3 F1           POP       AF
2AD4 CD3025       CALL      2530
2AD7 2812         JR        Z,+18;2AEB
2AD9 F5           PUSH      AF
2ADA CD991E       CALL      1E99
2ADD D1           POP       DE
2ADE 78           LD        A,B
2ADF B1           OR        C
2AE0 37           SCF
2AE1 2805         JR        Z,+5;2AEB
2AE3 E1           POP       HL
2AE4 E5           PUSH      HL
2AE5 A7           AND        A
2AE6 ED42         SBC        HL,BC
2AE8 7A           LD        A,D
2AE9 DE00         SBC        00
2AEB E1           POP       HL
2AEC D1           POP       DE
2AED C9           RET
;
2AEE EB           EX        DE,HL
2AEF 23           INC       HL

```

```

2AF0 5E      LD      E,(HL)
2AF1 23      INC     HL
2AF2 56      LD      D,(HL)
2AF3 C9      RET
;
2AF4 CD3025  CALL    2530
2AF7 C8      RET     Z
2AF8 CDA930  CALL    30A9
2AFB DA151F  JP      C,1F15
2AFE C9      RET
;
2AFF 2A4D5C  LD      HL,(DEST)
2B02 FDCB374E BIT    1,(IY+YFLAGX)
2B06 285E    JR      Z,+94;2B66
2B08 010500  LD      BC,0005
2B0B 03      INC     BC
2B0C 23      INC     HL
2B0D 7E      LD      A,(HL)
2B0E FE20    CP      20;space
2B10 28FA    JR      Z,-6;2B0C
2B12 300B    JR      NC,+11;2B1F
2B14 FE10    CP      10
2B16 3B11    JR      C,+17;2B29
2B18 FE16    CP      16
2B1A 300D    JR      NC,+13;2B29
2B1C 23      INC     HL
2B1D 18ED    JR      -19;2B0C
;
2B1F CD882C  CALL    2C88
2B22 38E7    JR      C,-25;2B0B
2B24 FE24    CP      '$'
2B26 CAC02B  JP      Z,2B00
2B29 79      LD      A,C
2B2A 2A595C  LD      HL,(ELINE)
2B2D 2B      DEC     HL
2B2E CD5516  CALL    1655
2B31 23      INC     HL
2B32 23      INC     HL
2B33 EB      EX      DE,HL
2B34 D5      PUSH    DE
2B35 2A4D5C  LD      HL,(DEST)
2B38 1B      DEC     DE
2B39 D606    SUB     06
2B3B 47      LD      B,A
2B3C 2811    JR      Z,+17;2B4F
2B3E 23      INC     HL
2B3F 7E      LD      A,(HL)
2B40 FE21    CP      21
2B42 38FA    JR      C,-6;2B3E
2B44 F620    OR      20
2B46 13      INC     DE
2B47 12      LD      (DE),A
2B48 10F4    DJNZ    -12;2B3E
; set bit 7 to flag last byte
2B4A F680    OR      80

```

```

2B4C 12      LD      (DE),A
2B4D 3EC0    LD      A,C0
2B4F 2A4D5C  LD      HL,(DEST)
2B52 AE      XOR     (HL)
2B53 F620    OR      20
2B55 E1      POP     HL
2B56 CDEA2B  CALL    2BEA
2B59 E5      PUSH    HL
2B5A EF      RST     28
2B5B 02      DEFB    +2;delete
2B5C 38      DEFB    +56;fp exit
2B5D E1      POP     HL
2B5E 010500  LD      BC,0005
2B61 A7      AND     A
2B62 ED42    SBC     HL,BC
2B64 1840    JR      +64;2BA6
;
2B66 FDCB0176 BIT     6,(IY+YFLAGS)
2B6A 2806    JR      Z,+6;2B72
2B6C 110600  LD      DE,0006
2B6F 19      ADD     HL,DE
2B70 18E7    JR      -25;2B59
;
2B72 2A4D5C  LD      HL,(DEST)
2B75 ED4B725C LD      BC,(STRLEN)
2B79 FDCB3746 BIT     0,(IY+YFLAGX)
2B7D 2030    JR      NZ,+48;2BAF
2B7F 78      LD      A,B
2B80 B1      OR      C
2B81 C8      RET     Z
2B82 E5      PUSH    HL
2B83 F7      RST     30
2B84 D5      PUSH    DE
2B85 C5      PUSH    BC
2B86 54      LD      D,H
2B87 5D      LD      E,L
2B88 23      INC     HL
2B89 3620    LD      (HL),20
2B8B EDB8    LDDR
2B8D E5      PUSH    HL
2B8E CDF12B  CALL    2BF1
2B91 E1      POP     HL
2B92 E3      EX      HL,(SP)
2B93 A7      AND     A
2B94 ED42    SBC     HL,BC
2B96 09      ADD     HL,BC
2B97 3002    JR      NC,+2;2B9B
2B99 44      LD      B,H
2B9A 4D      LD      C,L
2B9B E3      EX      HL,(SP)
2B9C EB      EX      DE,HL
2B9D 78      LD      A,B
2B9E B1      OR      C
2B9F 2802    JR      Z,+2;2BA3
2BA1 EDB0    LDIR

```

2BA3 C1	POP	BC
2BA4 D1	POP	DE
2BA5 E1	POP	HL
2BA6 EB	EX	DE,HL
2BA7 78	LD	A,B
2BA8 B1	OR	C
2BA9 C8	RET	Z
2BAA D5	PUSH	DE
2BAE EDB0	LDIR	
2BAD E1	POP	HL
2BAE C9	RET	
;		
2BAF 2B	DEC	HL
2BB0 2B	DEC	HL
2BB1 2B	DEC	HL
2BB2 7E	LD	A,(HL)
2BB3 E5	PUSH	HL
2BB4 C5	PUSH	BC
2BB5 CDC62B	CALL	2BC6
2BB8 C1	POP	BC
2BB9 E1	POP	HL
2BBA 03	INC	BC
2BBB 03	INC	BC
2BBC 03	INC	BC
2BED C3E819	JP	19E8
;		
2BC0 3EDF	LD	A,DF
2BC2 2A4D5C	LD	HL,(DEST)
2BC5 A6	AND	(HL)
2BC6 F5	PUSH	AF
2BC7 CDF12B	CALL	2BF1
2BCA EB	EX	DE,HL
2BCB 09	ADD	HL,BC
2BCC C5	PUSH	BC
2BCD 2B	DEC	HL
2BCE 224D5C	LD	(DEST),HL
2BD1 03	INC	BC
2BD2 03	INC	BC
2BD3 03	INC	BC
2BD4 2A595C	LD	HL,(ELINE)
2BD7 2B	DEC	HL
2BD8 CD5516	CALL	1655
2BDB 2A4D5C	LD	HL,(DEST)
2BDE C1	POP	BC
2BDF C5	PUSH	BC
2BE0 03	INC	BC
2BE1 EDB8	LDDR	
2BE3 EB	EX	DE,HL
2BE4 23	INC	HL
2BE5 C1	POP	BC
2BE6 70	LD	(HL),B
2BE7 2B	DEC	HL
2BE8 71	LD	(HL),C
2BE9 F1	POP	AF
2BEA 2B	DEC	HL

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```

2BEB 77          LD      (HL),A
2BEC 2A595C      LD      HL,(ELINE)
2BEF 2B          DEC     HL
2BF0 C9          RET
; get item off calc stack (see also 2AB1)
2BF1 2A655C      LD      HL,(STKEND)
2BF4 2B          DEC     HL
2BF5 46          LD      B,(HL)
2BF6 2B          DEC     HL
2BF7 4E          LD      C,(HL)
2BF8 2B          DEC     HL
2BF9 56          LD      D,(HL)
2BFA 2B          DEC     HL
2BFB 5E          LD      E,(HL)
2BFC 2B          DEC     HL
2BFD 7E          LD      A,(HL)
2BFE 22655C      LD      (STKEND),HL
2C01 C9          RET
;          DIM command
2C02 CDB228      CALL    28B2
2C05 C28A1C      JP      NZ,1C8A
2C08 CD3025      CALL    2530
2C0B 2008        JR      NZ,+8;2C15
2C0D CBB1        RES     6,C
2C0F CD9629      CALL    2996
2C12 CDEE1B      CALL    1BEE
2C15 3808        JR      C,+8;2C1F
2C17 C5          PUSH    BC
2C18 CDB819      CALL    19B8
2C1B CDE819      CALL    19E8
2C1E C1          POP     BC
2C1F CBF9        SET     7,C
2C21 0600        LD      B,00
2C23 C5          PUSH    BC
2C24 210100      LD      HL,0001
2C27 CB71        BIT     6,C
2C29 2002        JR      NZ,+2;2C2D
2C2B 2E05        LD      L,05
2C2D EB          EX      DE,HL
2C2E E7          RST     20
2C2F 26FF        LD      H,FF
2C31 CDCC2A      CALL    2ACC
2C34 DA202A      JP      C,2A20
2C37 E1          POP     HL
2C38 C5          PUSH    BC
2C39 24          INC     H
2C3A E5          PUSH    HL
2C3B 60          LD      H,B
2C3C 69          LD      L,C
2C3D CDF42A      CALL    2AF4
2C40 EB          EX      DE,HL
2C41 DF          RST     18
2C42 FE2C        CP      2C;comma
2C44 28E8        JR      Z,-24;2C2E
2C46 FE29        CP      ')'

```



```

2C48 20BE      JR      NZ,-69;2C05
2C4A E7        RST      20
2C4B C1        POP      BC
2C4C 79        LD       A,C
2C4D 68        LD       L,B
2C4E 2600      LD       H,00
2C50 23        INC      HL
2C51 23        INC      HL
2C52 29        ADD      HL,HL
2C53 19        ADD      HL,DE
2C54 DA151F    JP       C,1F15
2C57 D5        PUSH     DE
2C58 C5        PUSH     BC
2C59 E5        PUSH     HL
2C5A 44        LD       B,H
2C5B 4D        LD       C,L
2C5C 2A595C    LD       HL,(ELINE)
2C5F 2B        DEC      HL
2C60 CD5516    CALL     1655
2C63 23        INC      HL
2C64 77        LD       (HL),A
2C65 C1        POP      BC
2C66 0B        DEC      BC
2C67 0B        DEC      BC
2C68 0B        DEC      BC
2C69 23        INC      HL
2C6A 71        LD       (HL),C
2C6B 23        INC      HL
2C6C 70        LD       (HL),B
2C6D C1        POP      BC
2C6E 78        LD       A,B
2C6F 23        INC      HL
2C70 77        LD       (HL),A
2C71 62        LD       H,D
2C72 6B        LD       L,E
2C73 1B        DEC      DE
2C74 3600      LD       (HL),00
2C76 CB71      BIT      6,C
2C78 2802      JR       Z,+2;2C7C
2C7A 3620      LD       (HL),20
2C7C C1        POP      BC
2C7D EDB8      LDDR
2C7F C1        POP      BC
2C80 70        LD       (HL),B
2C81 2B        DEC      HL
2C82 71        LD       (HL),C
2C83 2B        DEC      HL
2C84 3D        DEC      A
2C85 20F8      JR       NZ,-8;2C7F
2C87 C9        RET
;
2C88 CD1B2D    CALL     2D1B
2C8B 3F        CCF
2C8C DB        RET      C
; test for alphabetic

```

```

2C8D FE41      CP      'A'
2C8F 3F        CCF
2C90 D0        RET     NC
2C91 FE5B      CP      'Z'+1
2C93 D8        RET     C
2C94 FE61      CP      'a'
2C96 3F        CCF
2C97 D0        RET     NC
2C98 FE7B      CP      'z'+1
2C9A C9        RET
;
2C9B FEC4      CP      C4;'BIN'
2C9D 2019      JR      NZ,+25;2CB8
2C9F 110000    LD      DE,0000
2CA2 E7        RST     20
2CA3 D631      SUB     '1'
2CA5 CE00      ADC     00
2CA7 200A      JR      NZ,+10;2CB3
2CA9 EB        EX      DE,HL
2CAA 3F        CCF
2CAB ED6A      ADC     HL,HL
2CAD DAAD31    JP      C,31AD
2CB0 EB        EX      DE,HL
2CB1 18EF      JR      -17;2CA2
;
2CB3 42        LD      B,D
2CB4 4B        LD      C,E
2CB5 C32B2D    JP      2D2B
;
2CB8 FE2E      CP      2E;period
2CBA 280F      JR      Z,+15;2CCE
2CBC CD3B2D    CALL    2D3B
2CBF FE2E      CP      2E;period
2CC1 2028      JR      NZ,+40;2CEB
2CC3 E7        RST     20
2CC4 CD1B2D    CALL    2D1B
2CC7 3822      JR      C,+34;2CEE
2CC9 180A      JR      +10;2CD5
;
2CCB E7        RST     20
2CCC CD1B2D    CALL    2D1B
2CCF DA8A1C    JP      C,1C8A
2CD2 EF        RST     28
2CD3 A0        DEFB    +160
2CD4 38        DEFB    +56;fp exit
2CD5 EF        RST     28
2CD6 A1        DEFB    +161
2CD7 C0        DEFB    +192;store 0
2CD8 02        DEFB    +2;delete
2CD9 38        DEFB    +56;fp exit
2CDA DF        RST     18
2CDB CD222D    CALL    2D22
2CDE 380B      JR      C,+11;2CEB
2CE0 EF        RST     28
2CE1 E0        DEFB    +224;get 0

```

```

2CE2 A4      DEFB      +164
2CE3 05      DEFB      +5;divide
2CE4 C0      DEFB      +192;store 0
2CE5 04      DEFB      +4;multiply
2CE6 0F      DEFB      +15;add
2CE7 38      DEFB      +56;fp exit
2CE8 E7      RST       20
2CE9 18EF    JR        -17;2CDA
; handle scientific notation with exponent
2CEB FE45    CP        'E'
2CED 2803    JR        Z,+3;2CF2
2CEF FE65    CP        'e'
2CF1 C0      RET       NZ
2CF2 06FF    LD        B,FF
2CF4 E7      RST       20
2CF5 FE2B    CP        2B;plus
2CF7 2805    JR        Z,+5;2CFE
2CF9 FE2D    CP        2D;minus
2CFB 2002    JR        NZ,+2;2CFF
2CFD 04      INC       B
2CFE E7      RST       20
2CFF CD1B2D  CALL      2D1B
2D02 38CB    JR        C,-53;2CCF
2D04 C5      PUSH      BC
2D05 CD3B2D  CALL      2D3B
2D08 CDD52D  CALL      2DD5
2D0B C1      POP       BC
2D0C DAAD31  JP        C,31AD
2D0F A7      AND       A
2D10 FAAD31  JP        M,31AD
2D13 04      INC       B
2D14 2802    JR        Z,+2;2D18
2D16 ED44    NEG
2D18 C34F2D  JP        2D4F
; test for numeric
2D1B FE30    CP        '0';zero
2D1D D8      RET       C
2D1E FE3A    CP        '9'+1
2D20 3F      CCF
2D21 C9      RET
;
2D22 CD1B2D  CALL      2D1B
2D25 D8      RET       C
2D26 D630    SUB       '0';zero
2D28 4F      LD        C,A
2D29 0600    LD        B,00
2D2B FD213A5C LD        IY,ERRNR
2D2F AF      XOR       A
2D30 5F      LD        E,A
2D31 51      LD        D,C
2D32 48      LD        C,B
2D33 47      LD        B,A
2D34 CDB62A  CALL      2AB6
2D37 EF      RST       28
2D38 38      DEFB      +56;fp exit

```

```

2D39 A7      AND      A
2D3A C9      RET
;
2D3B F5      PUSH     AF
2D3C EF      RST      28
2D3D A0      DEFB     +160
2D3E 38      DEFB     +56;fp exit
2D3F F1      POP      AF
2D40 CD222D  CALL     2D22
2D43 D8      RET      C
2D44 EF      RST      28
2D45 01      DEFB     +1;exchg
2D46 A4      DEFB     +164
2D47 04      DEFB     +4;multiply
2D48 0F      DEFB     +15;add
2D49 38      DEFB     +56;fp exit
2D4A CD7400  CALL     0074
2D4D 18F1    JR       -15;2D40
;
2D4F 07      RLCA
2D50 0F      RRCA
2D51 3002    JR       NC,+2;2D55
2D53 2F      CPL
2D54 3C      INC      A
2D55 F5      PUSH     AF
2D56 21925C  LD        HL,MEMBOT
2D59 CD0B35  CALL     350B
2D5C EF      RST      28
2D5D A4      DEFB     +164
2D62 300D    JR       NC,+13;2D71
2D64 F5      PUSH     AF
2D65 EF      RST      28
2D66 C1      DEFB     +193;store 1
2D67 E0      DEFB     +224;get 0
2D68 00      DEFB     +0;j true
2D69 04      DEFB     +4;multiply
2D6A 04      DEFB     +4;multiply
2D6B 33      DEFB     +51;jump
2D6C 02      DEFB     +2;delete
2D6D 05      DEFB     +5;divide
2D6E E1      DEFB     +225;get 1
2D6F 38      DEFB     +56;fp exit
2D70 F1      POP      AF
2D71 2808    JR       Z,+8;2D7B
2D73 F5      PUSH     AF
2D74 EF      RST      28
2D75 31      DEFB     +49;copy
2D76 04      DEFB     +4;multiply
2D77 38      DEFB     +56;fp exit
2D78 F1      POP      AF
2D79 18E5    JR       -27;2D60
;
2D7B EF      RST      28
2D7C 02      DEFB     +2;delete
2D7D 38      DEFB     +56;fp exit

```

```

2D7E C9      RET
;
2D7F 23      INC      HL
2D80 4E      LD       C,(HL)
2D81 23      INC      HL
2D82 7E      LD       A,(HL)
2D83 A9      XOR      C
2D84 91      SUB      C
2D85 5F      LD       E,A
2D86 23      INC      HL
2D87 7E      LD       A,(HL)
2D88 89      ADC      C
2D89 A9      XOR      C
2D8A 57      LD       D,A
2D8B C9      RET
;
2D8C 0E00    LD       C,00
2D8E E5      PUSH     HL
2D8F 3600    LD       (HL),00
2D91 23      INC      HL
2D92 71      LD       (HL),C
2D93 23      INC      HL
2D94 7B      LD       A,E
2D95 A9      XOR      C
2D96 91      SUB      C
2D97 77      LD       (HL),A
2D98 23      INC      HL
2D99 7A      LD       A,D
2D9A 89      ADC      C
2D9B A9      XOR      C
2D9C 77      LD       (HL),A
2D9D 23      INC      HL
2D9E 3600    LD       (HL),00
2DA0 E1      POP      HL
2DA1 C9      RET
;
2DA2 EF      RST      28
2DA3 38      DEFB     +56;fp exit
2DA4 7E      LD       A,(HL)
2DA5 A7      AND      A
2DA6 2805    JR       Z,+5;2DAD
2DA8 EF      RST      28
2DA9 A2      DEFB     +162
2DAA 0F      DEFB     +15;add
2DAB 27      DEFB     +39;INT
2DAC 38      DEFB     +56;fp exit
2DAD EF      RST      28
2DAE 02      DEFB     +2;delete
2DAF 38      DEFB     +56;fp exit
2DB0 E5      PUSH     HL
2DB1 D5      PUSH     DE
2DB2 EB      EX       DE,HL
2DB3 46      LD       B,(HL)
2DB4 CD7F2D  CALL     2D7F
2DB7 AF      XOR      A

```

```

2DB8 90      SUB      B
2DB9 CB79    BIT      7,C
2DBB 42      LD       B,D
2DBC 4B      LD       C,E
2DBD 7B      LD       A,E
2DBE D1      POP      DE
2DBF E1      POP      HL
2DC0 C9      RET
;
2DC1 57      LD       D,A
2DC2 17      RLA
2DC3 9F      SBC      A
2DC4 5F      LD       E,A
2DC5 4F      LD       C,A
2DC6 AF      XOR      A
2DC7 47      LD       B,A
2DC8 CDB62A  CALL     2AB6
2DCB EF      RST      28
2DCC 34      DEFB     +52;literal
2DCD EF      DEFB     +239
2DCE 1A      DEFB     +26
2DCF 20      DEFB     +32
2DD0 9A      DEFB     +154
2DD1 85      DEFB     +133
2DD2 04      DEFB     +4;multiply
2DD3 27      DEFB     +39;INT
2DD4 38      DEFB     +56;fp exit
2DD5 CDA22D  CALL     2DA2
2DD8 D8      RET      C
2DD9 F5      PUSH     AF
2DDA 05      DEC      B
2DDB 04      INC      B
2DDC 2803    JR       Z,+3;2DE1
2DDE F1      POP      AF
2DDF 37      SCF
2DE0 C9      RET
2DE1 F1      POP      AF
2DE2 C9      RET
;
2DE3 EF      RST      28
2DE4 31      DEFB     +49;copy
2DE5 36      DEFB     +54;a<0
2DE6 00      DEFB     +0;j true
2DE7 0B      DEFB     +11;a<>b
2DE8 31      DEFB     +49;copy
2DE9 37      DEFB     +55;a>0
2DEA 00      DEFB     +0;j true
2DEB 0D      DEFB     +13;a<b
2DEC 02      DEFB     +2;delete
2DED 38      DEFB     +56;fp exit
2DEE 3E30    LD       A,'0';zero
2DF0 D7      RST      10
2DF1 C9      RET
;
2DF2 2A383E  LD       HL,(3E38)

```

2DF5 2D	DEC	L
2DF6 D7	RST	10
2DF7 EF	RST	28
2DF8 A0	DEFB	+160
2DF9 C3	DEFB	+195;store 3
2DFA C4	DEFB	+196;store 4
2DFB C5	DEFB	+197;store 5
2DFC 02	DEFB	+2;delete
2DFD 38	DEFB	+56;fp exit
2DFE D9	EXX	
2DFF E5	PUSH	HL
2E00 D9	EXX	
2E01 EF	RST	28
2E02 31	DEFB	+49;copy
2E03 27	DEFB	+39;INT
2E04 C2	DEFB	+194;store 2
2E05 03	DEFB	+3;subtract
2E06 E2	DEFB	+226;get 2
2E07 01	DEFB	+1;exchg
2E08 C2	DEFB	+194;store 2
2E09 02	DEFB	+2;delete
2E0A 38	DEFB	+56;fp exit
2E0B 7E	LD	A,(HL)
2E0C A7	AND	A
2E0D 2047	JR	NZ,+71;2E56
2E0F CD7F2D	CALL	2D7F
2E12 0610	LD	B,10
2E14 7A	LD	A,D
2E15 A7	AND	A
2E16 2006	JR	NZ,+6;2E1E
2E18 B3	OR	E
2E19 2809	JR	Z,+9;2E24
2E1B 53	LD	D,E
2E1C 0608	LD	B,08
2E1E D5	PUSH	DE
2E1F D9	EXX	
2E20 D1	POP	DE
2E21 D9	EXX	
2E22 1857	JR	+87;2E7B
2E24 EF	RST	28
2E25 E2	DEFB	+226;get 2
2E26 38	DEFB	+56;fp exit
2E27 7E	LD	A,(HL)
2E28 D67E	SUB	7E
2E2A CDC12D	CALL	2DC1
2E2D 57	LD	D,A
2E2E 3AAC5C	LD	A,(5CAC)
2E31 92	SUB	D
2E32 32AC5C	LD	(5CAC),A
2E35 7A	LD	A,D
2E36 CD4F2D	CALL	2D4F
2E39 EF	RST	28
2E3A 31	DEFB	+49;copy
2E3B 27	DEFB	+39;INT
2E3C C1	DEFB	+193;store 1

```

2E3D 03      DEFB      +3;subtract
2E3E E1      DEFB      +225;get 1
2E3F 38      DEFB      +56;fp exit
2E40 CDD52D  CALL      2DD5
2E43 E5      PUSH      HL
2E44 32A15C  LD         (5CA1),A
2E47 3D      DEC        A
2E48 17      RLA
2E49 9F      SBC        A
2E4A 3C      INC        A
2E4B 21AB5C  LD         HL,5CAB
2E4E 77      LD         (HL),A
2E4F 23      INC        HL
2E50 86      ADD        (HL)
2E51 77      LD         (HL),A
2E52 E1      POP        HL
2E53 C3CF2E  JP         2ECF
;
2E56 D680    SUB        80
2E58 FE1C    CP         1C
2E5A 3813    JR         C,+19;2E6F
2E5C CDC12D  CALL      2DC1
2E5F D607    SUB        07
2E61 47      LD         B,A
2E62 21AC5C  LD         HL,5CAC
2E65 86      ADD        (HL)
2E66 77      LD         (HL),A
2E67 78      LD         A,B
2E68 ED44    NEG
2E6A CD4F2D  CALL      2D4F
2E6D 1892    JR         -110;2E01
;
2E6F EB      EX         DE,HL
2E70 CDBA2F  CALL      2FBA
2E73 D9      EXX
2E74 CBFA    SET        7,D
2E76 7D      LD         A,L
2E77 D9      EXX
2E78 D680    SUB        80
2E7A 47      LD         B,A
2E7B CB23    SLA        E
2E7D CB12    RL         D
2E7F D9      EXX
2E80 CB13    RL         E
2E82 CB12    RL         D
2E84 D9      EXX
2E85 21AA5C  LD         HL,5CAA
2E88 0E05    LD         C,05
2E8A 7E      LD         A,(HL)
2E8B 8F      ADC        A
2E8C 27      DAA
2E8D 77      LD         (HL),A
2E8E 2B      DEC        HL
2E8F 0D      DEC        C
2E90 20F8    JR         NZ,-8;2E8A

```



```

2E92 10E7      DJNZ      -25;2E7B
2E94 AF        XOR       A
2E95 21A65C    LD        HL,5CA6
2E98 11A15C    LD        DE,5CA1
2E9B 0609      LD        B,09
2E9D ED6F      RLD
2E9F 0EFF      LD        C,FF
2EA1 ED6F      RLD
2EA3 2004      JR        NZ,+4;2EA9
2EA5 0D        DEC       C
2EA6 0C        INC       C
2EA7 200A      JR        NZ,+10;2EB3
2EA9 12        LD        (DE),A
2EAA 13        INC       DE
2EAB FD3471    INC       (IY+YMEMBT+25)
2EAE FD3472    INC       (IY+YMEMBT+26)
2EB1 0E00      LD        C,00
2EB3 CB40      BIT       0,B
2EB5 2801      JR        Z,+1;2EB8
2EB7 23        INC       HL
2EB8 10E7      DJNZ      -25;2EA1
2EBA 3AAB5C    LD        A,(5CAB)
2EBD D609      SUB       09
2EBF 380A      JR        C,+10;2ECB
2EC1 FD3571    DEC       (IY+YMEMBT+25)
2EC4 3E04      LD        A,04
2EC6 FD8E6F    CP        (IY+YMEMBT+23)
2EC9 1841      JR        +65;2F0C
;
2ECB EF        RST       28
2ECC 02        DEFB      +2;delete
2ECD E2        DEFB      +226;get 2
2ECE 38        DEFB      +56;fp exit
2ECF EB        EX        DE,HL
2ED0 CDBA2F    CALL      2FBA
2ED3 D9        EXX
2ED4 3E80      LD        A,80
2ED6 95        SUB       L
2ED7 2E00      LD        L,00
2ED9 CBFA      SET       7,D
2EDB D9        EXX
2EDC CDDD2F    CALL      2FDD
2EDF FD7E71    LD        A,(IY+YMEMBT+25)
2EE2 FE08      CP        08
2EE4 3806      JR        C,+6;2EEC
2EE6 D9        EXX
2EE7 CB12      RL        D
2EE9 D9        EXX
2EEA 1820      JR        +32;2F0C
;
2EEC 010002    LD        BC,0200
2EEF 7B        LD        A,E
2EF0 CD8B2F    CALL      2F8B
2EF3 5F        LD        E,A
2EF4 7A        LD        A,D

```

2EF5 CD8B2F	CALL	2F8B
2EF8 57	LD	D,A
2EF9 C5	PUSH	BC
2EFA D9	EXX	
2EFB C1	POP	BC
2EFC 10F1	DJNZ	-15;2EEF
2EFE 21A15C	LD	HL,5CA1
2F01 79	LD	A,C
2F02 FD4E71	LD	C,(IY+YMEMBT+25)
2F05 09	ADD	HL,BC
2F06 77	LD	(HL),A
2F07 FD3471	INC	(IY+YMEMBT+25)
2F0A 18D3	JR	-45;2EDF
;		
2F0C F5	PUSH	AF
2F0D 21A15C	LD	HL,5CA1
2F10 FD4E71	LD	C,(IY+YMEMBT+25)
2F13 0600	LD	B,00
2F15 09	ADD	HL,BC
2F16 41	LD	E,C
2F17 F1	POP	AF
2F18 2B	DEC	HL
2F19 7E	LD	A,(HL)
2F1A CE00	ADC	00
2F1C 77	LD	(HL),A
2F1D A7	AND	A
2F1E 2805	JR	Z,+5;2F25
2F20 FE0A	CF	0A
2F22 3F	CCF	
2F23 3008	JR	NC,+8;2F2D
2F25 10F1	DJNZ	-15;2F18
2F27 3601	LD	(HL),01
2F29 04	INC	B
2F2A FD3472	INC	(IY+YMEMBT+26)
2F2D FD7071	LD	(IY+YMEMBT+25),B
2F30 EF	RST	28
2F31 02	DEFB	+2;delete
2F32 38	DEFB	+56;fp exit
2F33 D9	EXX	
2F34 E1	POP	HL
2F35 D9	EXX	
2F36 ED4BAB5C	LD	BC,(5CAB)
2F3A 21A15C	LD	HL,5CA1
2F3D 78	LD	A,B
2F3E FE09	CF	09
2F40 3804	JR	C,+4;2F46
2F42 FEFC	CF	FC
2F44 3826	JR	C,+38;2F6C
2F46 A7	AND	A
2F47 CCEF15	CALL	Z,15EF
2F4A AF	XOR	A
2F4B 90	SUB	B
2F4C FA522F	JP	M,2F52
2F4F 47	LD	B,A
2F50 180C	JR	+12;2F5E

```

2F52 79      LD      A,C
2F53 A7      AND     A
2F54 2803    JR      Z,+3;2F59
2F56 7E      LD      A,(HL)
2F57 23      INC     HL
2F58 0D      DEC     C
2F59 CDEF15  CALL    15EF
2F5C 10F4    DJNZ   -12;2F52
2F5E 79      LD      A,C
2F5F A7      AND     A
2F60 C8      RET     Z
2F61 04      INC     B
2F62 3E2E    LD      A,2E;period
2F64 D7      RST     10
2F65 3E30    LD      A,'0';zero
2F67 10FB    DJNZ   -5;2F64
2F69 41      LD      B,C
2F6A 18E6    JR      -26;2F52
;
2F6C 50      LD      D,B
2F6D 15      DEC     D
2F6E 0601    LD      B,01
2F70 CD4A2F  CALL    2F4A
2F73 3E45    LD      A,'E'
2F75 D7      RST     10
2F76 4A      LD      C,D
2F77 79      LD      A,C
2F78 A7      AND     A
2F79 F2832F  JP      F,2F83
2F7C ED44    NEG
2F7E 4F      LD      C,A
2F7F 3E2D    LD      A,2D;minus
2F81 1802    JR      +2;2F85
2F83 3E2B    LD      A,2B;plus
2F85 D7      RST     10
2F86 0600    LD      B,00
2F88 C31B1A  JP      1A1B
;
2F8B D5      PUSH    DE
2F8C 6F      LD      L,A
2F8D 2600    LD      H,00
2F8F 5D      LD      E,L
2F90 54      LD      D,H
2F91 29      ADD     HL,HL
2F92 29      ADD     HL,HL
2F93 19      ADD     HL,DE
2F94 29      ADD     HL,HL
2F95 59      LD      E,C
2F96 19      ADD     HL,DE
2F97 4C      LD      C,H
2F98 7D      LD      A,L
2F99 D1      POP     DE
2F9A C9      RET
;
2F9B 7E      LD      A,(HL)

```

2F9C 3600	LD	(HL),00
2F9E A7	AND	A
2F9F C8	RET	Z
2FA0 23	INC	HL
2FA1 CB7E	BIT	7,(HL)
2FA3 CBFE	SET	7,(HL)
2FA5 2B	DEC	HL
2FA6 C8	RET	Z
2FA7 C5	PUSH	BC
2FA8 010500	LD	BC,0005
2FAB 09	ADD	HL,BC
2FAC 41	LD	B,C
2FAD 4F	LD	C,A
2FAE 37	SCF	
2FAF 2B	DEC	HL
2FB0 7E	LD	A,(HL)
2FB1 2F	CPL	
2FB2 CE00	ADC	00
2FB4 77	LD	(HL),A
2FB5 10F8	DJNZ	-8;2FAF
2FB7 79	LD	A,C
2FB8 C1	POP	BC
2FB9 C9	RET	
;		
2FBA E5	PUSH	HL
2FBB F5	PUSH	AF
2FBC 4E	LD	C,(HL)
2FBD 23	INC	HL
2FBE 46	LD	B,(HL)
2FBF 77	LD	(HL),A
2FC0 23	INC	HL
2FC1 79	LD	A,C
2FC2 4E	LD	C,(HL)
2FC3 C5	PUSH	BC
2FC4 23	INC	HL
2FC5 4E	LD	C,(HL)
2FC6 23	INC	HL
2FC7 46	LD	B,(HL)
2FC8 EB	EX	DE,HL
2FC9 57	LD	D,A
2FCA 5E	LD	E,(HL)
2FCB D5	PUSH	DE
2FCC 23	INC	HL
2FCD 56	LD	D,(HL)
2FCE 23	INC	HL
2FCF 5E	LD	E,(HL)
2FD0 D5	PUSH	DE
2FD1 D9	EXX	
2FD2 D1	POP	DE
2FD3 E1	POP	HL
2FD4 C1	POP	BC
2FD5 D9	EXX	
2FD6 23	INC	HL
2FD7 56	LD	D,(HL)
2FD8 23	INC	HL

```

2FD9 5E      LD      E,(HL)
2FDA F1      POP     AF
2FDB E1      POP     HL
2FDC C9      RET
;
2FDD A7      AND     A
2FDE C8      RET     Z
2FDF FE21    CP      21
2FE1 3016    JR      NC,+22;2FF9
2FE3 C5      PUSH    BC
2FE4 47      LD      E,A
2FE5 D9      EXX
2FE6 CB2D    SRA     L
2FE8 CB1A    RR      D
2FEA CB1B    RR      E
2FEC D9      EXX
2FED CB1A    RR      D
2FEF CB1B    RR      E
2FF1 10F2    DJNZ    -14;2FE5
2FF3 C1      POP     BC
2FF4 D0      RET     NC
2FF5 CD0430  CALL    3004
2FF8 C0      RET     NZ
2FF9 D9      EXX
2FFA AF      XOR     A
2FFB 2E00    LD      L,00
2FFD 57      LD      D,A
2FFE 5D      LD      E,L
2FFF D9      EXX
3000 110000  LD      DE,0000
3003 C9      RET
;
3004 1C      INC     E
3005 C0      RET     NZ
3006 14      INC     D
3007 C0      RET     NZ
3008 D9      EXX
3009 1C      INC     E
300A 2001    JR      NZ,+1;300D
300C 14      INC     D
300D D9      EXX
300E C9      RET
;
300F EB      EX      DE,HL
3010 CD6E34  CALL    346E
3013 EB      EX      DE,HL
3014 1A      LD      A,(DE)
3015 B6      OR      (HL)
3016 2026    JR      NZ,+38;303E
3018 D5      PUSH    DE
3019 23      INC     HL
301A E5      PUSH    HL
301B 23      INC     HL
301C 5E      LD      E,(HL)
301D 23      INC     HL

```

```

301E 56      LD      D,(HL)
301F 23      INC     HL
3020 23      INC     HL
3021 23      INC     HL
3022 7E      LD      A,(HL)
3023 23      INC     HL
3024 4E      LD      C,(HL)
3025 23      INC     HL
3026 46      LD      B,(HL)
3027 E1      POP     HL
3028 EB      EX      DE,HL
3029 09      ADD     HL,BC
302A EB      EX      DE,HL
302B 8E      ADC     (HL)
302C 0F      RRCA
302D CE00    ADC     00
302F 200B    JR      NZ,+11;303C
3031 9F      SEC     A
3032 77      LD      (HL),A
3033 23      INC     HL
3034 73      LD      (HL),E
3035 23      INC     HL
3036 72      LD      (HL),D
3037 2B      DEC     HL
3038 2B      DEC     HL
3039 2B      DEC     HL
303A D1      POP     DE
303B C9      RET
;
303C 2B      DEC     HL
303D D1      POP     DE
303E CD9332  CALL    3293
3041 D9      EXX
3042 E5      PUSH    HL
3043 D9      EXX
3044 D5      PUSH    DE
3045 E5      PUSH    HL
3046 CD9B2F  CALL    2F9B
3049 47      LD      B,A
304A EB      EX      DE,HL
304B CD9B2F  CALL    2F9B
304E 4F      LD      C,A
304F B8      CP      B
3050 3003    JR      NC,+3;3055
3052 78      LD      A,B
3053 41      LD      B,C
3054 EB      EX      DE,HL
3055 F5      PUSH    AF
3056 90      SUB     B
3057 CDBA2F  CALL    2FBA
305A CDDD2F  CALL    2FDD
305D F1      POP     AF
305E E1      POP     HL
305F 77      LD      (HL),A
3060 E5      PUSH    HL

```

3061	68	LD	L,E
3062	61	LD	H,C
3063	19	ADD	HL,DE
3064	D9	EXX	
3065	EB	EX	DE,HL
3066	ED4A	ADC	HL,BC
3068	EB	EX	DE,HL
3069	7C	LD	A,H
306A	8D	ADC	L
306B	6F	LD	L,A
306C	1F	RRA	
306D	AD	XOR	L
306E	D9	EXX	
306F	EB	EX	DE,HL
3070	E1	POP	HL
3071	1F	RRA	
3072	3008	JR	NC,+8;307C
3074	3E01	LD	A,01
3076	CDDD2F	CALL	2FDD
3079	34	INC	(HL)
307A	2823	JR	Z,+35;309F
307C	D9	EXX	
307D	7D	LD	A,L
307E	E680	AND	80
3080	D9	EXX	
3081	23	INC	HL
3082	77	LD	(HL),A
3083	2B	DEC	HL
3084	281F	JR	Z,+31;30A5
3086	7B	LD	A,E
3087	ED44	NEG	
3089	3F	CCF	
308A	5F	LD	E,A
308B	7A	LD	A,D
308C	2F	CPL	
308D	CE00	ADC	00
308F	57	LD	D,A
3090	D9	EXX	
3091	7B	LD	A,E
3092	2F	CPL	
3093	CE00	ADC	00
3095	5F	LD	E,A
3096	7A	LD	A,D
3097	2F	CPL	
3098	CE00	ADC	00
309A	3007	JR	NC,+7;30A3
309C	1F	RRA	
309D	D9	EXX	
309E	34	INC	(HL)
309F	CAAD31	JP	Z,31AD
30A2	D9	EXX	
30A3	57	LD	D,A
30A4	D9	EXX	
30A5	AF	XOR	A
30A6	C35531	JP	3155

```

;
30A9 C5      PUSH      BC
30AA 0610    LD        B,10
30AC 7C      LD        A,H
30AD 4D      LD        C,L
30AE 210000  LD        HL,0000
30B1 29      ADD       HL,HL
30B2 380A    JR        C,+10;30BE
30B4 CB11    RL        C
30B6 17      RLA
30B7 3003    JR        NC,+3;30BC
30B9 19      ADD       HL,DE
30BA 3802    JR        C,+2;30BE
30BC 10F3    DJNZ     -13;30B1
30BE C1      POP       BC
30BF C9      RET
;
30C0 CDE934  CALL     34E9
30C3 D8      RET       C
30C4 23      INC       HL
30C5 AE      XOR       (HL)
30C6 CBFE    SET       7,(HL)
30C8 2B      DEC       HL
30C9 C9      RET
;
30CA 1A      LD        A,(DE)
30CB B6      OR        (HL)
30CC 2022    JR        NZ,+34;30F0
30CE D5      PUSH     DE
30CF E5      PUSH     HL
30D0 D5      PUSH     DE
30D1 CD7F2D  CALL     2D7F
30D4 EB      EX        DE,HL
30D5 E3      EX        HL,(SP)
30D6 41      LD        B,C
30D7 CD7F2D  CALL     2D7F
30DA 78      LD        A,B
30DB A9      XOR       C
30DC 4F      LD        C,A
30DD E1      POP       HL
30DE CDA930  CALL     30A9
30E1 EB      EX        DE,HL
30E2 E1      POP       HL
30E3 380A    JR        C,+10;30EF
30E5 7A      LD        A,D
30E6 B3      OR        E
30E7 2001    JR        NZ,+1;30EA
30E9 4F      LD        C,A
30EA CD8E2D  CALL     2D8E
30ED D1      POP       DE
30EE C9      RET
;
30EF D1      POP       DE
30F0 CD9332  CALL     3293
30F3 AF      XOR       A

```


30F4 CDC030	CALL	30C0
30F7 D8	RET	C
30F8 D9	EXX	
30F9 E5	PUSH	HL
30FA D9	EXX	
30FB D5	PUSH	DE
30FC EB	EX	DE,HL
30FD CDC030	CALL	30C0
3100 EB	EX	DE,HL
3101 385A	JR	C,+90;315D
3103 E5	PUSH	HL
3104 CDBA2F	CALL	2FBA
3107 78	LD	A,B
3108 A7	AND	A
3109 ED62	SEC	HL,HL
310B D9	EXX	
310C E5	PUSH	HL
310D ED62	SEC	HL,HL
310F D9	EXX	
3110 0621	LD	B,21
3112 1811	JR	+17;3125
;		
3114 3005	JR	NC,+5;311B
3116 19	ADD	HL,DE
3117 D9	EXX	
3118 ED5A	ADC	HL,DE
311A D9	EXX	
311B D9	EXX	
311C CB1C	RR	H
311E CB1D	RR	L
3120 D9	EXX	
3121 CB1C	RR	H
3123 CB1D	RR	L
3125 D9	EXX	
3126 CB18	RR	B
3128 CB19	RR	C
312A D9	EXX	
312B CB19	RR	C
312D 1F	RRA	
312E 10E4	DJNZ	-28;3114
3130 EB	EX	DE,HL
3131 D9	EXX	
3132 EB	EX	DE,HL
3133 D9	EXX	
3134 C1	POP	BC
3135 E1	POP	HL
3136 78	LD	A,B
3137 81	ADD	C
3138 2001	JR	NZ,+1;313B
313A A7	AND	A
313B 3D	DEC	A
313C 3F	CCF	
313D 17	RLA	
313E 3F	CCF	
313F 1F	RRA	

3140 F24631	JF	P,3146
3143 3068	JR	NC,+104;31AD
3145 A7	AND	A
3146 3C	INC	A
3147 2008	JR	NZ,+8;3151
3149 3806	JR	C,+6;3151
314B D9	EXX	
314C CB7A	BIT	7,D
314E D9	EXX	
314F 205C	JR	NZ,+92;31AD
3151 77	LD	(HL),A
3152 D9	EXX	
3153 78	LD	A,B
3154 D9	EXX	
3155 3015	JR	NC,+21;316C
3157 7E	LD	A,(HL)
3158 A7	AND	A
3159 3E80	LD	A,80
315B 2801	JR	Z,+1;315E
315D AF	XOR	A
315E D9	EXX	
315F A2	AND	D
3160 CDFB2F	CALL	2FFB
3163 07	RLCA	
3164 77	LD	(HL),A
3165 382E	JR	C,+46;3195
3167 23	INC	HL
3168 77	LD	(HL),A
3169 2B	DEC	HL
316A 1829	JR	+41;3195
316C 0620	LD	B,20
316E D9	EXX	
316F CB7A	BIT	7,D
3171 D9	EXX	
3172 2012	JR	NZ,+18;3186
3174 07	RLCA	
3175 CB13	RL	E
3177 CB12	RL	D
3179 D9	EXX	
317A CB13	RL	E
317C CB12	RL	D
317E D9	EXX	
317F 35	DEC	(HL)
3180 28D7	JR	Z,-41;3159
3182 10EA	DJNZ	-22;316E
3184 18D7	JR	-41;315D
3186 17	RLA	
3187 300C	JR	NC,+12;3195
3189 CD0430	CALL	3004
318C 2007	JR	NZ,+7;3195
318E D9	EXX	
318F 1680	LD	D,80
3191 D9	EXX	
3192 34	INC	(HL)
3193 2818	JR	Z,+24;31AD

```

3195 E5      PUSH    HL
3196 23      INC     HL
3197 D9      EXX
3198 D5      PUSH    DE
3199 D9      EXX
319A C1      POP     EC
319B 78      LD      A,B
319C 17      RLA
319D CB16    RL      (HL)
319F 1F      RRA
31A0 77      LD      (HL),A
31A1 23      INC     HL
31A2 71      LD      (HL),C
31A3 23      INC     HL
31A4 72      LD      (HL),D
31A5 23      INC     HL
31A6 73      LD      (HL),E
31A7 E1      POP     HL
31A8 D1      POP     DE
31A9 D9      EXX
31AA E1      POP     HL
31AB D9      EXX
31AC C9      RET
;
31AD CF      RST      08
31AE 05      DEFB     +5;number too big
31AF CD9332  CALL     3293
31B2 EB      EX       DE,HL
31B3 AF      XOR      A
31B4 CDC030  CALL     30C0
31B7 38F4    JR       C,-12;31AD
31B9 EB      EX       DE,HL
31BA CDC030  CALL     30C0
31BD D8      RET      C
31BE D9      EXX
31BF E5      PUSH    HL
31C0 D9      EXX
31C1 D5      PUSH    DE
31C2 E5      PUSH    HL
31C3 CDBA2F  CALL     2FBA
31C6 D9      EXX
31C7 E5      PUSH    HL
31C8 60      LD      H,B
31C9 69      LD      L,C
31CA D9      EXX
31CB 61      LD      H,C
31CC 68      LD      L,B
31CD AF      XOR      A
31CE 06DF    LD      B,DF
31D0 1810    JR       +16;31E2
;
31D2 17      RLA
31D3 CB11    RL      C
31D5 D9      EXX
31D6 CB11    RL      C

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31D8 CB10      RL      B
31DA D9        EXX
31DB 29        ADD     HL,HL
31DC D9        EXX
31DD ED6A      ADC     HL,HL
31DF D9        EXX
31E0 3810      JR      C,+16;31F2
31E2 ED52      SBC     HL,DE
31E4 D9        EXX
31E5 ED52      SBC     HL,DE
31E7 D9        EXX
31E8 300F      JR      NC,+15;31F9
31EA 19        ADD     HL,DE
31EB D9        EXX
31EC ED5A      ADC     HL,DE
31EE D9        EXX
31EF A7        AND     A
31F0 1808      JR      +8;31FA
;
31F2 A7        AND     A
31F3 ED52      SBC     HL,DE
31F5 D9        EXX
31F6 ED52      SBC     HL,DE
31F8 D9        EXX
31F9 37        SCF
31FA 04        INC     B
31FB FAD231    JP      M,31D2
31FE F5        PUSH    AF
31FF 28E1      JR      Z,-31;31E2
3201 5F        LD      E,A
3202 51        LD      D,C
3203 D9        EXX
3204 59        LD      E,C
3205 50        LD      D,B
3206 F1        POP     AF
3207 CB18      RR      B
3209 F1        POP     AF
320A CB18      RR      B
320C D9        EXX
320D C1        POP     BC
320E E1        POP     HL
320F 78        LD      A,B
3210 91        SUB     C
3211 C33D31    JP      313D
;
3214 7E        LD      A,(HL)
3215 A7        AND     A
3216 C8        RET     Z
3217 FE81      CP      81
3219 3006      JR      NC,+6;3221
321B 3600      LD      (HL),00
321D 3E20      LD      A,20
321F 1851      JR      +81;3272
;
3221 FE91      CP      91

```

```

3223 201A      JR      NZ,+26;323F
3225 23        INC     HL
3226 23        INC     HL
3227 23        INC     HL
3228 3E80      LD      A,80
322A A6        AND     (HL)
322B 2B        DEC     HL
322C B6        OR      (HL)
322D 2B        DEC     HL
322E 2003      JR      NZ,+3;3233
3230 3E80      LD      A,80
3232 AE        XOR     (HL)
3233 2B        DEC     HL
3234 2036      JR      NZ,+54;326C
3236 77        LD      (HL),A
3237 23        INC     HL
3238 36FF      LD      (HL),FF
323A 2B        DEC     HL
323B 3E18      LD      A,18
323D 1833      JR      +51;3272
;
323F 302C      JR      NC,+44;326D
3241 D5        PUSH    DE
3242 2F        CPL
3243 C691      ADD     91
3245 23        INC     HL
3246 56        LD      D,(HL)
3247 23        INC     HL
3248 5E        LD      E,(HL)
3249 2B        DEC     HL
324A 2B        DEC     HL
324B 0E00      LD      C,00
324D CB7A      BIT     7,D
324F 2801      JR      Z,+1;3252
3251 0D        DEC     C
3252 CBFA      SET     7,D
3254 0608      LD      B,08
3256 90        SUB     B
3257 80        ADD     B
3258 3804      JR      C,+4;325E
325A 5A        LD      E,D
325B 1600      LD      D,00
325D 90        SUB     B
325E 2807      JR      Z,+7;3267
3260 47        LD      B,A
3261 CB3A      SRL     D
3263 CB1B      RR      E
3265 10FA      DJNZ    -6;3261
3267 CD8E2D    CALL    2D8E
326A D1        POP     DE
326B C9        RET
;
326C 7E        LD      A,(HL)
326D D6A0      SUB     A0
326F F0        RET     F

```

3270 ED44	NEG	
3272 D5	PUSH	DE
3273 EB	EX	DE,HL
3274 2B	DEC	HL
3275 47	LD	B,A
3276 CB38	SRL	B
3278 CB38	SRL	B
327A CB38	SRL	B
327C 2805	JR	Z,+5;3283
327E 3600	LD	(HL),00
3280 2B	DEC	HL
3281 10FB	DJNZ	-5;327E
3283 E607	AND	07
3285 2809	JR	Z,+9;3290
3287 47	LD	B,A
3288 3EFF	LD	A,FF
328A CB27	SLA	A
328C 10FC	DJNZ	-4;328A
328E A6	AND	(HL)
328F 77	LD	(HL),A
3290 EB	EX	DE,HL
3291 D1	POP	DE
3292 C9	RET	
;		
3293 CD9632	CALL	3296
3296 EB	EX	DE,HL
3297 7E	LD	A,(HL)
3298 A7	AND	A
3299 C0	RET	NZ
329A D5	PUSH	DE
329B CD7F2D	CALL	2D7F
329E AF	XOR	A
329F 23	INC	HL
32A0 77	LD	(HL),A
32A1 2B	DEC	HL
32A2 77	LD	(HL),A
32A3 0691	LD	B,91
32A5 7A	LD	A,D
32A6 A7	AND	A
32A7 2008	JR	NZ,+8;32B1
32A9 E3	OR	E
32AA 42	LD	B,D
32AB 2810	JR	Z,+16;32BD
32AD 53	LD	D,E
32AE 58	LD	E,B
32AF 0689	LD	B,89
32B1 EB	EX	DE,HL
32B2 05	DEC	B
32B3 29	ADD	HL,HL
32B4 30FC	JR	NC,-4;32B2
32B6 CB09	RRC	C
32B8 CB1C	RR	H
32BA CB1D	RR	L
32BC EB	EX	DE,HL
32BD 2B	DEC	HL

```

32BE 73          LD      (HL),E
32BF 2B          DEC     HL
32C0 72          LD      (HL),D
32C1 2B          DEC     HL
32C2 70          LD      (HL),B
32C3 D1          POP     DE
32C4 C9          RET
;      DATA (coding omitted)
; constants table
32C5 00B000      ;zero
32C8 40B00001    ;one
32CC 3000        ;half
32CE F1490FDAA2  ;pi/2
32D3 40B0000A    ;ten
; calculator functions table
; indexed by byte values following
; RST 28 (up to hex 38)
32D7 8F363C34    DEFW    368F,343C
32DB A1330F30    DEFW    33A1,300F
32DF CA30AF31    DEFW    30CA,31AF
32E3 51381B35    DEFW    3851,351B
32E7 24353B35    DEFW    3524,353B
32EB 3B353B35    DEFW    353B,353B
32EF 3B353B35    DEFW    353B,353B
32F3 3B351430    DEFW    353B,3014
32F7 2D353B35    DEFW    352D,353B
32FB 3B353B35    DEFW    353B,353B
32FF 3B353B35    DEFW    353B,353B
3303 3B359C35    DEFW    353B,359C
3307 DE35BC34    DEFW    35DE,34BC
330B 45366E34    DEFW    3645,346E
330F 6936DE35    DEFW    3669,35DE
3313 7436B537    DEFW    3674,37B5
3317 AA37DA37    DEFW    37AA,37DA
331B 33384338    DEFW    3833,3843
331F E2371337    DEFW    37E2,3713
3323 C436AF36    DEFW    36C4,36AF
3327 4A389234    DEFW    384A,3492
332B 6A34AC34    DEFW    346A,34AC
332F A534B334    DEFW    34A5,34B3
3333 1F36C935    DEFW    361F,35C9
3337 0135C033    DEFW    3501,33C0
333B A0368636    DEFW    36A0,3686
333F C6337A36    DEFW    33C6,367A
3343 0635F934    DEFW    3506,34F9
3347 9B368337    DEFW    369B,3783
334B 1432A233    DEFW    3214,33A2
334F 4F2D9732    DEFW    2D4F,3297
3353 49341B34    DEFW    3449,341B
3357 2D340F34    DEFW    342D,340F
;      Floating Point Calculator
335B      FPCALC:
335B CDBF35      CALL    35BF
335E 78          LD      A,B
335F 32675C      LD      (BREG),A

```

```

3362 D9      EXX
3363 E3      EX      HL,(SP)
3364 D9      EXX
3365 ED53655C LD      (STKEND),DE
3369 D9      EXX
336A 7E      LD      A,(HL)
336B 23      INC     HL
336C E5      PUSH    HL
336D A7      AND     A
336E F28033  JP      F,3380
3371 57      LD      D,A
3372 E660     AND     60
3374 0F      RRCA
3375 0F      RRCA
3376 0F      RRCA
3377 0F      RRCA
3378 C67C     ADD     7C
337A 6F      LD      L,A
337B 7A      LD      A,D
337C E61F     AND     1F
337E 180E     JR      +14;338E
;
3380 FE18     CP      18
3382 3008     JR      NC,+8;338C
3384 D9      EXX
3385 01FBFF    LD      BC,FFFF
3388 54      LD      D,H
3389 5D      LD      E,L
338A 09      ADD     HL,BC
338B D9      EXX
338C 07      RLCA
338D 6F      LD      L,A
338E 11D732    LD      DE,32D7
3391 2600     LD      H,00
3393 19      ADD     HL,DE
3394 5E      LD      E,(HL)
3395 23      INC     HL
3396 56      LD      D,(HL)
3397 216533    LD      HL,3365
339A E3      EX      HL,(SP)
339B D5      PUSH    DE
339C D9      EXX
339D ED4B665C LD      BC,(5C66)
33A1 C9      RET
;
33A2 F1      POP     AF
33A3 3A675C    LD      A,(BREG)
33A6 D9      EXX
33A7 18C3     JR      -61;336C
;
33A9 D5      PUSH    DE
33AA E5      PUSH    HL
33AB 010500    LD      BC,0005
33AE CD051F    CALL   1F05
33B1 E1      POP     HL

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```

33B2 D1      POP      DE
33B3 C9      RET
;
33B4 ED5B655C LD      DE,(STKEND)
33B8 CDC033  CALL     33C0
33BB ED53655C LD      (STKEND),DE
33BF C9      RET
;
33C0 CDA933  CALL     33A9
33C3 EDB0    LDIR
33C5 C9      RET
;
33C6 62      LD      H,D
33C7 6B      LD      L,E
33C8 CDA933  CALL     33A9
33CB D9      EXX
33CC E5      PUSH    HL
33CD D9      EXX
33CE E3      EX      HL,(SP)
33CF C5      PUSH    BC
33D0 7E      LD      A,(HL)
33D1 E6C0    AND     C0
33D3 07      RLCA
33D4 07      RLCA
33D5 4F      LD      C,A
33D6 0C      INC     C
33D7 7E      LD      A,(HL)
33D8 E63F    AND     3F
33DA 2002    JR      NZ,+2;33DE
33DC 23      INC     HL
33DD 7E      LD      A,(HL)
33DE C650    ADD     50
33E0 12      LD      (DE),A
33E1 3E05    LD      A,05
33E3 91      SUB     C
33E4 23      INC     HL
33E5 13      INC     DE
33E6 0600    LD      B,00
33E8 EDB0    LDIR
33EA C1      POP     BC
33EB E3      EX      HL,(SP)
33EC D9      EXX
33ED E1      POP     HL
33EE D9      EXX
33EF 47      LD      B,A
33F0 AF      XOR     A
33F1 05      DEC     B
33F2 C8      RET     Z
33F3 12      LD      (DE),A
33F4 13      INC     DE
33F5 18FA    JR      -6;33F1
;
33F7 A7      AND     A
33F8 C8      RET     Z
33F9 F5      PUSH    AF

```

```

33FA D5      PUSH      DE
33FB 110000   LD        DE,0000
33FE CDC833   CALL      33C8
3401 D1      POP       DE
3402 F1      POP       AF
3403 3D      DEC       A
3404 18F2     JR        -14;33FB
;
3406 4F      LD        C,A
3407 07      RLCA
3408 07      RLCA
3409 81      ADD       C
340A 4F      LD        C,A
340B 0600     LD        B,00
340D 09      ADD       HL,BC
340E C9      RET
;
340F D5      PUSH      DE
3410 2A685C   LD        HL,(MEM)
3413 CD0634   CALL      3406
3416 CDC033   CALL      33C0
3419 E1      POP       HL
341A C9      RET
;
341B 62      LD        H,D
341C 6B      LD        L,E
341D D9      EXX
341E E5      PUSH      HL
341F 21C532   LD        HL,32C5
3422 D9      EXX
3423 CDF733   CALL      33F7
3426 CDC833   CALL      33C8
3429 D9      EXX
342A E1      POP       HL
342B D9      EXX
342C C9      RET
;
342D E5      PUSH      HL
342E EB      EX        DE,HL
342F 2A685C   LD        HL,(MEM)
3432 CD0634   CALL      3406
3435 EB      EX        DE,HL
3436 CDC033   CALL      33C0
3439 EB      EX        DE,HL
343A E1      POP       HL
343B C9      RET
;
343C 0605     LD        B,05
343E 1A      LD        A,(DE)
343F 4E      LD        C,(HL)
3440 EB      EX        DE,HL
3441 12      LD        (DE),A
3442 71      LD        (HL),C
3443 23      INC       HL
3444 13      INC       DE

```

```

3445 10F7      DJNZ      -9;343E
3447 EB       EX        DE,HL
3448 C9       RET
;
3449 47       LD        B,A
344A CD5E33    CALL     335E
344D 310FC0    LD        SP,C00F
3450 02       LD        (BC),A
3451 A0       AND       B
3452 C231E0    JP        NZ,E031
3455 04       INC       B
3456 E2C103    JP        PO,03C1
3459 38CD     JR        C,-51;3428
345B C633     ADD       33
345D CD6233    CALL     3362
3460 0F       RRCA
3461 01C202    LD        BC,02C2
3464 35       DEC       (HL)
3465 EEE1     XOR       E1
3467 03       INC       BC
3468 38C9     JR        C,-55;3433
346A 06FF     LD        B,FF
346C 1806     JR        +6;3474
;
346E CDE934    CALL     34E9
3471 D8       RET       C
3472 0600     LD        B,00
3474 7E       LD        A,(HL)
3475 A7       AND       A
3476 280B     JR        Z,+11;3483
3478 23       INC       HL
3479 78       LD        A,B
347A E680     AND       80
347C B6       OR        (HL)
347D 17       RLA
347E 3F       CCF
347F 1F       RRA
3480 77       LD        (HL),A
3481 2B       DEC       HL
3482 C9       RET
;
3483 D5       PUSH     DE
3484 E5       PUSH     HL
3485 CD7F2D    CALL     2D7F
3488 E1       POP      HL
3489 78       LD        A,B
348A B1       OR        C
348B 2F       CPL
348C 4F       LD        C,A
348D CD8E2D    CALL     2D8E
3490 D1       POP      DE
3491 C9       RET
;
3492 CDE934    CALL     34E9
3495 D8       RET       C

```

```

3496 D5      PUSH    DE
3497 110100   LD      DE,0001
349A 23      INC     HL
349B CB16     RL      (HL)
349D 2B      DEC     HL
349E 9F      SBC     A
349F 4F      LD      C,A
34A0 CD8E2D   CALL    2D8E
34A3 D1      POP     DE
34A4 C9      RET
;
34A5 CD991E   CALL    1E99
34A8 ED78     IN      A,(C)
34AA 1804     JR      +4;34B0
34AC CD991E   CALL    1E99
34AF 0A      LD      A,(BC)
34B0 C3282D   JP      2D28
;
34B3 CD991E   CALL    1E99
34B6 212B2D   LD      HL,2D2B
34B9 E5      PUSH    HL
34BA C5      PUSH    BC
34BB C9      RET
;
34BC CDF12B   CALL    2BF1
34BF 0B      DEC     BC
34C0 78      LD      A,B
34C1 B1      OR      C
34C2 2023     JR      NZ,+35;34E7
34C4 1A      LD      A,(DE)
34C5 CD8D2C   CALL    2C8D
34C8 3809     JR      C,+9;34D3
34CA D690     SUB     90
34CC 3819     JR      C,+25;34E7
34CE FE15     CP      15
34D0 3015     JR      NC,+21;34E7
34D2 3C      INC     A
34D3 3D      DEC     A
34D4 87      ADD     A
34D5 87      ADD     A
34D6 87      ADD     A
34D7 FEAB     CP      AB
34D9 300C     JR      NC,+12;34E7
34DB ED4B7B5C LD      EC,(UDG)
34DF 81      ADD     C
34E0 4F      LD      C,A
34E1 3001     JR      NC,+1;34E4
34E3 04      INC     B
34E4 C32B2D   JP      2D2B
;
34E7 CF      RST      08
34E8 09      DEFB     +9;inv argument
;
34E9 E5      PUSH    HL
34EA C5      PUSH    BC

```

```

34EB 47      LD      B,A
34EC 7E      LD      A,(HL)
34ED 23      INC     HL
34EE B6      OR      (HL)
34EF 23      INC     HL
34F0 B6      OR      (HL)
34F1 23      INC     HL
34F2 B6      OR      (HL)
34F3 78      LD      A,B
34F4 C1      POP     BC
34F5 E1      POP     HL
34F6 C0      RET     NZ
34F7 37      SCF
34F8 C9      RET
;
34F9 CDE934  CALL    34E9
34FC D8      RET     C
34FD 3EFF    LD      A,FF
34FF 1806    JR      +6;3507
3501 CDE934  CALL    34E9
3504 1805    JR      +5;350B
3506 AF      XOR     A
3507 23      INC     HL
3508 AE      XOR     (HL)
3509 2B      DEC     HL
350A 07      RLCA
350B E5      PUSH    HL
350C 3E00    LD      A,00
350E 77      LD      (HL),A
350F 23      INC     HL
3510 77      LD      (HL),A
3511 23      INC     HL
3512 17      RLA
3513 77      LD      (HL),A
3514 1F      RRA
3515 23      INC     HL
3516 77      LD      (HL),A
3517 23      INC     HL
3518 77      LD      (HL),A
3519 E1      POP     HL
351A C9      RET
;
351B EB      EX      DE,HL
351C CDE934  CALL    34E9
351F EB      EX      DE,HL
3520 D8      RET     C
3521 37      SCF
3522 18E7    JR      -25;350B
;
3524 EB      EX      DE,HL
3525 CDE934  CALL    34E9
3528 EB      EX      DE,HL
3529 D0      RET     NC
352A A7      AND     A
352B 18DE    JR      -34;350B

```

```

;
352D EB      EX      DE,HL
352E CDE934  CALL    34E9
3531 EB      EX      DE,HL
3532 D0      RET     NC
3533 D5      PUSH    DE
3534 1B      DEC     DE
3535 AF      XOR     A
3536 12      LD      (DE),A
3537 1B      DEC     DE
3538 12      LD      (DE),A
3539 D1      POP     DE
353A C9      RET
;
353B 78      LD      A,B
353C D608    SUB     08
353E CB57    BIT     2,A
3540 2001    JR      NZ,+1;3543
3542 3D      DEC     A
3543 0F      RRCA
3544 3008    JR      NC,+8;354E
3546 F5      PUSH    AF
3547 E5      PUSH    HL
3548 CD3C34  CALL    343C
354B D1      POP     DE
354C EB      EX      DE,HL
354D F1      POP     AF
354E CB57    BIT     2,A
3550 2007    JR      NZ,+7;3559
3552 0F      RRCA
3553 F5      PUSH    AF
3554 CD0F30  CALL    300F
3557 1833    JR      +51;358C
;
3559 0F      RRCA
355A F5      PUSH    AF
355B CDF12B  CALL    2BF1
355E D5      PUSH    DE
355F C5      PUSH    BC
3560 CDF12B  CALL    2BF1
3563 E1      POP     HL
3564 7C      LD      A,H
3565 B5      OR      L
3566 E3      EX      HL,(SP)
3567 78      LD      A,B
3568 200B    JR      NZ,+11;3575
356A B1      OR      C
356B C1      POP     BC
356C 2804    JR      Z,+4;3572
356E F1      POP     AF
356F 3F      CCF
3570 1816    JR      +22;3588
3572 F1      POP     AF
3573 1813    JR      +19;3588
;

```

```

3575 B1      OR      C
3576 280D    JR      Z,+13;3585
3578 1A      LD      A,(DE)
3579 96      SUB     (HL)
357A 3809    JR      C,+9;3585
357C 20ED    JR      NZ,-19;356B
357E 0B      DEC     BC
357F 13      INC     DE
3580 23      INC     HL
3581 E3      EX      HL,(SP)
3582 2B      DEC     HL
3583 18DF    JR      -33;3564
;
3585 C1      POP     BC
3586 F1      POP     AF
3587 A7      AND     A
3588 F5      PUSH    AF
3589 EF      RST     28
358A A0      DEFB    +160
358B 38      DEFB    +56;fp exit
358C F1      POP     AF
358D F5      PUSH    AF
358E DC0135  CALL    C,3501
3591 F1      POP     AF
3592 F5      PUSH    AF
3593 D4F934  CALL    NC,34F9
3596 F1      POP     AF
3597 0F      RRCA
3598 D40135  CALL    NC,3501
359B C9      RET
;
359C CDF12B  CALL    2BF1
359F D5      PUSH    DE
35A0 C5      PUSH    BC
35A1 CDF12B  CALL    2BF1
35A4 E1      POP     HL
35A5 E5      PUSH    HL
35A6 D5      PUSH    DE
35A7 C5      PUSH    BC
35A8 09      ADD     HL,BC
35A9 44      LD      B,H
35AA 4D      LD      C,L
35AB F7      RST     30
35AC CDB22A  CALL    2AB2
35AF C1      POP     BC
35B0 E1      POP     HL
35B1 78      LD      A,B
35B2 B1      OR      C
35B3 2802    JR      Z,+2;35B7
35B5 EDE0    LDIR
35B7 C1      POP     BC
35B8 E1      POP     HL
35B9 78      LD      A,B
35BA B1      OR      C
35BB 2802    JR      Z,+2;35BF

```

```

35BD EDB0      LDIR
35BF 2A655C    LD      HL,(STKEND)
35C2 11FBFF    LD      DE,FFFB
35C5 E5        PUSH    HL
35C6 19        ADD     HL,DE
35C7 D1        POP     DE
35C8 C9        RET
;
35C9 CDD52D    CALL    2DD5
35CC 380E      JR      C,+14;35DC
35CE 200C      JR      NZ,+12;35DC
35D0 F5        PUSH    AF
35D1 010100    LD      BC,0001
35D4 F7        RST     30
35D5 F1        POP     AF
35D6 12        LD      (DE),A
35D7 CDB22A    CALL    2AB2
35DA EB        EX      DE,HL
35DB C9        RET
;
35DC CF        RST     08
35DD 0A        DEFB    +10;int out of range
;
35DE 2A5D5C    LD      HL,(CHADD)
35E1 E5        PUSH    HL
35E2 78        LD      A,B
35E3 C6E3      ADD     E3
35E5 9F        SBC     A
35E6 F5        PUSH    AF
35E7 CDF12B    CALL    2BF1
35EA D5        PUSH    DE
35EB 03        INC     BC
35EC F7        RST     30
35ED E1        POP     HL
35EE ED535D5C  LD      (CHADD),DE
35F2 D5        PUSH    DE
35F3 EDB0      LDIR
35F5 EB        EX      DE,HL
35F6 2B        DEC     HL
35F7 360D      LD      (HL),0D
35F9 FDCB01BE  RES     7,(IY+YFLAGS)
35FD CDFB24    CALL    24FB
3600 DF        RST     18
3601 FE0D      CP      CR
3603 2007      JR      NZ,+7;360C
3605 E1        POP     HL
3606 F1        POP     AF
3607 FDAE01    XOR     (IY+YFLAGS)
360A E640      AND     40
360C C28A1C    JP      NZ,1C8A
360F 225D5C    LD      (CHADD),HL
3612 FDCB01FE  SET     7,(IY+YFLAGS)
3616 CDFB24    CALL    24FB
3619 E1        POP     HL
361A 225D5C    LD      (CHADD),HL

```



```

361D 18A0      JR      -96;35BF
;
361F 010100    LD      BC,0001
3622 F7        RST     30
3623 225B5C    LD      (KCUR),HL
3626 E5        PUSH    HL
3627 2A515C    LD      HL,(CURCHL)
362A E5        PUSH    HL
362B 3EFF      LD      A,FF
362D CD0116    CALL    SELDEV
3630 CDE32D    CALL    2DE3
3633 E1        POP     HL
3634 CD1516    CALL    1615
3637 D1        POP     DE
3638 2A5B5C    LD      HL,(KCUR)
363B A7        AND     A
363C ED52      SBC     HL,DE
363E 44        LD      B,H
363F 4D        LD      C,L
3640 CDB22A    CALL    2AB2
3643 EB        EX      DE,HL
3644 C9        RET
;
3645 CD941E    CALL    1E94
3648 FE10      CP      10
364A D29F1E    JP      NC,1E9F
364D 2A515C    LD      HL,(CURCHL)
3650 E5        PUSH    HL
3651 CD0116    CALL    SELDEV
3654 CDE615    CALL    SLCTIP
3657 010000    LD      BC,0000
365A 3003      JR      NC,+3;365F
365C 0C        INC     C
365D F7        RST     30
365E 12        LD      (DE),A
365F CDB22A    CALL    2AB2
3662 E1        POP     HL
3663 CD1516    CALL    1615
3666 C3BF35    JP      35BF
;
3669 CDF12B    CALL    2BF1
366C 78        LD      A,B
366D B1        OR      C
366E 2801      JR      Z,+1;3671
3670 1A        LD      A,(DE)
3671 C32B2D    JP      2D2B
;
3674 CDF12B    CALL    2BF1
3677 C32B2D    JP      2D2B
;
367A D9        EXX
367B E5        PUSH    HL
367C 21675C    LD      HL,BREG
367F 35        DEC     (HL)
3680 E1        POP     HL

```

```

3681 2004      JR      NZ,+4;3687
3683 23        INC     HL
3684 D9        EXX
3685 C9        RET
;
3686 D9        EXX
3687 5E        LD      E,(HL)
3688 7B        LD      A,E
3689 17        RLA
368A 9F        SEC     A
368B 57        LD      D,A
368C 19        ADD     HL,DE
368D D9        EXX
368E C9        RET
;
368F 13        INC     DE
3690 13        INC     DE
3691 1A        LD      A,(DE)
3692 1B        DEC     DE
3693 1B        DEC     DE
3694 A7        AND     A
3695 20EF      JR      NZ,-17;3686
3697 D9        EXX
3698 23        INC     HL
3699 D9        EXX
369A C9        RET
;
369B F1        POP     AF
369C D9        EXX
369D E3        EX      HL,(SP)
369E D9        EXX
369F C9        RET
;
36A0 EF        RST     28
36A1 C0        DEFB    +192;store 0
36A2 02        DEFB    +2;delete
36A3 31        DEFB    +49;copy
36A4 E0        DEFB    +224;get 0
36A5 05        DEFB    +5;divide
36A6 27        DEFB    +39;INT
36A7 E0        DEFB    +224;get 0
36A8 01        DEFB    +1;exchg
36A9 C0        DEFB    +192;store 0
36AA 04        DEFB    +4;multiply
36AB 03        DEFB    +3;subtract
36AC E0        DEFB    +224;get 0
36AD 38        DEFB    +56;fp exit
36AE C9        RET
;
36AF EF        RST     28
36B0 31        DEFB    +49;copy
36B1 36        DEFB    +54;a<0
36B2 00        DEFB    +0;j true
36B3 04        DEFB    +4
36B4 3A        DEFB    +58;truncate

```

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```

36B5 38      DEFB      +56;fp exit
36B6 C9      RET
; floating point function list
36B7 31      DEFB      +49;copy
36B8 3A      DEFB      +58;truncate
36B9 C0      DEFB      +192;store 0
36BA 03      DEFB      +3;subtract
36BB E0      DEFB      +224;get 0
36BC 01      DEFB      +1;exchg
36BD 30      DEFB      +48;NOT
36BE 00      DEFB      +0;j true
36BF 03      DEFB      +3
36C0 A1      DEFB      +161
36C1 03      DEFB      +3;subtract
36C2 38      DEFB      +56;fp exit
36C3 C9      RET
;
36C4 EF      RST       28
36C5 3D      DEFB      +61;restack
36C6 34      DEFB      +52;literal
36C7 F138AA3E DEFB      +241,+56,+170,+59
36C8 29      DEFB      +41
36CC 04      DEFB      +4;multiply
36CD 31      DEFB      +49;copy
36CE 27      DEFB      +39;int
36CF C3      DEFB      +195;store 3
36D0 03      DEFB      +3;subtract
36D1 31      DEFB      +49;copy
36D2 0F      DEFB      +15;add
36D3 A1      DEFB      +161
36D4 03      DEFB      +3;subtract
36D5 88      DEFB      +136
36D6 1336    DEFB      +19,+54
36D8 586566  DEFB      +88,+101,+102
36DB 9D786540 DEFB      +157,+120,+101,+64
36DF A26032C9 DEFB      +162,+96,+50,+201
36E3 E721F7AF DEFB      +231,+33,+247,+175
36E7 24      DEFB      +36
36E8 EB2FB0B0 DEFB      +235,+47,+176,+176
36EC 14      DEFB      +20
36ED EE7EBB94 DEFB      +238,+126,+187,+148
36F1 58      DEFB      +88
36F2 F13A7EF8 DEFB      +241,+58,+126,+248
36F6 CF      DEFB      +207
36F7 E3      DEFB      +227;get 3
36F8 38      DEFB      +56;fp exit
36F9 CDD52D  CALL      2DD5
36FC 2007    JR        NZ,+7;3705
36FE 3803    JR        C,+3;3703
3700 86      ADD       (HL)
3701 3009    JR        NC,+9;370C
3703 CF      RST       08
3704 05      DEFB      +5;num too big
;
3705 3807    JR        C,+7;370E

```

```

3707 96      SUB      (HL)
3708 3004     JR       NC,+4;370E
370A ED44     NEG
370C 77      LD       (HL),A
370D C9      RET
;
370E EF      RST      28
370F 02      DEFB     +2
3710 A0      DEFB     +160
3711 38      DEFB     +56
3712 C9      RET
;
3713 EF      RST      28
3714 3D      DEFB     +61;restack
3715 31      DEFB     +49;copy
3716 37      DEFB     +55;a>0
3717 00      DEFB     +0;j true
3718 04      DEFB     +4
3719 38      DEFB     +56;fp exit
371A CF      RST      08
371B 09      DEFB     +9;inv argument
; function list
371C A0      DEFB     +160
371D 02      DEFB     +2;delete
371E 38      DEFB     +56;fp exit
371F 7E      LD       A,(HL)
3720 3680     LD       (HL),80
3722 CD282D   CALL    2D28
;
3725 EF      RST      28
3726 34      DEFB     +52;literal
3727 3800     DEFB     +56,+0
3729 03      DEFB     +3;subtract
372A 01      DEFB     +1;exchg
372B 31      DEFB     +49;copy
372C 34      DEFB     +52;literal
372D F04CCCCC DEFB     +240,+76,+204,+204
3731 CD      DEFB     +205
3732 03      DEFB     +3;subtract
3733 37      DEFB     +55;a>0
3734 00      DEFB     +0;j true
3735 08      DEFB     +8
3736 01      DEFB     +1;exchg
3737 A1      DEFB     +161
3738 03      DEFB     +3;subtract
3739 01      DEFB     +1;exchg
373A 38      DEFB     +56;fp exit
373B 34      INC      (HL)
;
373C EF      RST      28
373D 01      DEFB     +1;exchg
373E 34      DEFB     +52;literal
373F F0317217 DEFB     +240,+49,+114,+23
3743 F8      DEFB     +248
3744 04      DEFB     +4;multiply

```

```

3745 01      DEFB      +1;exchg
3746 A2      DEFB      +162
3747 03      DEFB      +3;subtract
3748 A2      DEFB      +162
3749 03      DEFB      +3;subtract
374A 31      DEFB      +49;copy
374B 34      DEFB      +52;literal
374C 3220    DEFB      +50,+32
374E 04      DEFB      +4;multiply
374F A2      DEFB      +162
3750 03      DEFB      +3;subtract
3751 8C      DEFB      +140
3752 11AC    DEFB      +17,+172
3754 1409    DEFB      +20,+9
3756 56DAA5  DEFB      +86,+218,+165
3759 5930C5  DEFB      +89,+48,+197
375C 5C90AA  DEFB      +92,+144,+170
375F 9E706F61 DEFB      +158,+112,+111,+97
3763 A1CBDA96 DEFB      +161,+203,+218,+150
3767 A4319FB4 DEFB      +164,+49,+159,+180
376B E7A0FE5C DEFB      +231,+160,+254,+92
376F FC      DEFB      +252
3770 EA1B43CA DEFB      +234,+27,+67,+202
3774 36      DEFB      +54
3775 EDA79C7E DEFB      +237,+167,+156,+126
3779 5E      DEFB      +94
377A F06E2380 DEFB      +240,+110,+35,+128
377E 93      DEFB      +147
377F 04      DEFB      +4;multiply
3780 0F      DEFB      +15;add
3781 38      DEFB      +56;fp exit
3782 C9      RET
;
3783 EF      RST       28
3784 3D      DEFB      +61;restack
3785 34      DEFB      +52;literal
3786 EE22F983 DEFB      +238,+34,+249,+131
378A 6E      DEFB      +110
378B 04      DEFB      +4;multiply
378C 31      DEFB      +49;copy
378D A2      DEFB      +162
378E 0F      DEFB      +15;add
378F 27      DEFB      +39;INT
3790 03      DEFB      +3;subtract
3791 31      DEFB      +49;copy
3792 0F      DEFB      +15;add
3793 31      DEFB      +49;copy
3794 0F      DEFB      +15;add
3795 31      DEFB      +49;copy
3796 2A      DEFB      +42;ABS
3797 A1      DEFB      +161
3798 03      DEFB      +3;subtract
3799 31      DEFB      +49;copy
379A 37      DEFB      +55;a>0
379B C0      DEFB      +192;store 0

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```

379C 00      DEFB      +0;j true
379D 04      DEFB      +4
379E 02      DEFB      +2;delete
379F 38      DEFB      +56;fp exit
37A0 C9      RET
; function list
37A1 A1      DEFB      +161
37A2 03      DEFB      +3;subtract
37A3 01      DEFB      +1;exchg
37A4 36      DEFB      +54;a<0
37A5 00      DEFB      +0;j true
37A6 02      DEFB      +2
37A7 1B      DEFB      +27;negate
37A8 38      DEFB      +56;fp exit
37A9 C9      RET
;
37AA EF      RST       28
37AB 39      DEFB      +57;get
37AC 2A      DEFB      +42;ABS
37AD A1      DEFB      +161
37AE 03      DEFB      +3;subtract
37AF E0      DEFB      +224;get 0
37B0 00      DEFB      +0;j true
37B1 06      DEFB      +6
37B2 1B      DEFB      +27;negate
37B3 33      DEFB      +51;jump
37B4 03      DEFB      +3
;
37B5 EF      RST       28
37B6 39      DEFB      +57;get
37B7 31      DEFB      +49;copy
37B8 31      DEFB      +49;copy
37B9 04      DEFB      +4;multiply
37BA 31      DEFB      +49;copy
37BB 0F      DEFB      +15;add
37BC A1      DEFB      +161
37BD 03      DEFB      +3;subtract
37BE 86      DEFB      +134
37BF 14E6    DEFB      +20,+230
37C1 5C1F0B  DEFB      +92,+31,+11
37C4 A38F38EE DEFB      +163,+143,+56,+238
37C8 E91563BB DEFB      +233,+21,+99,+187
37CC 23      DEFB      +35
37CD EE920DCD DEFB      +238,146,+13,+205
37D1 ED      DEFB      +237
37D2 F1235D1B DEFB      +241,+35,+93,+27
37D6 EA      DEFB      +234
37D7 04      DEFB      +4;multiply
37D8 38      DEFB      +56;fp exit
37D9 C9      RET
;
37DA EF      RST       28
37DB 31      DEFB      +49;copy
37DC 1F      DEFB      +31;SIN
37DD 01      DEFB      +1;exchg

```

```

37DE 20      DEFB      +32;COS
37DF 05      DEFB      +5;divide
37E0 38      DEFB      +56;fp exit
37E1 C9      RET
;
37E2 CD9732  CALL      3297
37E5 7E      LD        A,(HL)
37E6 FE81    CP        81
37E8 380E    JR        C,+14;37F8
37EA EF      RST       28
37EB A1      DEFB      +161
37EC 1B      DEFB      +27;negate
37ED 01      DEFB      +1;exchg
37EE 05      DEFB      +5;divide
37EF 31      DEFB      +49;copy
37F0 36      DEFB      +54;a<0
37F1 A3      DEFB      +163
37F2 01      DEFB      +1;exchg
37F3 00      DEFB      +0;j true
37F4 06      DEFB      +6
37F5 1B      DEFB      +27;negate
37F6 33      DEFB      +51;jump
37F7 03      DEFB      +3
;
37F8 EF      RST       28
37F9 A0      DEFB      +160
37FA 01      DEFB      +1;exchg
37FB 31      DEFB      +49;copy
37FC 31      DEFB      +49;copy
37FD 04      DEFB      +4;multiply
37FE 31      DEFB      +49;copy
37FF 0F      DEFB      +15;add
3800 A1      DEFB      +161
3801 03      DEFB      +3;subtract
3802 8C      DEFB      +140
3803 10B2    DEFB      +16,+178
3805 130E    DEFB      +19,+14
3807 55E48D  DEFB      +85,+228,+141
380A 5839BC  DEFB      +88,+57,+188
380D 5B98FD  DEFB      +91,+152,+253
3810 9E003675 DEFB      +158,+0,+54,+117
3814 A0DBE8B4 DEFB      +160,+219,+232,+180
3818 6342C4  DEFB      +99,+66,+196
381B E6B50936 DEFB      +230,+181,+9,+54
381F BE      DEFB      +190
3820 E936731B DEFB      +233,+54,+115,+27
3824 5D      DEFB      +93
3825 ECD8DE63 DEFB      +236,+216,+222,+99
3829 BE      DEFB      +190
382A F061A1B3 DEFB      +240,+97,+161,+179
382E 0C      DEFB      +12
382F 04      DEFB      +4;multiply
3830 0F      DEFB      +15;add
3831 38      DEFB      +56;fp exit
3832 C9      RET

```

```

;
3833 EF      RST      28
3834 31      DEFB     +49;copy
3835 31      DEFB     +49;copy
3836 04      DEFB     +4;multiply
3837 A1      DEFB     +161
3838 03      DEFB     +3;subtract
3839 1B      DEFB     +27;negate
383A 28      DEFB     +40;SQR
383B A1      DEFB     +161
383C 0F      DEFB     +15;add
383D 05      DEFB     +5;divide
383E 24      DEFB     +36;ATN
383F 31      DEFB     +49;copy
3840 0F
3841 38      DEFB     +56;fp exit
3842 C9      RET
;
3843 EF      RST      28
3844 22      DEFB     +34;ASN
3845 A3      DEFB     +163
3846 03      DEFB     +3;subtract
3847 1B      DEFB     +27;negate
3848 38      DEFB     +56;fp exit
3849 C9      RET
;
384A EF      RST      28
384B 31      DEFB     +49;copy
384C 30      DEFB     +48;NOT
384D 00      DEFB     +0;j true
384E 1E      DEFB     +30
384F A2      DEFB     +162
3850 38      DEFB     +56;fp exit
;
3851 EF      RST      28
3852 01      DEFB     +1;exchg
3853 31      DEFB     +49;copy
3854 30      DEFB     +48;NOT
3855 00      DEFB     +0;j true
3856 07      DEFB     +7
3857 25      DEFB     +37;LN
3858 04      DEFB     +4;multiply
3859 38      DEFB     +56;fp exit
385A C3C436  JP      36C4
; function list
385D 02      DEFB     +2;delete
385E 31      DEFB     +49;copy
385F 30      DEFB     +48;NOT
3860 00      DEFB     +0;j true
3861 09      DEFB     +9
3862 A0      DEFB     +160
3863 01      DEFB     +1;exchg
3864 37      DEFB     +55;a>0
3865 00      DEFB     +0;j true
3866 06      DEFB     +6

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```

3867 A1      DEFB      +161
3868 01      DEFB      +1;exchg
3869 05      DEFB      +5;divide
386A 02      DEFB      +2;delete
386B A1      DEFB      +161
386C 38      DEFB      +56;fp exit
386D C9      RET
;
;          unused in ROM
386E FFFF      DEFB      HI,HI
3870 FFFFFFFF  DEFB      HI,HI,HI,HI
3CFC FFFFFFFF  DEFB      HI,HI,HI,HI
;
; character set bit map from +32 to +127
3D00 00000000 00000000 ;20 space
3D08 00101010 10001000 ;21 exclamation
3D10 00242400 00000000 ;22 quote
3D18 00247E24 247E2400 ;23 hash
3D20 00083E28 3E0A3E08 ;24 dollar
3D28 00626408 10264600 ;25 percent
3D30 00102810 2A443A00 ;26 ampersand
3D38 00081000 00000000 ;27 apostrophe
3D40 00040808 08080400 ;28 left paren
3D48 00201010 10102000 ;29 right paren
3D50 00001408 3E081400 ;2A asterisk
3D58 00000808 3E080800 ;2B plus
3D60 00000000 00080810 ;2C comma
3D68 00000000 3E000000 ;2D minus
3D70 00000000 00181800 ;2E period
3D78 00000204 08102000 ;2F slash
3D80 003C464A 52623C00 ;30 0 (zero)
3D88 00182808 08083E00 ;31 1
3D90 003C4202 3C407E00 ;32 2
3D98 003C420C 02423C00 ;33 3
3DA0 00081828 487E0800 ;34 4
3DA8 007E407C 02423C00 ;35 5
3DB0 003C407C 42423C00 ;36 6
3DB8 007E0204 08101000 ;37 7
3DC0 003C423C 42423C00 ;38 8
3DC8 003C4242 3E023C00 ;39 9
3DD0 00000010 00001000 ;3A colon
3DD8 00001000 00101020 ;3B semicolon
3DE0 00000408 10080400 ;3C less than
3DE8 0000003E 003E0000 ;3D equals
3DF0 00001008 04081000 ;3E greater than
3DF8 003C4204 08000800 ;3F query
3E00 003C4A56 5E403C00 ;40 at-sign
3E08 003C4242 7E424200 ;41 A
3E10 007C427C 42427C00 ;42 B
3E18 003C4240 40423C00 ;43 C
3E20 00784442 42447800 ;44 D
3E28 007E407C 40407E00 ;45 E
3E30 007E407C 40404000 ;46 F
3E38 003C4240 4E423C00 ;47 G
3E40 0042427E 42424200 ;48 H

```

```

3E48 003E0808 08083E00 ;49 I
3E50 00020202 42423C00 ;4A J
3E58 00444870 48444200 ;4B K
3E60 00404040 40407E00 ;4C L
3E68 0042665A 42424200 ;4D M
3E70 00426252 4A464200 ;4E N
3E78 003C4242 42423C00 ;4F O (letter)
3E80 007C4242 7C404000 ;50 P
3E88 003C4242 524A3C00 ;51 Q
3E90 007C4242 7C444200 ;52 R
3E98 003C403C 02423C00 ;53 S
3EA0 00FE1010 10101000 ;54 T
3EA8 00424242 42423C00 ;55 U
3EB0 00424242 42241800 ;56 V
3EB8 00424242 425A2400 ;57 W
3EC0 00422418 18244200 ;58 X
3EC8 00824428 10101000 ;59 Y
3ED0 007E0408 10207E00 ;5A Z
3ED8 000E0808 08080E00 ;5B left sq bracket
3EE0 00004020 10080400 ;5C back slash
3EE8 00701010 10107000 ;5D right sq bracket
3EF0 00103854 10101000 ;5E up arrow
3EF8 00000000 000000FF ;5F underline
3F00 001C2278 20207E00 ;60 pound
3F08 00003804 3C443C00 ;61 a
3F10 0020203C 22223C00 ;62 b
3F18 00001C20 20201C00 ;63 c
3F20 0004043C 44443C00 ;64 d
3F28 00003844 78403C00 ;65 e
3F30 000C1018 10101000 ;66 f
3F38 00003C44 443C0438 ;67 g
3F40 00404078 44444400 ;68 h
3F48 00100030 10103800 ;69 i
3F50 00040004 04042418 ;6A j
3F58 00202830 30282400 ;6B k
3F60 00101010 10100C00 ;6C l
3F68 00006854 54545400 ;6D m
3F70 00007844 44444400 ;6E n
3F78 00003844 44443800 ;6F o
3F80 00007844 44784040 ;70 p
3F88 00003C44 443C0406 ;71 q
3F90 00001C20 20202000 ;72 r
3F98 00003840 38047800 ;73 s
3FA0 00103810 10100C00 ;74 t
3FA8 00004444 44443800 ;75 u
3FB0 00004444 28281000 ;76 v
3FB8 00004454 54542800 ;77 w
3FC0 00004428 10284400 ;78 x
3FC8 00004444 443C0438 ;79 y
3FD0 00007C08 10207C00 ;7A z
3FD8 000E0830 08080E00 ;7B left brace
3FE0 00080808 08080800 ;7C vertical bar
3FE8 0070100C 10107000 ;7D right brace
3FF0 00142800 00000000 ;7E tilde (wavy line)
3FF8 3C4299A1 A199423C ;7F copyright symbol

```

END

M I C R O D R I V E

&

I N T E R F A C E 1

D E C O D E D

Details of the Microdrive & Interface 1
for
Machine Code Programmers

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Chapter 1 INTRODUCTION

This document details the design of the Sinclair ZX Interface 1 from the practical viewpoint of a machine code programmer, with some introductory material where necessary.

The Sinclair ZX Interface 1 (IF1 for short) is a black slab of electronics that fits under and screws into your Sinclair ZX Spectrum, making electrical contact through the existing edge connector. The signals necessary to drive the printer are extended through to the back of the unit, although it is suspected that the levels do not match perfectly such that some printers may not work with some IF1 units.

The IF1 comes with the necessary connectors for a network of up to sixty four Spectrums and from one to eight Microdrives. You will however need to buy a cable for the bidirectional RS232 interface.

As a result of the design of the IF1, many of the new software routines inside the IF1 can be accessed by function calls from a program running in the ZX Spectrum itself.

The internal details of the IF1 are jealously protected by Sinclair Research Ltd and may in any case change - but the software interface will remain the same. It makes sense for programmers to use the function calls to ensure compatibility with future models of the IF1.

At this stage the IF1 has not been subjected to the mass market and it is possible that unusual features and even bugs will appear under extended thrashing by consumers. Up to the end of January 1984 the author will pay ONE POUND STERLING (wow!) for the first written notification of each such unusual item. Corrections and comments about this document are also welcome.

Chapter 2 RS232 INTERFACE

RS232 is a common method in the data processing world of sending and receiving information as bit patterns, one bit at a time.

The RS232 serial data transmission convention and the ASCII character representation (where 'A' has the bit pattern 0100 0001 value 65 decimal) are about the only 'standards' common to most computers: micro, mini and mainframe alike.

The RS232 interface is therefore the first step to swapping data between your Spectrum and almost any other computer in the world. You can also connect the IF1 to the telephone system through a modem, or to a plain paper printer that has a matching RS232 interface.

The IF1 provides a single system variable that determines the speed in both the send and receive directions, two software channels for Basic programmers (binary and text) and two machine code functions (send byte and receive byte).

The speed of the RS232 interface is measured in bits per second from 1 to 19200, loosely known as the baud rate. Here are the ten conventional baud rates with an indication of their applications: 50 and 110 for electro-mechanical typewriters, 300 and 600 for the public telephone system, 1200 and 2400 and 4800 for private telephone connections, 9600 for most computer interfaces, 19200 for higher speed computer interfaces.

The speed is controlled in the IF1 by the new system variable BAUD (see System Variables Appendix). This is a software delay set by the Basic statement `FORMAT 'b';speed` or `FORMAT 't';speed`. It can also be computed and set from machine code using the formula $BAUD = \text{nearest integer to } (134615/\text{speed}) - 2$. For instance a speed of 9600 bps gives the value +12, which is the default value of BAUD.

The binary channel 'b' sends and receives a byte as a full 8-bit pattern regardless of its meaning. The text channel 't' sends and receives characters in the range up to 127 decimal.

On input to the 't' channel using `INPUT` or `INKEY$` in Basic, any byte value outside the range 0-127 is treated as the equivalent character 128 less.

On output from the 't' channel the control characters below 32 are ignored, except that `ENTER` (value 13) is sent as a carriage return (value 13) followed by a line feed (value 10). A graphic character in the range 128 to 164 is translated into a question mark (value 63). Spectrum tokens from 165 to 255 are sent as the text equivalent, eg the value 255 is sent as the four letters 'COPY'.

GoS(c)1983 SPECTRUM INTERFACE 1: RS232 INTERFACE

Now follows a description of the IF1 function calls that concern the RS232 interface. For further details about the interface, see the RS232 Appendix.

Function +29 (1DH) RECEIVE RS232 BYTE WITH TIMEOUT

When called from machine code (see Chapter 5) this function gets a single byte (if available) from the RS232 interface at the current baud rate.

The function tests for a byte either from the system variable SERBYT, which acts as a one byte backup buffer, or from the interface itself. If found, the byte is returned in the A register with the carry flag set.

The IF1 assembles a byte from 8 data bits which arrive one at a time (bit 0 first), followed by one stop bit - the stop bit is accepted but ignored.

If there is no activity on the interface (no data or not connected) the routine times out. The carry flag is cleared and the A register is returned with a zero value.

After switching off the Clear To Send signal, the IF1 stays around awhile to check that there is no more activity from the other system. If any fresh signals arrive, the incoming byte is assembled and stored in the backup buffer SERBYT and the serial flag SERFL is set non zero, ready for the next call to this function.

Function +30 (1EH) SEND RS232 BYTE

This function takes a single byte from the A register and sends it to the RS232 interface for serial transmission at the current baud rate.

The interface transmits the byte as the 8 data bits one at a time (bit 0 sent first) followed by two stop bits.

Chapter 3 MICRODRIVE

Data is recorded on a Microdrive cartridge as a number of files, each of which is a series of records up to 512 bytes each. There is a logical maximum of 256 small files, but the practical limit is determined by the data space available on the cartridge.

There are two types of Microdrive file: they can be distinguished as data files and program files. A data file can be handled in Basic with PRINT, INPUT, INKEY\$ and the new command MOVE. A program file can only be handled by SAVE, LOAD, VERIFY and MERGE. As a further security feature, a filename that starts with the null character CHR\$ 0 will not appear in a catalogue of the cartridge although it can be accessed if you use the correct name. Similar use of control characters in a filename can confuse the innocent and frustrate the pirates, since a file can only be accessed by its correct name.

The data records on a cartridge are stored in fixed length sectors. The number of sectors on a cartridge is determined when the cartridge is initialised. The FORMAT command (eg FORMAT "m";1;"AC-0184") writes each sector with its cartridge name and sector number, up to the maximum possible number of sectors on that particular cartridge.

A bad sector found during a FORMAT is marked as unavailable so that it will not be used for storing data. Later on, the creation of a drive map (see below) will again check the sectors and set bit flags in memory for any more sectors that have become unuseable as well as those already unavailable.

A sector contains, with appropriate timing data, a sector header block of 15 bytes, 16 bytes of record control information and 512 record data bytes.

The sector header block identifies the cartridge name and sector number and also carries a header flag byte and checksum byte.

The record control information gives the filename, record number, length of the current record, a record flag byte and separate checksum bytes for the control bytes and data bytes. The record flag byte includes a security bit that flags the file type as data or program.

The data comprises 512 bytes (half a KiloByte) unless this is the last record in a file. Partial blocks are buffered in the channel area for that file until the block is full or the file is closed. A bit is set in the record flag byte to signal the last record, which might therefore be shorter than 512 bytes.

The main software feature of the Microdrive is the absence of a physical catalogue on the cartridge tape loop. The existence and location of the records of a file is deduced simply by looking for the records, which are self-identifying since they each carry the filename and record number.

For instance, the command CAT 1 builds up the catalogue by scanning the whole cartridge on drive number 1 and noting which filenames are referenced by the valid records.

This economical approach has some drawbacks. When a program opens a new file, the software has to read the whole cartridge to check that the file does not already exist. At the same time a map of the free sectors must be created because a new record is always written into the first free sector on a cartridge.

There is also a danger that, if a small file is represented by only one sector on the cartridge, that sector may be misread. The software would then assume that the file does not exist. In the case of an OPEN operation, a new file of the same name would be opened for writing which could cause a lot of confusion. For a CAT command, the file would be omitted from the catalogue list. (Incidentally, if the CAT command does not show the file you expect, repeat the command - even with scrolling there is a limit to the amount that CAT can display at one time).

When a program opens a file on a particular drive, the software checks to see if a map exists in memory for that drive - if not, one is created.

The Basic programming manual in Chapter 24 shows an address for the start of the Microdrive maps that is no longer true. When the IF1 is activated, some extra system variables are created which push the starting address of the first map up to 23792 decimal (5CF0 hex).

The system keeps a single map for each drive that contains at least one open file, thus the number of maps cannot exceed the number of attached drives. If no files are open, there are no maps.

The map for a drive occupies 32 bytes which is 256 bits. Bit x of byte y represents sector $y*8 + x$, numbering from zero in each case. Thus bit 0 of byte 0 represents sector 0 and bit 7 of byte 31 represents sector 255. The bit is set if the corresponding sector is already occupied or otherwise unavailable for new data, and reset if the sector is free. A free sector is defined as a block of less than 512 bytes not marked 'end of file'.

Four Spectrum channels are kept open at all times, for the keyboard, screen, internal workspace and printer, and occupy five bytes each. The first IF1 channel area (eg for a Microdrive file) is therefore twenty bytes beyond the start of the system variable address CHANS.

In Basic, the number of files that can be open at any one time is limited by the number of streams (0 to 15) attached to the channels and the available memory. The only limit in machine code is memory space for the channel areas, since the IF1 functions assume the caller is handling the channels via the IX register. Note that the channel address in IX is only valid if the CHANS address and contents remain the same. The opening or closing of a file, for example, is liable to change both these items.

Now follows a description of each IF1 function call that concerns the Microdrive. For further details about the Microdrive, see the Microdrive Appendix.

Function +33 (21H) with A=0 DE-SELECT DRIVE

Turns all the drive motors off, de-selects all the drives and enables interrupts.

Error return: none.

Function +33 (21H) with A=1 SELECT DRIVE

Selects the drive specified (range 1-8). Interrupts are disabled and the motor is started in the selected drive.

Error return: no response from the drive.

This is usually because it is not plugged in or there is no formatted cartridge in it. All drives are de-selected before the error return.

Function +34 (22H) OPEN MICRODRIVE DATA FILE

The data file is defined by the first file specifier (DSTR1, NSTR1, FSTR1) in the extra system variables. Note that there is no way for you to specify whether the file is new or old.

The function creates a new channel area in CHANS, ensures that a map exists for that drive and pushes everything in memory up towards STKEND to make room. The function returns with IX pointing to the channel area.

The drive is selected and searched. If the file is found to exist then its first record is read into the buffer and bit 0 of the channel flag byte (CHFLAG) is reset to indicate that the file has been opened for reading.

If the file does not exist, ie no records are found, the map has been updated to show the location of all free sectors; bit 0 of the channel flag byte is set to indicate that the file has been opened for writing. A file can be opened more than once for reading (in Basic it can be attached to several different streams at the same time) but a file can only be opened once for writing.

Note that every file opened creates a fresh channel area, even if the same filename is already open from a previous function call. This allows the same data file to be read from two streams. For example, a program can hold one record in a computer dating file while searching the same file for a suitable partner; similarly, a parts file can hold cross references to a sub assembly.

Error return: not a data file; first record of existing file not found; file already open for writing.

Function +35 (23H) CLOSE MICRODRIVE DATA FILE

The caller gives the channel address in IX. If the file was opened for write, the buffer is flushed; the current record is written onto the first free sector of the microdrive.

The channel is deallocated and the rest of memory to STKEND is moved down. Similarly for the drive map, unless it is in use by another channel.

Error return: no free sectors (for current record to be written).

Function +36 (24H) ERASE MICRODRIVE FILE

The file (data or program) is defined by the first file specifier (DSTR1, NSTR1, FSTR1) in the extra system variables. The function does not report an error if it cannot find the file.

The function inserts a temporary channel area in CHANS and ensures that a drive map exists. The drive is searched for records belonging to that file and the sectors are marked as available.

The temporary channel is then closed. Similarly for the corresponding map, unless it is in use by another channel.

Error return: none.

Function +37 (25H) READ MICRODRIVE DATA RECORD (SEQUENTIAL)

The caller gives the channel address in IX. The function reads the next record in the data file belonging to that channel. If successful, the relative record number in CHREC is incremented.

Error return: read past end of file; no such record; not a data file. If not a data file, the channel is closed.

Function +38 (26H) WRITE MICRODRIVE DATA RECORD

The caller gives the channel address in IX. The function writes the record from the channel onto the next free sector on the drive. Note that the relative record number is not incremented.

Error return: no free sectors.

Function +39 (27H) READ MICRODRIVE RECORD RANDOM

The caller gives the channel address in IX. The function reads the record specified by CHREC into the channel area. Note that the relative record number is not incremented.

Error return: no free sectors; not a data file.
If not a data file, the channel is closed.

Function +40 (28H) READ MICRODRIVE SECTOR

The caller gives the channel address in IX and should have previously selected the drive. The function reads the data block from the sector specified by CHREC. The carry flag is set if the data is not valid or if there is a checksum error. The data in the buffer will be erased if it belongs to a program file.

Errors detected: sector not found within one revolution.

Function +41 (29H) READ NEXT MICRODRIVE SECTOR

The caller gives the channel address in IX and should have previously selected the drive. The function reads the data block from the next sector, specified by HDNUMB in the channel header block. This can be a convenient way of finding the location of a cartridge.

The carry flag is set if the data is not valid or if there is a checksum error. The data in the buffer will be erased if it belongs to a program file.

Error return: sector not found within one revolution.

Function +42 (2AH) WRITE MICRODRIVE SECTOR

The caller gives the channel address in IX and should have previously selected the drive. The function writes the data block into the sector identified by CHREC. The map is marked to indicate that the sector is occupied.

Error return: drive is write protected; sector not found.

Function +43 (2BH) CREATE MICRODRIVE CHANNEL AREA

The data file is defined by the first file specifier as for the Open function +34 (22H). The function inserts a new channel area and ensures that a map exists for the appropriate drive. The function returns with IX pointing to the channel area.

Error return: none.

Function +44 (2CH) DELETE MICRODRIVE CHANNEL AREA

The caller gives the channel address in IX. It is deallocated and the rest of memory to the address in STKEND is moved down. Similarly for the drive map, unless it is in use by another channel.

Chapter 4 LOCAL AREA NETWORK

The network on the ZX Interface 1 is probably the cheapest commercial implementation of a local area network (LAN) in the world. It allows for the high speed linking of up to 64 ZX Spectrum computers using only two wires : signal and ground.

Each computer in the network (net for short) is assigned a station number from 1 (default) up to 64. The FORMAT "n";x command in Basic is used to change the station number.

Station numbers 64 and 62 are recognised by the IF1 system as the 'printer server' and its user station respectively. Station 62 can LIST over the net to the printer server, where the listing is printed with the MOVE command. See the IF1 manual for details of its operation in Basic.

Information is passed around the net in packets, with the source and destination station numbers attached to the message (rather like an airmail letter address and return address).

The IF1 uses the 'anarchy' method, similar to Ethernet, as opposed to the 'circulating slot' method of the Cambridge Ring. The advantage and disadvantage of anarchy is that no-one is in control; if more than one station tries to transmit at the same time (known as contention) the result is a garbled message.

The solution is a matter of etiquette! if the net is quiet you may try to send a message; if someone else starts at the same time, you both stop and try again later. The IF1 contains a nice refinement in that every station waits for the net to be free for a randomised interval before placing its packet on the net. This helps to avoid a false start where two packets collide because they both started at the same time.

The net has two file types as for the Microdrive: data and program. The net channels for program files are opened and closed automatically by the SAVE, LOAD, MERGE and VERIFY commands.

It is possible and interesting, if not useful, to receive program files over the net and process them as data, in the following manner :-

Sender

```
SAVE "n";1
```

Receiver

```
100 CLOSE £8 ; OPEN £8;"n";1
```

```
200 LET a%=INKEY$£8 ; IF a%="" THEN GOTO 200
```

```
300 PRINT CODE a%;" " ; GO TO 200
```

The main use of the network is of course to transfer data files. A typical transaction between two net stations is arranged as an exchange of data items. In Basic each station runs a program as follows :-

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```
100 IF receiver THEN GOTO 400
200 CLOSE £8: OPEN £8;"n";1
300 INPUT a$: PRINT £8;a$
400 CLOSE £8: OPEN £8;"n";1
500 INPUT £8;a$: PRINT a$
600 GOTO 200
```

If the receiver tries to input data beyond the end of the net buffer, the software takes the error return "end of file". The receiver must be aware of the end of file in advance, for instance by watching for a terminal data value or, as above, by fixing the number of data items. In machine code it may be feasible to monitor the relative values of the system and channel variables such as NCCUR & NCIBL.

A description of the IF1 network functions follows. See the Network Appendix for details of the net channel area.

Function +45 (2DH) OPEN NET CHANNEL

The caller puts his own station number into the system variable NTSTAT and the other station number into DSTR1 (assuming the extra system variables have been allocated).

The function opens a net channel between the two specified stations and returns with the IX register pointing to the net channel.

Error return: none.

Function +46 (2EH) CLOSE NET CHANNEL

The caller gives the channel address in IX. If there is still data in the channel to be sent, ie NCOBL > 0, then the buffer is flushed: the current packet is transmitted.

The channel is deallocated and the rest of memory to STKEND is moved down.

Error return: none.

Function +47 (2FH) RECEIVE NET PACKET

The caller gives the channel address in IX. The function gets the next packet, if any, from the net either as a broadcast or from a specific station addressed to the current station number. If the other station number (channel variable NCIRIS) is zero then the function expects a broadcast packet.

The channel variable NCNUMB contains the block number of the packet that has been requested. The packet is acknowledged when received successfully and NCNUMB is incremented. To avoid delays in case the previous acknowledgement had been lost, each acknowledgement covers two blocks: the current one and the one before.

TIMING The function waits indefinitely for a broadcast, and up to 12 ms before 'timing out' for a packet from a specific station number. If a packet arrives within that time, the function should still complete within 50 ms in total.

The carry flag is set if the function timed out; it is also set if an error was detected in the packet received, but the error return is not taken.

Error return: none.

Function +48 (30H) SEND NETWORK PACKET

The caller gives the channel address in IX, the end of file flag in the A register and sets up other parameters as shown below. The function sends the packet to the net as either a broadcast or addressed to a specific station number, in which case the function waits for an acknowledgement from the addressed station. The block number (channel variable NCNUMB) is incremented.

The end of file marker in the A register is either zero (normal) or 1 (this record is the end of file) and it is stored in the channel variable NCTYPE.

The number of bytes to send (non zero) is stored in the channel variable NCOBL. If the station number in the system variable NTDEST is zero then the packet is treated as a broadcast.

Chapter 5 MISCELLANEOUS FUNCTIONS

To make the job of writing application software easier, especially where random access is required to Microdrive files, functions in the Interface 1 ROM have been made available to the machine code programmer.

Most of the functions relate to the extra facilities provided by the Interface 1 hardware, and are discussed in the appropriate chapters. However, some functions have been added to make programming of the standard system easier and do not relate directly to the new hardware. Of course, without the IF1 none of the function calls exist.

The functions are called from address 8 in machine code:-

```
RST    08
DEFB   n
```

where n is the code for a particular function

An economical way of calling a function from Basic is to store the necessary machine code in a REM statement in the following manner,

```
1      REM CAT 1⊙ represents hex CF 31 C9 which calls function +49
4000   LET n=5+PEEK 23635+256*PEEK 23636 : REM n=(PROG)+5
4100   REM could POKE n+1,function here if required
4200   RANDOMIZE USR n
4900   RETURN
```

If the function cannot complete the request, or if it is abandoned in response to the break key, it makes an error return. That is, it loads SP from ERRSP and returns. Note that the caller can choose to handle errors by tampering with the contents of ERRSP.

As usual, register IY should point into the system variables at ERRNR (5C3A 23610) when any of the Spectrum or IF1 functions are called.

The extra system variables are created on the first function call to the IF1 software. A setup function +49 (31H) is also provided to make sure that the variables have been allocated, for instance if they are to be modified before the first function call proper.

The miscellaneous functions and their parameters are described next. All registers except those mentioned as returning a value are likely to be corrupted during execution of the function. A summary list of the functions is given in an Appendix.

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Function +27 (1BH) CONSOLE INPUT

Waits for input from the Spectrum keyboard using the usual keyscan routine, picks the character out of the system variable LASTK and returns it to the caller in the A register. The character is not echoed to the screen.

Function +28 (1CH) CONSOLE OUTPUT

Takes the character in the A register and calls the standard output routine in the system stream -2, which is attached to the screen channel 's', as for the Basic command PRINT.

Function +31 (1FH) ZX PRINTER OUTPUT

Takes the character in the A register and calls the standard output routine in stream 3, which is normally attached to the printer channel 'p', as for the Basic command LPRINT.

Function +32 (20H) KEYBOARD TEST

Tests the keyboard port to see if a key is being pressed and returns immediately. Sets the carry flag if there was some activity.

Function +49 (31H) CREATE SYSTEM VARIABLES

Tests the current value of the system variable CHANS to see if the extra system variables already exist. If not, the function makes space for and initialises the extra system variables needed for IF1.

The function should be called before initialising any of the extra system variables. For instance, during any activity on the net channel (also on the RS232 interface) the screen border flashes. To avoid this irritating feature, you can change either the border colour or the extra system variable IOBORD at the start of your program so that they both match, or the contrast is at least reduced (eg White and Yellow). Function +49 (31H) would be used in this case to ensure that IOBORD exists before it is referenced.

Appendix A: SYSTEM VARIABLES

With the microdrive, network & RS232 software the complete set of system variables is shown below. To maintain consistency with existing documentation, the names of the variables match those in the Sinclair Spectrum manuals.

-058	5C00	23552	KSTATE	Keyboard byte
-050	5C08	23560	LASTK	Last keypress
-049	5C09	23561	REPDEL	Delay until repeat starts (default +35)
-048	5C0A	23562	REPPER	Key repeat delay (default 5)
-047	5C0B	23563	DEFADD	=> DEF FN params during evaluation
-045	5C0D	23565	KDATA	Second byte of colour control from keyboard
-044	5C0E	23566	TVDATA	Both bytes of colour, AT, TAB controls
-042	5C10	23568	STRMS	Address of stream array (attached channels)
-004	5C36	23606	CHARS	+256 => bit patterns of Ascii character set
-002	5C38	23608	RASP	Duration of buzz (eg if no mem for input)
-001	5C39	23609	PIP	Duration of keyboard click (default 0)
+000	5C3A	23610	ERRNR	+1 = error report code <<< IY points here
+001	5C3B	23611	FLAGS	Eg bit 5=LASTK is valid/bit 1=printer output
+002	5C3C	23612	TVFLAG	Flag bits
+003	5C3D	23613	ERRSP	=> top of stack for RET on error
+005	5C3F	23615	LISTSP	=> return from auto list
+007	5C41	23617	MODE	Keyword,Extended,Graphics or Letters/Caps
+008	5C42	23618	NEWPPC	Next line number of program
+010	5C44	23620	NSPPC	Next statement offset (in next line)
+011	5C45	23621	PPC	Current program line number
+013	5C47	23623	SUBPPC	Current statement offset (in current line)
+014	5C48	23624	BORDCR	Bits 5 4 3 = Border colour
+015	5C49	23625	EPCC	Program cursor line number
+017	5C4B	23627	VARS	=> first variable
+019	5C4D	23629	DEST	=> variable during assignment
+021	5C4F	23631	CHANS	=> first channel area
+023	5C51	23633	CURCHL	=> current channel entry
+025	5C53	23635	PROG	=> first line number in program
+027	5C55	23637	NXTLIN	=> next program line
+029	5C57	23639	DATADD	=> just past last DATA item read
+031	5C59	23641	ELINE	=> edit line
+033	5C5B	23643	KCUR	=> cursor
+035	5C5D	23645	CHADD	=> next program byte
+037	5C5F	23647	XPTR	=> syntax error
+039	5C61	23649	WORKSP	=> workspace
+041	5C63	23651	STKBOT	=> calculator stack base
+043	5C65	23653	STKEND	Topmost address used by Basic
+045	5C67	23655	BREG	Byte used by calculator
+046	5C68	23656	MEM	=> calculator memory
+048	5C6A	23658	FLAGS2	Bit flags

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+049	5C6B	23659	DFSZ	Lines in lower screen (default 2)
+050	5C6C	23660	STOP	Line number of top line of auto list
+052	5C6E	23662	OLDPPC	Continuation line number
+054	5C70	23664	OSPCC	(or OSPCC) continuation statement number
+055	5C71	23665	FLAGX	Bit flags
+056	5C72	23666	STRLEN	String length during assignment
+058	5C74	23668	TADDR	=> next syntax table item
+060	5C76	23670	SEED	word used by random number routines
+062	5C78	23672	FRAMES	Frame counter: low, medium, high bytes
+065	5C7B	23675	UDG	=> bit patterns for user defined graphics
+067	5C7D	23677	COORDS	Plot x value
+068	5C7E	23678		Plot y value
+069	5C7F	23679	PPOSN	Printer position (range 33-02)
+070	5C80	23680	PRCC	Low byte of next address in printer buffer
+071	5C81	23681		Spare
+072	5C82	23682	ECHOE	Column, Line for input buffer
+074	5C84	23684	DFCC	Next screen location for PRINT
+076	5C86	23686	DFCCL	Next screen location in lower screen
+078	5C88	23688	SPOSN	Screen column 33-02
+079	5C89	23689		Screen line 24-01
+080	5C8A	23690	SPOSNL	Lower screen column
+081	5C8B	23691		Lower screen line
+082	5C8C	23692	SCRCT	-1 = remaining scroll count (0 is maximum)
+083	5C8D	23693	ATTRP	Screen colours
+084	5C8E	23694	MASKP	Defines the transparent screen colours
+085	5C8F	23695	ATTRT	Temporary colours
+086	5C90	23696	MASKT	Defines the transparent temporary colours
+087	5C91	23697	PFLAG	Bit flags
+088	5C92	23698	MEMBOT	Scratchpad area for calculator routines
+118	5CB0	23728	SPARE2	Word referenced only by NMI @ 0066H
+120	5CB2	23730	RAMTOP	=> highest stack byte (value 3E hex)
+122	5CB4	23732	PRAMT	=> highest byte that passed RAM test
+123	5CB5	23733	(last standard system variable byte)
***** EXTRA SYSTEM VARIABLES USED WITH INTERFACE 1				
+124	5CB6	23734	FLAGS3	Bit flags
+125	5CB7	23735	VECTOR	Address used to extend the Basic interpreter
+127	5CB9	23737	SBRT	ROM paging subroutine
+128	5CBA	23738	SBRTHL	
+137	5CC3	23747	BAUD	Two byte number determining baud rate Calculated BAUD=(3500000/(26*baud rate))-2
+139	5CC5	23749	NTSTAT	Own net station number 1-64 (default 1)
+140	5CC6	23750	IOEORD	Border colour during I/O (default black)
+141	5CC7	23751	SERFL	RS232 flag (on input, 1=byte buffered)
+142	5CC8	23752	SERBYT	RS232 byte (on input, backup buffer)
+143	5CC9	23753	SECTOR	Two byte workspace used by Microdrive
+145	5CCB	23755	CHADDT	Temporary store for CHADD
+147	5CCD	23757	NTRESP	Store for net response code

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Network buffer				
+148	5CCE	23758	NTDEST	Destination station number 0-64
+149	5CCF	23759	NTSRCE	Source station number 1-64
+150	5CD0	23760	NTNUMB	Net block number 0-65535
+152	5CD2	23762	NTTYPE	Header type code
+153	5CD3	23763	NTLEN	Data block length 0-255
+154	5CD4	23764	NTDCS	Data block checksum
+155	5CD5	23765	NTHCS	Header block checksum
First 8 byte file specifier				
+156	5CD6	23766	DSTR1	Two byte drive number 1-8
+158	5CD8	23768	SSTR1	Stream number 1-15
+159	5CD9	23769	LSTR1	Device type M/N/T/B
+160	5CDA	23770	NSTR1	Two byte length of filename
+162	5CDC	23772	FSTR1	Address of filename
Second 8 byte file specifier for MOVE & LOAD				
+164	5CDE	23774	DSTR2	Two byte drive number 1-8
+166	5CE0	23776	SSTR2	Stream number 1-15
+167	5CE1	23777	LSTR2	Device type M/N/T/B
+168	5CE2	23778	NSTR2	Two byte length of filename
+170	5CE4	23780	FSTR2	Address of filename
Workspace for SAVE & LOAD & VERIFY & MERGE				
+172	5CE6	23782	HD00	;
+173	5CE7	23783	HD08	Length of data 0-65535
+175	5CE9	23785	HD0D	Start of data 0-65535
+177	5CEB	23787	HD0F	Program length 0-65535
+179	5CED	23789	HD11	Line number to start program
Miscellaneous				
+181	5CEF	23791	COPIES	Number of copies made by SAVE (default 1)
Start of Microdrive map & Channel space				
+182	5CF0	23792	;	
(PROG)	5D05	23813	Start of program when IF1 enabled & streams closed	
(PROG)+0	High byte of line number			
(PROG)+1	Low byte			
(PROG)+2	Low byte of length of program line			
(PROG)+3	High byte			
(PROG)+4	First token in Basic program (eg REM)			
(PROG)+5	... remainder of Basic program			

Appendix B: RS232 HARDWARE

The connection on the IF1 is a 9-hole socket although only six of the holes are actually connected to the IF1 electronics. By convention, the nine holes are numbered in two rows from right to left, looking from the back of the IF1 unit. Pin 1 is thus at the top right and pin 6 is underneath it at the bottom right.

Pin	Signal meaning
1	not used
2	Data level input to Spectrum
3	Data level output from Spectrum
4	High = other end is turned on
5	High = other end is ready to receive
6	not used
7	Held low as ground reference voltage level
8	not used
9	Held high to signal that Spectrum is turned on

You will have to buy a 9-way D-plug and cable to fit onto the D-socket at the IF1 end of the RS232 link. Sinclair Research Ltd sell the particular cable that you will probably need, ending in a conventional 25-way D-plug and carrying the IF1's full range of six signals (known in the standard texts as TX, RX, DTR, CTS, GND and DSR respectively).

If you want or need to build your own RS232 cable, you will need to wire a 9-way D-plug to a suitable 6-wire (signals as above) or 3-wire (pins 2, 3 and 7) cable.

For the 3-wire interface you will need to solder or otherwise connect pin 9 (high when Spectrum is turned on) to pins 4 and 5 on the 9-way D-plug; this way the IF1 does not hang up waiting for whatever is at the other end of the RS232 cable to become ready for action. Naturally the other end had better be ready when the Spectrum does send out information.

Whatever cable you have, the commonest initial 'fault' seems to be due to the general muddle surrounding pins 2 and 3 on the RS232 plugs/sockets. It happens that the signal comes out of IF1 on pin 3 and data is expected to arrive at IF1 on pin 2. If nothing happens when you test your cable, it is always worth swapping the wires between pins 2 and 3 at any one end of the cable.

Only system designers need be concerned with a much rarer problem: the 8251A, the upgrade of the Intel 8251 chip, may occasionally send doubled characters when used with the CTS handshake line. The solution is to amend the 8251A driver routine to make sure that the transmit buffer is empty before sending the next byte. Note that this is a general fault in the 'other system' which is innocently exposed by the IF1!

Appendix C: MICRODRIVE HARDWARE

The Microdrive is an ingenious little tape recorder that accepts a removeable cartridge containing a continuous tape loop. If you are one of those who have the irresistible urge to peek inside your Microdrive, the main screws are hidden under the metallic faceplate (with the Spectrum colour flash in the corner). There is also a catch at the rear, near the base. Be warned that your guarantee would probably be invalidated if you were actually to undo the screws!

The IF1 comes with a single ribbon cable that plugs from the left hand side of the unit into the first Microdrive. The cable is symmetrical physically and electrically, so it does not matter which way up (or round) you connect it, as long as the cable is not twisted.

Up to eight Microdrives can be screwed together, with a keyed double socket between each pair to carry the signals along the 'daisy chain'. The drive nearest the IF1 is addressed by the software as drive number 1, counting outwards up to the maximum drive number 8.

The cartridges used with the Microdrive are continuous tape loops, complete with rollers and pressure pad, packed into a tiny box measuring 34 mm wide by 45mm long by 8 mm thick. Open the box by holding the narrow sides of the box and pulling the ribbed end of the cartridge.

Each cartridge is sold with some sticky labels and sticky numbers. The long thin labels go on the visible end of the cartridge and the oblong labels go on the marked flat area which is hidden when the cartridge is inside the box. (Unfortunately the Interface 1 manual describes the ribbed end of the cartridge as the 'top' and the flat area as the 'side' as if the Microdrive was turned up towards the ceiling).

Each cartridge has a write protect tab, like a cassette tape, but the absence of a tab does not physically prevent writing: the IF1 tests for the tab before starting a write operation.

To fit a cartridge into a drive, first ensure that the Spectrum is turned on and the red light on the front of the drive is off. Take the cartridge out of its box and hold it with the label area uppermost; push it into the slot until half the label is protruding and then press it firmly fully home. During this last stage the cartridge appears to be going in crooked but the ribbed section should end up snug against the slot.

Do not remove the cartridge when the red light is on. If by some mischance the red light stays on longer than 2 minutes, it is possible that the software has lost control of the drive. One solution is to switch off the whole system and then retrieve the tape, although the voltage transients may have corrupted the part of the tape under the tape head.

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The information on a cartridge is stored in fixed length sectors. The components of a sector take the following approximate times in milliseconds during a FORMAT write operation:-

Header block	1.1 ms	Cartridge name, sector number, checksum
Gap	3.2 ms	
Control & Data	21.2 ms	File, record, length, flag, data, checksums
Gap	6.1 ms	
TOTAL	31.6 ms	

A complete sector thus takes just under 32 milliseconds to pass the tape head during the FORMAT operation. Depending on the precise length of the tape loop and the speed of the drive motor, a tape cartridge (nominally 7 seconds long) should hold from 210 to 230 sectors. The IF1 software assumes an absolute limit of 256 sectors.

Since each sector holds 512 bytes of data, a tape can at best hold from 105 KB to 115 KB of data. Allowing for tape faults (sectors marked as not available) the useful range in practice is from 85 KB to 100 KB. A tape with less than 85 KB after the FORMAT operation can be considered a dud.

Appendix D: MICRODRIVE CHANNEL DATA

This information is derived from the Microdrive & Interface 1 manual.

When a microdrive file is opened, an area of length 595 bytes called a 'channel' is created. It is inserted into the space between the address indicated by the system variable CHANS and the address indicated by the system variable PROG. Thus the program is moved up in memory towards the address held in the system variable STKEND. The IX register is generally used in machine code to address a channel.

```

+00      DEFW  0008  ;RST 08 intercept address output
+02      DEFW  0008  ;RST 08 intercept address input
+04      DEFB  40     ;'M' for microdrive
+05      DEFW  output routine ;in IF1 ROM
+07      DEFW  input routine  ;in IF1 ROM
+09      DEFW  +595   ;length of buffer
          ;current channel byte counter in data area
+11  CHBYTE: DEFW  0;next data byte to be accessed, range 0-512 ?
          ;current channel record number in file
+13  CHREC:  DEFB  0;range 0-255
+14  CHNAME: DEFB  ten character filename, trailing spaces
+24  CHFLAG: DEFB  0;bit 0 set if writing,else reading;other bits unused
+25  CHDRIV: DEFB  0;drive number 1-8
+26  CHMAP:  DEFW  address of the map for this drive
+28      DEFB  12 bytes of 'preamble' for header workspace
+40  HDFLAG: DEFB  flag byte bit 0 set (in use), 1-7 unused
+41  HDNUMB: DEFB  sector number range 0-255
+42      DEFW  unused
+44  HDNAME: DEFB  ten character cartridge name, trailing spaces
+54  HDCHK:  DEFB  header checksum
+55      DEFB  12 bytes of 'preamble' for data workspace
;--- This is the start of the data block as written to a cartridge
+67  RECFLG: DEFB  record flag byte bit 0=0,1=last rec in file
      ;      ;      ;bit 2=not a PRINT file (ie secure, not readable)
      ;      ;      ;bits 3-7 unused
+68  RECNUM: DEFB  record number range 0-255
+69  RECLEN: DEFW  record length in bytes 0-512
+71  RECNAM: DEFB  10 byte filename, trailing spaces
+81  DESCHK: DEFB  checksum of preceding 14 bytes since RECNUM
+82  CHDATA: DEFB  512 bytes of channel data
+594  DCHK:  DEFB  checksum of preceding 512 bytes
;--- This is the end of the data block as written to a cartridge

```


Appendix E: NETWORK CHANNEL DATA

When a stream is opened to the net, a channel is created in the CHANS area, as described previously for a Microdrive channel. A network channel is 276 bytes long and contains a 255 byte buffer. The IX register is generally used to address the channel in machine code.

Temporary net channels are also created for the duration of a SAVE, LOAD, VERIFY or MERGE command.

+00	DEFW	8	
+02	DEFW	8	
+04	DEFB	4E; 'N'	
+05	DEFW	address of output subroutine in ROM	
+07	DEFW	address of input subroutine in ROM	
+09	DEFW	+276;length	
+11	NCIRIS: DEFB	destination station number	
+12	NCSELF: DEFB	station number of this Spectrum (source)	
+13	NCNUMB: DEFW	block number	
+15	NCTYPE: DEFB	type of packet 0=data, 1=EOF	
+16	NCOBL: DEFB	number of bytes in data block 0-255	
+17	NCDCS: DEFB	data checksum	
+18	NCHCS: DEFB	header checksum	
+19	NCCUR: DEFB	position of the last data byte taken	
+20	NCIBL: DEFB	number of valid data bytes	
+21	NCB: DEFB	255 byte data buffer	
+275	last data byte

Appendix F: NETWORK ALGORITHMS

NETWORK TRANSMIT

- Step 1
Wait until the net has been free for a random interval of 2 to 3 ms.
- Step 2
Send a brief scout signal. If there is a collision (someone else transmitted at the same time) then repeat from step 1.
- Step 3
Send the header packet, which is the 8 bytes from NCIRIS to NCHCS inclusive in the net channel area.
- Step 4
If the packet is not acknowledged within 1 ms, repeat from step 1.
- Step 5
Send the variable length data packet (up to 255 bytes) from the data buffer.
- Step 6
If the packet is not acknowledged within 1 ms, repeat from step 1.

NETWORK RECEIVE

A scout and header packet together take about 1.6 ms and are repeated about once every 8 ms until an acknowledgement is received. The transmission of a scout, header packet and maximum size data packet take about 37 ms.

- Step 1
Wait until the net has been free for at least 2 ms.
- Step 2
Wait for the net to become active, which should be a scout signal.
- Step 3
Receive the header packet and verify the checksum, which confirms that the header has the correct source (station or broadcast) and destination (station) numbers and the correct message sequence number. If the checksum is not correct then repeat from step 1. Send an acknowledgement unless it is a broadcast.
- Step 4
Receive the data block and verify the checksum. If the checksum is not correct then repeat from step 1. Send an acknowledgement unless it is a broadcast.

Appendix G: SUMMARY OF FUNCTIONS

Function +27 (1BH)	CONSOLE INPUT
Function +28 (1CH)	CONSOLE OUTPUT
Function +29 (1DH)	RECEIVE RS232 BYTE WITH TIMEOUT
Function +30 (1EH)	SEND RS232 BYTE
Function +31 (1FH)	ZX PRINTER OUTPUT
Function +32 (20H)	KEYBOARD TEST
Function +33 (21H)	SELECT/DE-SELECT DRIVE
Function +34 (22H)	OPEN MICRODRIVE DATA FILE
Function +35 (23H)	CLOSE MICRODRIVE DATA FILE
Function +36 (24H)	ERASE MICRODRIVE FILE
Function +37 (25H)	READ MICRODRIVE DATA RECORD (SEQUENTIAL)
Function +38 (26H)	WRITE MICRODRIVE DATA RECORD
Function +39 (27H)	READ MICRODRIVE RECORD RANDOM
Function +40 (28H)	READ MICRODRIVE SECTOR
Function +41 (29H)	READ NEXT MICRODRIVE SECTOR
Function +42 (2AH)	WRITE MICRODRIVE SECTOR
Function +43 (2BH)	CREATE MICRODRIVE CHANNEL AREA
Function +44 (2CH)	DELETE MICRODRIVE CHANNEL AREA
Function +45 (2DH)	OPEN NET CHANNEL
Function +46 (2EH)	CLOSE NET CHANNEL
Function +47 (2FH)	RECEIVE NET PACKET
Function +48 (30H)	SEND NET PACKET
Function +49 (31H)	CREATE SYSTEM VARIABLES

Appendix H: INTERFACE 1 MESSAGES

The messages from the IF1 are not directly accessible from machine code in the Spectrum. They are given here to show the range of messages possible.

The error report number 8 "End of file" in the Basic programming manual is enabled when the IF1 is active. For instance, the error occurs if you try to read beyond the last data item in a net channel. The 'report number' in Basic for the standard Spectrum messages is one greater than the message index used in the ROM.

The IF1 message index is given in decimal and hex, followed by the text of the message.

```
-01 FF "Program finished"
+00 00 "Nonsense in BASIC"
        Commonly used when things get out of hand, eg missing quote,
+01 01 "Invalid stream number"
+02 02 "Invalid device expression"
+03 03 "Invalid name"
+04 04 "Invalid drive number"
+05 05 "Invalid station number"
+06 06 "Missing name"
+07 07 "Missing station number"
+08 08 "Missing drive number"
+09 09 "Missing baud rate"
+10 0A "Header mismatch error"
        Checksum error on a sector header. ?
+11 0B "Stream already open"
+12 0C "Writing to a 'read' file"
+13 0D "Reading a 'write' file"
+14 0E "Drive 'write' protected"
+15 0F "Microdrive full"
+16 10 "Microdrive not present"
+17 11 "File not found"
+18 12 "Hook code error"
        IF1 function number after RST 08 is out of range.
+19 13 "CODE error"
+20 14 "MERGE error"
+21 15 "Verification has failed"
+22 16 "Wrong file type"
```

ends

