SGS DESIGN NOTE

DN 340

NANOCOMPUTER EXPERIMENT ROUTINES: SOFTWARE USE AND LISTING

PROGRAM NE-Z RELEASE 2.2

The 2K bytes NE-Z is a software package consisting of more than 30 educational routines described in the Z80 Nanobook vol. III. It is available on ~~two~~ one M2716 EPROMs and runs on a NBZ-80S system.

Features

- Bootstrap to load the routines ir RAM in locations 0100H to 07FFH, where they can be executed.
- Basic examples of Z80 interfacing I/Oand memory decoding and addressing.
- Experiments with the Z80 peripherals chips, Z80 PIO and Z80 CTC.
- Complete demonstration of the powerfull and complex Z80 interrupt structure, with experiments on maskable, non-maskable interrupts and the mode 3 maskable interupt.
- Digital IC's tester, for up to 20 Low Power Schottky IC's.

MAY 1981

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Installation

The two M2708 containing NE-Z software must be inserted in the corresponding sockets Q49 and Q50 on the NBZ80 board, occuping memory space from FØØØH to F7FFH.
If the inserction is correct, in memory location FØØØ should appear 'FB' content and in F4ØØ 'CD'.
To look at memory contents NC-Z commands are used.

Execution

Start execution of the bootstrap, to down load the routines into RAM by entering FØØØH and pressing the GO key on the NKZ80 Data entry/display station. On the NKZ80 display will appear the following phrase: "SGS-ATES NONAROUTINES RELEASE 2.2 LOADED CIAO ..." .
The routines are now loaded in RAM locations 0100H to 07FFH, ready to be executed.
At the end of this operation the control returns to the Nanocomputer operating system and the display will show the PC content.

Now the user can select from the Nanobook vol. III. the exercise to execute, check the operating instructions and start execution using NC-Z monitor.

Listing

On the following pages is a complete listing, fully commented of the NE-Z routines showing the absolute addresses in the RAM of the programs after down loading.
Also included, for your interest, are the bootstrap (BLKMVE) and message display (NANORZ) routines used on entry to the software.

Finally there is a symbol cross reference for ease of location of all the labels used un the assembly language routines.


```
                    1  *HEADING        NE-Z release 2.2
                    2  ;
                    3  ;
                    4  ;
                    5  ;
                    6  ;
                    7  ;
                    8  ;
                    9  ;       *      *  *******           ********
                   10  ;       **     *  *                      *
                   11  ;       * *    *  *                     *
                   12  ;       *  *   *  ***    **********     *
                   13  ;       *   *  *  *                    *
                   14  ;       *    * *  *                   *
                   15  ;       *     **  ********          ********
                   16  ;
                   17  ;
                   18  ;
                   19  ;
                   20  ;
                   21  ;
                   22  ;
                   23  ;
                   24  ;
                   25  ;
                   26  ;
                   27  ; COPYRIGHT 79 BY SGS-ATES . ALL RIGHT RESERVED.
                   28  ; No part of this listing may be reproduced,
                   29  ; stored in a retrieval system, or trasmitted,
                   30  ; in any form or by any means, electronic, mechanical
                   31  ; photocopying, recording, or otherwise, without the
                   32  ; prior written permission of SGS-ATES.
                   33  ;
                   34  ;
                   35  ;
                   36  ; NE-Z release 2.2 matches with NC-Z release 2.0 and 2.1
                   37  ;
                   38  ;
                   39  ;
```

```
                        40  *HEADING        REL 2.2
                        41  ORGIN   EQU     0100H
0100                    42          ORG     ORGIN
                        43  TABLE   EQU     0F00H
                        44  ADDL    EQU     0FE4H
                        45  ADDH    EQU     0FE5H
                        46  PSEL    EQU     00H
                        47  DATAH   EQU     0FE3H
                        48  DATAL   EQU     0FE2H
                        49  LEDH    EQU     0FB8H
                        50  LEDL    EQU     0FB9H
                        51  CONVDI  EQU     0FA7CH
                        52  DISPL   EQU     0F909H
                        53  BAUDRT  EQU     0FAEH
                        54  CHECKB  EQU     0F99DH
                        55  KBSCAN  EQU     0F8DBH
                        56  ADD7    EQU     0FBAH
                        57  MASKW   EQU     0003H
                        58  REFIC   EQU     800H
                        59  UNKIC   EQU     0C00H
                        60  DSTACK  EQU     0C00H
                        61  BAUD    EQU     0F9F2H
                        62  CHFSTK  EQU     0FA0H
                        63  ;
                        64  ;
                        65  ;
                        66  ;
                        67  ;
                        68  ;
```



```
                        69  *HEADING        LOOP1
0100    D3C5            70  LOOP1   OUT     (0C5H),A        ;Output the contents
                        71                                  ;of the accumulator
                        72                                  ;to port C5
0102    18FC            73          JR      LOOP1           ;Repeat until break
                        74                                  ;or reset
                        75  ;
                        76  ;
                        77  ;
```

NOTES:

```
LOOP2                          NANO.ROUTINES  release.2.2        PAGE   4
 LOC   OBJ CODE M STMT SOURCE STATEMENT                          ASM 5.8

                      78  *HEADING       LOOP2
0104    3E21          79  LOOP2   LD      A,21H                 ;Initialize the accumulator
0106    DBC5          80          IN      A,(0C5H)              ;Input a byte of
                      81                                        ;data from port C5
0108    18FA          82          JR      LOOP2                 ;Repeat until break or reset
                      83  ;
                      84  ;
                      85  ;
```

NOTES:

```
DECODE                         NANO.ROUTINES  release.2.2        PAGE   5
 LOC   OBJ CODE M STMT SOURCE STATEMENT                          ASM 5.8

                      86  *HEADING       DECODE
010A    0E20          87  DECODE  LD      C,20H                 ;Load the device code into
                      88                                        ;register C
010C    06C5          89          LD      B,0C5H                ;Load a nice looking byte
                      90                                        ;into register B for subsequent
                      91                                        ;observation on the upper half
                      92                                        ;of the address bus
010E    ED61          93  LOOP3   OUT     (C),H                 ;Output the content of the H
                      94                                        ;register to port pointed to
                      95                                        ;by register C
0110    18FC          96          JR      LOOP3                 ;Repeat output instruction
                      97                                        ;until break or reset
                      98  ;
                      99  ;
                     100  ;
```

NOTES:

```
                    101  *HEADING        PULSR
0112  0E20          102  PULSR   LD      C,20H           ;Load register C with the
                    103                                  ; device code
0114  21000F        104          LD      HL,TABLE        ;Load register pair HL with
                    105                                  ;the starting memory address
0117  0608          106          LD      B,08H           ;Load register B with the byte
                    107                                  ;counter
0119  D3C0          108          OUT     (0C0H),A        ;Clear the decade counter
011B  EDB3          109          OTIR                    ;Output the byte string
                    110                                  ;beginning at address HL of
                    111                                  ;length (B) to port (C)
011D  76            112          HALT                    ;Halt the CPU
                    113  ;
                    114  ;
                    115  ;
011E  3EFF          116  MEM1    LD      A,0FFH          ;Initialize the accumulator
0120  3C            117  LOOP4   INC     A               ;Begin memory test for next
                    118                                  ;value
0121  32007F        119          LD      (7F00H),A       ;Initialize location 7F00 to
                    120                                  ;contents of A
0124  01FF00        121          LD      BC,00FFH        ;BC = byte counter for LDIR
                    122                                  ;instruction
0127  11017F        123          LD      DE,7F01H        ;DE = pointer to destination
                    124                                  ;block
012A  21007F        125          LD      HL,7F00H        ;HL = pointer to source block
012D  EDB0          126          LDIR                    ;Load locations 7F00-7FFF with
                    127                                  ;contents of register A
                    128  ;
012F  010001        129  CHECK   LD      BC,0100H        ;Check that above load worked,
                    130                                  ;BC = byte cnt
0132  21007F        131          LD      HL,7F00H        ;HL = pointer to location to
                    132                                  ;be checked
0135  EDA1          133  NXTLOC  CPI                     ;Compare (HL) with contents
                    134                                  ;of A
0137  200B          135          JR      NZ,ERROR        ;Mismach indicates error
0139  E23E01        136          JP      PO,NEXXT        ;Parity flag = 0 indicates
                    137                                  ;BC = 0000, go to next test
                    138                                  ;byte (INC A)
013C  18F7          139          JR      NXTLOC          ;Match and BC not = 0000, so
                    140                                  ;to next location
                    141  ;
013E  FEFF          142  NEXXT   CP      0FFH            ;See if A = FF.
0140  20DE          143          JR      NZ,LOOP4        ;If not, test next byte
0142  1820          144          JR      END             ;If so, test is over
                    145  ;
0144  08            146  ERROR   EX      AF,AF'          ;Display error byte by using
                    147                                  ;two routines from Nano-
                    148                                  ;computer operating system
0145  3E70          149          LD      A,70H
0147  08            150          EX      AF,AF'
0148  3EE0          151          LD      A,0E0H
014A  32E50F        152          LD      (ADDH),A        ;Load 'E' in leftmost display
                    153                                  ;digit
014D  2B            154          DEC     HL              ;HL = pointer to bad location
014E  7D            155          LD      A,L
014F  32E20F        156          LD      (DATAL),A
0152  7C            157          LD      A,H
0153  32E30F        158          LD      (DATAH),A
```



```
0156  21B90F        159          LD      HL,LEDL
0159  11E50F        160          LD      DE,ADDH
015C  CD7CFA        161          CALL    CONVDI
015F  CD09F9        162  ERRLP   CALL    DISPL
0162  18FB          163          JR      ERRLP
                    164  ;
0164  08            165  END     EX      AF,AF'          ;Display F's if test OK
0165  3E00          166          LD      A,00H
0167  08            167          EX      AF,AF'
0168  3EFF          168          LD      A,0FFH
016A  32E50F        169          LD      (ADDH),A
016D  32E40F        170          LD      (ADDL),A
0170  32E30F        171          LD      (DATAH),A
0173  32E20F        172          LD      (DATAL),A
0176  21B90F        173          LD      HL,LEDL
0179  11E50F        174          LD      DE,ADDH
017C  CD7CFA        175          CALL    CONVDI
017F  CD09F9        176  OK      CALL    DISPL
0182  18FB          177          JR      OK
                    178  ;
                    179  ;
                    180  ;
```

NOTES:

```
                    181  *HEADING        XFER
0184    016600      182  XFER    LD      BC,OK+5H-MEM1   ;Set-up for LDIR OK+5H-MEM1 is
                    183                                  ;the number of bytes is
                    184                                  ;program MEM1
0187    11007F      185          LD      DE,7F00H        ;Destination is static RAM
018A    211E01      186          LD      HL,MEM1         ;Source block is MEM1 program
018D    EDB0        187          LDIR                    ;Do it
018F    FF          188          RST 38H                 ;Return control to the Nano-
                    189                                  ;computer operating system
                    190  ;
                    191  ;
                    192  ;
```

NOTES:


```
                    193  *HEADING        UCINP
0190    D311        194  UCINP   OUT     (11H),A         ;Latch data from logic switches
0192    CD9A01      195          CALL    WAIT            ;Delay for awhile
0195    0E12        196          LD      C,12H           ;Set up C register with input
                    197                                  ;device code
0197    ED40        198          IN      B,(C)           ;Input data from latch into B
                    199                                  ;register by enabling the
                    200                                  ;buffers
0199    FF          201          RST     38H             ;Return control to the Nano-
                    202                                  ;computer operating system
                    203  ;
019A    210500      204  WAIT    LD      HL, 0005H       ;Delay loop
019D    11FFFF      205  LOOP5   LD      DE,0FFFFH
01A0    1B          206  LOOP6   DEC     DE
01A1    7A          207          LD      A,D
01A2    B3          208          OR      E
01A3    20FB        209          JR      NZ,LOOP6
01A5    2B          210          DEC     HL
01A6    7D          211          LD      A,L
01A7    B4          212          OR      H
01A8    20F3        213          JR      NZ,LOOP5
01AA    C9          214          RET
                    215  ;
                    216  ;
                    217  ;
```

NOTES:

```
 LOC   OBJ CODE M STMT SOURCE STATEMENT                    ASM 5.8

                   218  *HEADING        UCINM
01AB   0E13       219  UCINM   LD       C,13H          ;Set up 13 as the device code
01AD   ED40       220  PCNTR   IN       B,(C)          ;Input pulse count to
                  221                                  ;register B
01AF   ED41       222          OUT      (C),B          ;Output count to LEDs
01B1   CD9A01     223          CALL     WAIT           ;Delay before next
                  224                                  ;count reading
01B4   18F7       225          JR       PCNTR          ;Repeat reade/write/wait cycle
                  226  ;
                  227  ;
                  228  ;
                  229  ;
```

NOTES:


```
 LOC   OBJ CODE M STMT SOURCE STATEMENT                    ASM 5.8

                   230  *HEADING        DDRIVE
01B6   010500     231  DDRIVE  LD       BC,0005H       ;B countains data to be
                  232                                  ;displayed C contains device
                  233                                  ;code for output port (PIO
                  234                                  ;#1 B, data)
01B9   3E00       235          LD       A,PSEL         ;A contains the display posi-
                  236                                  ;tion selector
01BB   00         237          NOP                     ;Filler so this program will
                  238                                  ;fit inside of next program
                  239                                  ;without having to reload
                  240                                  ;most of the bytes
01BC   ED79       241          OUT      (C),A          ;Output display address to the
                  242                                  ;HCF4514 by toggling bit D0
01BE   3C         243          INC      A
01BF   ED79       244          OUT      (C),A
01C1   3D         245          DEC      A
01C2   ED79       246          OUT      (C),A
01C4   ED41       247          OUT      (C),B          ;Output data
01C6   76         248          HALT
                  249  ;
                  250  ;
                  251  ;
```

NOTES:

```
DISTST                          NANO.ROUTINES  release.2.2      PAGE  12
 LOC   OBJ CODE M STMT SOURCE STATEMENT                          ASM 5.8

                    252  *HEADING       DISTST
01C7   010500       253  DISTST  LD      BC,0005H        ;B contains data to be
                    254                                  ;displayed C contains output
                    255                                  ;device code
01CA   AF           256  DATALP  XOR     A               ;A contains the position to be
                    257                                  ;displayed
01CB   160A         258          LD      D,0AH           ;D is the display position
                    259                                  ;counter
01CD   ED79         260  OUTPUT  OUT     (C),A           ;Output display address to
                    261                                  ;HCF4514 by toggling bit D0
01CF   3C           262          INC     A
01D0   ED79         263          OUT     (C),A
01D2   3D           264          DEC     A
01D3   ED79         265          OUT     (C),A
01D5   ED41         266          OUT     (C),B           ;Output data
                    267  ;
01D7   3C           268          INC     A               ;Increment position pointer to
                    269                                  ;point to next display position
01D8   3C           270          INC     A
01D9   CDE301       271          CALL    DELAY           ;Pause so display is constant
                    272                                  ;for a short period
01DC   15           273          DEC     D               ;Decrement position counter
01DD   20EE         274          JR      NZ,OUTPUT       ;If D is not zero, then go back
                    275                                  ;to output byte to next display
                    276                                  ;position
01DF   04           277          INC     B               ;If all display positions have
                    278                                  ;been tested, update the output
                    279                                  ;data
01E0   04           280          INC     B
01E1   18E7         281          JR      DATALP          ;Start again with new data byte
                    282  ;
01E3   D5           283  DELAY   PUSH    DE              ;Save DE
01E4   16F0         284          LD      D,0F0H          ;Timing byte
01E6   CDF2F9       285  DREGL   CALL    BAUD            ;BAUD is a routine in the
                    286                                  ;operating system that delays
                    287                                  ;exactly one sampling period.
                    288                                  ;The length of the period is
                    289                                  ;set via a timing byte stored
                    290                                  ;in memory. In subroutine DELAY,
                    291                                  ;the delay will be 16 (base 10)
                    292                                  ;sampling periods
01E9   15           293          DEC     D               ;
01EA   20FA         294          JR      NZ,DREGL
01EC   D1           295          POP     DE              ;Restore DE
01ED   C9           296          RET
                    297  ;
                    298  ;
                    299  ;
```

```
KBTST                           NANO.ROUTINES  release.2.2      PAGE  13
 LOC   OBJ CODE M STMT SOURCE STATEMENT                          ASM 5.8

                    300  *HEADING       KBTST
01EE   CD9DF9       301  KBTST   CALL    CHECKB          ;Check for pressed key
01F1   28FB         302          JR      Z,KBTST         ;Z-flag = 1 implies that no key
                    303                                  ;is pressed
01F3   CDDBF8       304  GETNO   CALL    KBSCAN          ;Z-flag = 0 implies that one or
                    305                                  ;more keys are pressed. See if
                    306                                  ;just one, and which one.
01F6   38F6         307          JR      C,KBTST         ;C-flag = 1 implies that more
                    308                                  ;than one key was pressed
01F8   32E20F       309          LD      (DATAL),A       ;C-flag = 0 implies that one
                    310                                  ;key was pressed and its number
                    311                                  ;is in register A. Display hex
                    312                                  ;key number in data display
                    313                                  ;positions
01FB   08           314          EX      AF,AF'          ;Set up for call to CONVDI
01FC   3EFC         315          LD      A,0FCH          ;Just display data digits
01FE   08           316          EX      AF,AF'
01FF   11E50F       317          LD      DE,ADDH
0202   21B90F       318          LD      HL,ADD7-1
0205   CD7CFA       319          CALL    CONVDI          ;Translate key no for display
0208   CD09F9       320  DSPLAY  CALL    DISPL           ;Display the key number
020B   CD9DF9       321          CALL    CHECKB          ;Check for pressed key
020E   28F8         322          JR      Z,DSPLAY        ;Keep displaying if no key
                    323                                  ;pressed
0210   18E1         324          JR      GETNO           ;Get key number if key is
                    325                                  ;pressed
                    326  ;
                    327  ;
                    328  ;
```

NOTES:

```
                        329  *HEADING        OUTSIM
0212   3E0F             330  OUTSIM  LD      A,0FH          ;Program the PIO #2 to Mode 0
0214   D30A             331          OUT     (0AH),A
0216   3E43             332          LD      A,43H          ;Output the byte 43H to PC0-7
                        333                                 ;lines
0218   D308             334          OUT     (08H),A
021A   76               335          HALT
                        336  ;
                        337  ;
                        338  ;
```

NOTES:


```
                        339  *HEADING        INIT0
                        340
                        341
021B   3EC3             342  INIT0   LD      A,0C3H         ;first byte is Jump
021D   323800           343          LD      (0038H),A      ;Load into RST location
0220   FD216E02         344          LD      IY,SERV1       ;address of service
0224   FD223900         345          LD      (0039H),IY     ;routine #1
0228   ED46             346          IM      0              ;Interrupt Mode 0
022A   08               347          EX      AF,AF'         ;set format for blanks
022B   3E40             348          LD      A,40H          ;for CONVDI
022D   08               349          EX      AF,AF'
022E   C3C302           350          JP      MAIN           ;Jump to routine MAIN
                        351  ;
                        352  ;
                        353  ;
```

NOTES:

```
                        354  *HEADING        INIT1
0231  3EC3              355  INIT1   LD      A,0C3H          ;first byte is Jump
0233  323800            356          LD      (0038H),A
0236  FD216E02          357          LD      IY,SERV1        ;address of service
023A  FD223900          358          LD      (0039H),IY      ;routine #1
023E  ED56              359          IM      1               ;Interrupt mode 1
0240  08                360          EX      AF,AF'          ;set format for blanks
0241  3E40              361          LD      A,40H           ;for CONVDI
0243  08                362          EX      AF,AF'
0244  C3C302            363          JP      MAIN            ;Jump to routine MAIN
                        364  ;
                        365  ;
                        366  ;
```

NOTES:


```
                        367  *HEADING        INIT2
0247  ED5E              368  INIT2   IM      2               ;Interrupt mode 2
0249  21000F            369          LD      HL, TABLE       ;address of vector table
024C  7C                370          LD      A,H.            ;high byte of address
024D  ED47              371          LD      I,A             ;set Interrupt register
024F  FD216E02          372          LD      IY,SERV1        ;first service routine
0253  FD22000F          373          LD      (TABLE),IY      ;set in vector table
0257  FD21F502          374          LD      IY,SERV2        ;second service routine
025B  FD22020F          375          LD      (TABLE+2),IY    ;set in vector table
025F  FD216B03          376          LD      IY,SERV3        ;third service routine
0263  FD22040F          377          LD      (TABLE+4),IY    ;set in vector table
0267  08                378          EX      AF,AF'          ;set format for CONVDI
0268  3E40              379          LD      A,40H
026A  08                380          EX      AF,AF'
026B  C3C302            381          JP      MAIN            ;Jump to routine MAIN
                        382  ;
                        383  ;
                        384  ;
```

04

NOTES:

```
                    385  *HEADING        SERV1
026E  C5            386  SERV1   PUSH    BC              ;Save CPU registers
026F  D5            387          PUSH    DE
0270  E5            388          PUSH    HL
0271  F5            389          PUSH    AF
0272  DDE5          390          PUSH    IX
0274  FDE5          391          PUSH    IY
0276  DD23          392  DS1     INC     IX              ;update data stack pointer
0278  DD23          393          INC     IX
027A  DD23          394          INC     IX
027C  00            395          NOP                     ;no operation
027D  DD3600FF      396          LD      (IX+00H),0FFH   ;set DLOOP1 time
0281  DD36010A      397          LD      (IX+01H),00AH   ;set CLOOP1 time
0285  DD360202      398  CLOOP1  LD      (IX+02H),02H    ;set DLOOP1 time
0289  21E50F        399          LD      HL,ADDH         ;point to display buffer
028C  ED57          400          LD      A,I             ;find value of IFF2
028E  EA9502        401          JP      PE,HIGH1
0291  3600          402  LOW1    LD      (HL),00H        ;value = 0
0293  1802          403          JR      NEXT1
0295  3610          404  HIGH1   LD      (HL),10H        ;value = 1
0297  2B            405  NEXT1   DEC     HL              ;move buffer pointer
0298  34            406          INC     (HL)            ;increment ADDL
0299  ED73E20F      407          LD      (DATAL),SP      ;copy SP to buffer
029D  21B90F        408          LD      HL,LEDL         ;set for CONVDI
02A0  11E50F        409          LD      DE,ADDH         ;set for CONVDI
02A3  CD7CFA        410          CALL    CONVDI
02A6  CD09F9        411  DLOOP1  CALL    DISPL
02A9  DD3500        412          DEC     (IX+00)         ;timer for display
02AC  20F8          413          JR      NZ,DLOOP1
02AE  DD3502        414          DEC     (IX+02)         ;timer for display
02B1  20F3          415          JR      NZ,DLOOP1
02B3  DD3501        416          DEC     (IX+01)         ;timer for service routine
02B6  20CD          417          JR      NZ,CLOOP1
02B8  FDE1          418          POP     IY              ;restore CPU registers
02BA  DDE1          419          POP     IX
02BC  F1            420          POP     AF
02BD  E1            421          POP     HL
02BE  D1            422          POP     DE
02BF  C1            423          POP     BC
02C0  FB            424          EI                      ;enable interrupts
02C1  ED4D          425          RETI                    ;return from interrupt
                    426  ;
                    427  ;
                    428  ;
```

ok


```
                    429  *HEADING        MAIN
02C3  FB            430  MAIN    EI                      ;enable interrupts
02C4  DD21000C      431          LD      IX,DSTACK       ;bottom of data stack
02C8  DD3600FF      432          LD      (IX+00H),0FFH   ;timer for display
02CC  21E50F        433          LD      HL,ADDH         ;set pointer to buffer
02CF  ED57          434          LD      A,I             ;find value of IFF2
02D1  EAD802        435          JP      PE,HIGH
02D4  3600          436  LOW     LD      (HL),00H        ;value = 0
02D6  1802          437          JR      NEXT
02D8  3610          438  HIGH    LD      (HL),10H        ;value = 1
02DA  2B            439  NEXT    DEC     HL              ;move buffer pointer
02DB  35            440          DEC     (HL)            ;decrement COUNT
02DC  ED73E20F      441          LD      (DATAL),SP      ;copy SP to buffer
02E0  21B90F        442          LD      HL,LEDL         ;set up for CONVDI
02E3  11E50F        443          LD      DE,ADDH         ;set up for CONVDI
02E6  00            444  DISAB   NOP                     ;no operation
02E7  CD7CFA        445          CALL    CONVDI
02EA  CD09F9        446  DLOOP   CALL    DISPL
02ED  DD3500        447          DEC     (IX+00H)        ;timer for display
02F0  20F8          448          JR      NZ,DLOOP
02F2  C3C302        449          JP      MAIN            ;Jump back to beginning
                    450  ;
                    451  ;
                    452  ;
```

ok

NOTES:

```
                    453  *HEADING        SERV2
02F5  76            454  SERV2   HALT                    ;Halt the microcomputer
                    455  ;
                    456  ;
                    457  ;
```

04

NOTES:


```
                    458  *HEADING        INIT1N
02F6  3EC3          459  INIT1N  LD      A,0C3H          ;first byte is JUMP
02F8  326600        460          LD      (0066H),A       ;non-maskable interrupt
02FB  FD211903      461          LD      IY,SERVN        ;address of service for
02FF  FD226700      462          LD      (0067H),IY      ;non-maskable interrupt
0303  ED56          463          IM      1               ;Interrupt mode 1
0305  3EC3          464          LD      A,0C3H          ;first byte is JUMP
0307  323B00        465          LD      (003BH),A
030A  FD216E02      466          LD      IY,SERV1        ;address of service
030E  FD223900      467          LD      (0039H),IY      ;routine #1
0312  08            468          EX      AF,AF'          ;set format for blanks
0313  3E40          469          LD      A,40H           ;for CONVDI
0315  08            470          EX      AF,AF'
0316  C3C302        471          JP      MAIN            ;Jump to routine MAIN
                    472  ;
                    473  ;
                    474  ;
```

NOTES:

```
                        475  *HEADING        SERVN
0319  C5                476  SERVN   PUSH    BC          ;save CPU registers
031A  D5                477          PUSH    DE
031B  E5                478          PUSH    HL
031C  F5                479          PUSH    AF
031D  DDE5              480          PUSH    IX
031F  FDE5              481          PUSH    IY
0321  DD23              482  DSN     INC     IX          ;update data stack pointer
0323  DD23              483          INC     IX
0325  DD23              484          INC     IX
0327  00                485          NOP                 ;no operation
0328  DD3600FF          486          LD      (IX+00H),0FFH ;set DLOOPN time
032C  DD36010A          487          LD      (IX+01H),00AH ;set CLOOPN time
0330  DD360202          488  CLOOPN  LD      (IX+02H),02H ;set DLOOPN time
0334  21E50F            489          LD      HL,ADDH     ;point to display buffer
0337  ED57              490          LD      A,I         ;find value of IFF2
0339  EA4003            491          JP      PE,HIGHN
033C  3600              492  LOWN    LD      (HL),00H    ;value = 0
033E  1802              493          JR      NEXTN
0340  3610              494  HIGHN   LD      (HL),10H    ;value = 1
0342  ED73E20F          495  NEXTN   LD      (DATAL),SP  ;copy SP to buffer
0346  21B90F            496          LD      HL,LEDL     ;set for CONVDI
0349  11E50F            497          LD      DE,ADDH     ;set for CONVDI
034C  CD7CFA            498          CALL    CONVDI
034F  CD09F9            499  DLOOPN  CALL    DISPL
0352  DD3500            500          DEC     (IX+00)     ;timer for display
0355  20F8              501          JR      NZ,DLOOPN
0357  DD3502            502          DEC     (IX+02)     ;timer for display
035A  20F3              503          JR      NZ,DLOOPN
035C  DD3501            504          DEC     (IX+01)     ;timer for service routine
035F  20CF              505          JR      NZ,CLOOPN
0361  FDE1              506          POP     IY          ;restore CPU registers
0363  DDE1              507          POP     IX
0365  F1                508          POP     AF
0366  E1                509          POP     HL
0367  D1                510          POP     DE
0368  C1                511          POP     BC
0369  ED45              512          RETN                ;return from non-maskable
                        513                              ;interrupt
                        514  ;
                        515  ;
                        516  ;
```



```
                        517  *HEADING        SERV3
036B  C5                518  SERV3   PUSH    BC          ;save CPU registers
036C  D5                519          PUSH    DE
036D  E5                520          PUSH    HL
036E  F5                521          PUSH    AF
036F  DDE5              522          PUSH    IX
0371  FDE5              523          PUSH    IY
0373  DD23              524  DS3     INC     IX          ;update data stack pointer
0375  DD23              525          INC     IX
0377  DD23              526          INC     IX
0379  00                527          NOP                 ;no operation
037A  DD3600FF          528          LD      (IX+00H),0FFH ;set DLOOP3 time
037E  DD36010A          529          LD      (IX+01H),00AH ;set CLOOP3 time
0382  DD360202          530  CLOOP3  LD      (IX+02H),02H ;set DLOOP3 time
0386  21E50F            531          LD      HL,ADDH     ;point to display buffer
0389  ED57              532          LD      A,I         ;find value of IFF2
038B  EA9203            533          JP      PE,HIGH3
038E  3600              534  LOW3    LD      (HL),00H    ;value = 0
0390  1802              535          JR      NEXT3
0392  3610              536  HIGH3   LD      (HL),10H    ;value = 1
0394  2B                537  NEXT3   DEC     HL          ;move buffer pointer
0395  34                538          INC     (HL)        ;increment ADDL
0396  34                539          INC     (HL)        ;increment ADDL
0397  ED73E20F          540          LD      (DATAL),SP  ;copy SP to buffer
039B  21B90F            541          LD      HL, LEDL    ;set for CONVDI
039E  11E50F            542          LD      DE,ADDH     ;set for CONVDI
03A1  CD7CFA            543          CALL    CONVDI
03A4  CD09F9            544  DLOOP3  CALL    DISPL
03A7  DD3500            545          DEC     (IX+00)     ;timer for display
03AA  20F8              546          JR      NZ,DLOOP3
03AC  DD3502            547          DEC     (IX+02)     ;timer for display
03AF  20F3              548          JR      NZ,DLOOP3
03B1  DD3501            549          DEC     (IX+01)     ;timer for service routine
03B4  20CC              550          JR      NZ,CLOOP3
03B6  FDE1              551          POP     IY          ;restore CPU registers
03B8  DDE1              552          POP     IX
03BA  F1                553          POP     AF
03BB  E1                554          POP     HL
03BC  D1                555          POP     DE
03BD  C1                556          POP     BC
03BE  FB                557          EI                  ;enable interrupts
03BF  ED4D              558          RETI                ;return from interrupt
                        559  ;
      ok                560  ;
                        561  ;
```

```
                        562  *HEADING        INITOC
03C1   ED5E             563  INITOC  IM      2               ;set Z80 interrupt mode
03C3   21000F           564          LD      HL,TABLE        ;address of vector table
03C6   7C               565          LD      A,H             ;high byte of address
03C7   ED47             566          LD      I,A             ;set interrupt register
03C9   FD21E803         567          LD      IY,SERVOC       ;PIO output service routine
03CD   FD22060F         568          LD      (TABLE+06H),IY  ;set in vector table
03D1   3E06             569          LD      A,06H           ;Load interrupt vector
03D3   D30A             570          OUT     (0AH),A         ;for port C
03D5   08               571          EX      AF,AF'          ;set format for CONVDI
03D6   3E40             572          LD      A,40H
03D8   08               573          EX      AF,AF'
03D9   3E0F             574          LD      A,0FH           ;Set PIO mode
03DB   D30A             575          OUT     (0AH),A
03DD   3E87             576  ENPIO   LD      A,87H           ;Enable PIO interrupts
03DF   D30A             577          OUT     (0AH),A
03E1   3EFF             578          LD      A,0FFH          ;Initialize CRDY signal.
03E3   D308             579  THROW   OUT     (08H),A
03E5   C3C302           580          JP      MAIN            ;Jump to routine MAIN
                        581  ;
                        582  ;
                        583  ;
```

NOTES:


```
                        584  *HEADING        SERVOC
03E8   E5               585  SERVOC  PUSH    HL              ;save CPU register status
03E9   F5               586          PUSH    AF
03EA   3AE40F           587          LD      A,(ADDL)        ;move buffer value to A
03ED   D308             588          OUT     (08H),A         ;output buffer value
03EF   F1               589          POP     AF              ;restore CPU register status
03F0   E1               590          POP     HL
03F1   FB               591          EI                      ;enable interrupts
03F2   ED4D             592          RETI                    ;return from interrupt
                        593  ;
                        594  ;
                        595  ;
```

NOTES:

```
                        596  *HEADING        INITID
03F4   ED5E             597  INITID  IM      2               ;Interrupt mode 2
03F6   21000F           598          LD      HL,TABLE        ;address of vector table
03F9   7C               599          LD      A,H             ;high byte of address
03FA   ED47             600          LD      I,A             ;set interrupt register
03FC   FD211F04         601          LD      IY,SERVID       ;input service routine
0400   FD22080F         602          LD      (TABLE+08H),IY  ;set in vector table
0404   3E08             603          LD      A,08H           ;Load interrupt vector
0406   D30B             604          OUT     (0BH),A
0408   08               605          EX      AF,AF'          ;set format for CONVDI
0409   3E40             606          LD      A,40H
040B   08               607          EX      AF,AF'
040C   3E4F             608          LD      A,4FH           ;Set PIO mode
040E   D30B             609          OUT     (0BH),A
0410   3E87             610          LD      A,87H           ;enable PIO interrupt
0412   D30B             611          OUT     (0BH),A
0414   DB09             612          IN      A,(09H)         ;initialize DRDY
0416   C3C302           613          JP      MAIN
                        614  ;
                        615  ;
                        616  ;
```

NOTES:


```
                        617  *HEADING        SERVIC
0419   C5               618  SERVIC  PUSH    BC              ;save BC
041A   0E08             619          LD      C,08H           ;PORT C interrupt
041C   C33104           620          JP      SERVI
                        621  ;
                        622  ;
                        623  ;
```

NOTES:

```
                    624  *HEADING        SERVID
041F  C5            625  SERVID  PUSH    BC
0420  0E09          626          LD      C,09H          ;PORT D interrupt
0422  C33104        627          JP      SERVI
                    628  ;
                    629  ;
                    630  ;
```

NOTES:


```
                    631  *HEADING        SERVIE
0425  C5            632  SERVIE  PUSH    BC
0426  0E0C          633          LD      C,0CH          ;PORT E interrupt
0428  C33104        634          JP      SERVI
                    635  ;
                    636  ;
                    637  ;
```

NOTES:

```
                        638  *HEADING        SERVIF
042B  C5                639  SERVIF  PUSH    BC
042C  0E0D              640          LD      C,0DH           ;PORT F interrupt
042E  C33104            641          JP      SERVI
                        642  ;
                        643  ;
                        644  ;
```

NOTES:


```
                        645  *HEADING        SERVI
0431  00                646  SERVI   NOP                     ;previously saved BC
0432  D5                647          PUSH    DE
0433  E5                648          PUSH    HL
0434  F5                649          PUSH    AF
0435  DDE5              650          PUSH    IX
0437  FDE5              651          PUSH    IY
0439  FD2AE40F          652          LD      IY,(ADDL)       ;save state of (ADDL)
043D  FDE5              653          PUSH    IY
043F  ED78              654          IN      A,(C)
0441  32E40F            655          LD      (ADDL),A        ;put byte in ADDL
0444  DD23              656  DSG     INC     IX              ;update data stack pointer
0446  DD23              657          INC     IX
0448  DD23              658          INC     IX
044A  00                659  ENABG   NOP                     ;no operation
044B  DD3600FF          660          LD      (IX+00H),0FFH   ;set DLOOPG time
044F  DD36010A          661          LD      (IX+01H),00AH   ;set CLOOPG time
0453  DD360202          662  CLOOPG  LD      (IX+02H),02H    ;set DLOOPG time
0457  21E50F            663          LD      HL,ADDH         ;point to display buffer
045A  ED57              664          LD      A,I             ;find value of IFF2
045C  EA6304            665          JP      PE,HIGHG
045F  3600              666  LOWG    LD      (HL),00H        ;value = 0
0461  1802              667          JR      NEXTG
0463  3610              668  HIGHG   LD      (HL),10H        ;value = 1
0465  ED73E20F          669  NEXTG   LD      (DATAL),SP      ;copy SP to buffer
0469  21B90F            670          LD      HL,LEDL         ;set for CONVDI
046C  11E50F            671          LD      DE,ADDH         ;set for CONVDI
046F  CD7CFA            672          CALL    CONVDI
0472  CD09F9            673  DLOOPG  CALL    DISPL
0475  DD3500            674          DEC     (IX+00)         ;timer for display
0478  20F8              675          JR      NZ,DLOOPG
047A  DD3502            676          DEC     (IX+02)         ;timer for display
047D  20F3              677          JR      NZ,DLOOPG
047F  DD3501            678          DEC     (IX+01)         ;timer for service routine
0482  20CF              679          JR      NZ,CLOOPG
0484  FDE1              680          POP     IY              ;restore contents of ADDL
0486  FD22E40F          681          LD      (ADDL),IY
048A  FDE1              682          POP     IY              ;restore CPU registers
048C  DDE1              683          POP     IX
048E  F1                684          POP     AF
048F  E1                685          POP     HL
0490  D1                686          POP     DE
0491  C1                687          POP     BC
0492  FB                688          EI                      ;enable interrupts
0493  ED4D              689          RETI                    ;return from interrupts
                        690  ;
                        691  ;
                        692  ;
```

```
                    693  *HEADING        INITPB
0495  ED5E          694  INITPB  IM      2           ;Z80 interrupt mode 2
0497  21000F        695          LD      HL,TABLE    ;address of vector table
049A  7C            696          LD      A,H         ;high byte of address
049B  ED47          697          LD      I,A         ;set interrupt register
049D  FD21E803      698          LD      IY,SERVOC   ;output service routine
04A1  FD22060F      699          LD      (TABLE+06H),IY ;set in vector table
04A5  FD211904      700          LD      IY,SERVIC   ;input service routine
04A9  FD220A0F      701          LD      (TABLE+0AH),IY ;set in vector table
04AD  3E06          702          LD      A,06H       ;load interrupt vector
04AF  D30A          703          OUT     (0AH),A     ;for port C
04B1  3E0A          704          LD      A,0AH       ;load interrupt vector
04B3  D30B          705          OUT     (0BH),A     ;for port D
04B5  08            706          EX      AF,AF'      ;set format for CONVDI
04B6  3E40          707          LD      A,40H       ;
04B8  08            708          EX      AF,AF'      ;
04B9  3E8F          709          LD      A,8FH       ;set PIO mode 2
04BB  D30A          710          OUT     (0AH),A     ;port C
04BD  3ECF          711          LD      A,0CFH      ;set PIO mode 3
04BF  D30B          712          OUT     (0BH),A     ;port D
04C1  3EFF          713          LD      A,0FFH      ;set mask byte Port D required
04C3  D30B          714          OUT     (0BH),A     ;to follow set PIO mode 3
04C5  3E87          715          LD      A,87H       ;enable PIO interrupts
04C7  D30A          716          OUT     (0AH),A     ;port C
04C9  D30B          717          OUT     (0BH),A     ;port D
04CB  3EFF          718          LD      A,0FFH      ;initialize CRDY
04CD  D308          719          OUT     (08H),A
04CF  DB08          720          IN      A,(08H)     ;initialize DRDY
04D1  C3C302        721          JP      MAIN        ;Jump to routine MAIN
                    722  ;
                    723  ;
                    724  ;
```

NOTES:


```
                    725  *HEADING        INITPM
04D4  ED5E          726  INITPM  IM      2           ;Z80 interrupt mode 2
04D6  21000F        727          LD      HL,TABLE    ;address of vector table
04D9  7C            728          LD      A,H         ;high byte of address
04DA  ED47          729          LD      I,A         ;set interrupt register
04DC  FD210505      730          LD      IY,SERVM    ;address of service routine
04E0  FD220C0F      731          LD      (TABLE+0CH),IY ;set in vector table
04E4  3E0C          732          LD      A,0CH       ;set interrupt vector for
04E6  D30B          733          OUT     (0BH),A     ;port D
04E8  08            734          EX      AF,AF'      ;set format for CONVDI
04E9  3E40          735          LD      A,40H
04EB  08            736          EX      AF,AF'
04EC  3ECF          737          LD      A,0CFH      ;set mode 3 for port D
04EE  D30B          738          OUT     (0BH),A
04F0  3E0F          739          LD      A,0FH       ;define input lines for
04F2  D30B          740          OUT     (0BH),A     ;port D
04F4  3E97          741  CWORD   LD      A,97H       ;set interrupt control word
04F6  D30B          742          OUT     (0BH),A
04F8  3EFC          743          LD      A,0FCH      ;monitor PB0,PB1
04FA  D30B          744          OUT     (0BH),A
04FC  0E09          745          LD      C,09H       ;initialize lamp monitors
04FE  3E00          746          LD      A,00H       ;to off position
0500  ED79          747          OUT     (C),A
0502  C3C302        748          JP      MAIN
                    749  ;
                    750  ;
                    751  ;
```

NOTES:

```
                    752  *HEADING        SERVM
0505   C5           753  SERVM   PUSH    BC              ;save CPU registers
0506   D5           754          PUSH    DE
0507   E5           755          PUSH    HL
0508   F5           756          PUSH    AF
0509   DDE5         757          PUSH    IX
050B   FDE5         758          PUSH    IY
050D   FD2AE40F     759          LD      IY,(ADDL)       ;save state of (ADDL)
0511   FDE5         760          PUSH    IY
0513   0E09         761          LD      C,09H           ;input from PIO port C
0515   ED78         762          IN      A,(C)
0517   E60F         763          AND     0FH             ;clear high order nibble
0519   32E40F       764          LD      (ADDL),A        ;put byte in ADDL
051C   17           765          RLA                     ;transpose high order nibble
051D   17           766          RLA                     ;with low order nibble
051E   17           767          RLA
051F   17           768          RLA
0520   ED79         769          OUT     (C),A           ;output to lamp monitors
0522   DD23         770  DSM     INC     IX              ;update data stack pointer
0524   DD23         771          INC     IX
0526   DD23         772          INC     IX
0528   00           773          NOP                     ;no operation
0529   DD3600FF     774          LD      (IX+00H),0FFH   ;set inner DLOOPM time
052D   DD36010A     775          LD      (IX+01H),00AH   ;set CLOOPM time
0531   DD360202     776  CLOOPM  LD      (IX+02H),02H    ;set outer DLOOPM time
0535   21E50F       777          LD      HL,ADDH         ;point to display buffer
0538   ED57         778          LD      A,I             ;find value of IFF2
053A   EA4105       779          JP      PE,HIGHM
053D   3600         780  LOWM    LD      (HL),00H        ;value = 0
053F   1802         781          JR      NEXTM
0541   3610         782  HIGHM   LD      (HL),10H        ;value = 1
0543   ED73E20F     783  NEXTM   LD      (DATAL),SP      ;copy SP to buffer
0547   21B90F       784          LD      HL,LEDL         ;set for CONVDI
054A   11E50F       785          LD      DE,ADDH         ;set for CONVDI
054D   CD7CFA       786          CALL    CONVDI
0550   CD09F9       787  DLOOPM  CALL    DISPL
0553   DD3500       788          DEC     (IX+00)         ;timer for display
0556   20F8         789          JR      NZ,DLOOPM
0558   DD3502       790          DEC     (IX+02)         ;timer for display
055B   20F3         791          JR      NZ,DLOOPM
055D   DD3501       792          DEC     (IX+01)         ;timer for service routine
0560   20CF         793          JR      NZ,CLOOPM
0562   FDE1         794          POP     IY              ;restore contents of ADDL
0564   FD22E40F     795          LD      (ADDL),IY
0568   FDE1         796          POP     IY              ;restore CPU registers
056A   DDE1         797          POP     IX
056C   F1           798          POP     AF
056D   E1           799          POP     HL
056E   D1           800          POP     DE
056F   C1           801          POP     BC
0570   FB           802          EI                      ;enable interrupts
0571   ED4D         803          RETI                    ;return from interrupt
                    804  ;
                    805  ;
                    806  ;
```



```
                    807  *HEADING        INITPP
0573   ED5E         808  INITPP  IM      2               ;Z80 mode 2 interrupts
0575   21000F       809          LD      HL,TABLE        ;address of vector table
0578   7C           810          LD      A,H             ;high byte of address
0579   ED47         811          LD      I,A             ;set interrupt vector
057B   FD211904     812          LD      IY,SERVIC       ;service for port C'
057F   FD220A0F     813          LD      (TABLE+0AH),IY  ;set in table
0583   FD211F04     814          LD      IY,SERVID       ;port D
0587   FD22080F     815          LD      (TABLE+08H),IY  ;set in table
058B   3E0A         816          LD      A,0AH           ;set interrupt vector for C
058D   D30A         817          OUT     (0AH),A
058F   3E0B         818          LD      A,0BH           ;set interrupt vector for D
0591   D30B         819          OUT     (0BH),A
0593   08           820          EX      AF,AF'          ;set format for CONVDI
0594   3E40         821          LD      A,40H
0596   08           822          EX      AF,AF'
0597   3E4F         823          LD      A,4FH           ;mode 1 for C and D
0599   D30A         824          OUT     (0AH),A
059B   D30B         825          OUT     (0BH),A
059D   3E87         826          LD      A,87H           ;enable C and D
059F   D30A         827          OUT     (0AH),A
05A1   D30B         828          OUT     (0BH),A
05A3   DB08         829          IN      A,(08H)         ;initialize CRDY
05A5   DB09         830          IN      A,(09H)         ;and DRDY
05A7   C3C302       831          JP      MAIN
                    832  ;
                    833  ;
                    834  ;
```

NOTES:

```
                        835  *HEADING        INITDC
05AA   ED5E             836  INITDC  IM      2               ;Z80 interrupt mode 2
05AC   21000F           837          LD      HL,TABLE        ;address of vector table
05AF   7C               838          LD      A,H             ;high byte of address
05B0   ED47             839          LD      I,A             ;set interrupt vector
05B2   FD212504         840          LD      IY,SERVIE       ;service routine port E input
05B6   FD220E0F         841          LD      (TABLE+0EH),IY  ;set in table
05BA   FD212B04         842          LD      IY,SERVIF       ;service routine port F input
05BE   FD22100F         843          LD      (TABLE+10H),IY  ;set in table
05C2   3E0E             844          LD      A,0EH           ;load interrupt vector E
05C4   D30E             845          OUT     (0EH),A
05C6   3E10             846          LD      A,10H           ;load interrupt vector F
05C8   D30F             847          OUT     (0FH),A
05CA   08               848          EX      AF,AF'          ;set format for CONVDI
05CB   3E40             849          LD      A,40H
05CD   08               850          EX      AF,AF'
05CE   3E4F             851          LD      A,4FH           ;set PIO mode 1
05D0   D30E             852          OUT     (0EH),A         ;port E
05D2   D30F             853          OUT     (0FH),A         ;port F
05D4   3E87             854          LD      A,87H           ;enable PIO
05D6   D30E             855          OUT     (0EH),A         ;port E
05D8   D30F             856          OUT     (0FH),A         ;port F
05DA   DB0C             857          IN      A,(0CH)         ;initialize ERDY
05DC   DB0D             858          IN      A,(0DH)         ;initialize FRDY
05DE   C37305           859          JP      INITPP
                        860  ;
                        861  ;
                        862  ;
```

NOTES:


```
                        863  *HEADING        SEROCX
05E1   C5               864  SEROCX  PUSH    BC              ;save CPU registers
05E2   D5               865          PUSH    DE
05E3   E5               866          PUSH    HL
05E4   F5               867          PUSH    AF
05E5   DDE5             868          PUSH    IX
05E7   FDE5             869          PUSH    IY
05E9   FD2AE40F         870          LD      IY,(ADDL)       ;save state of (ADDL)
05ED   FDE5             871          PUSH    IY
05EF   DD23'            872  DSX     INC     IX              ;update data stack pointer
05F1   DD23             873          INC     IX
05F3   DD23             874          INC     IX
05F5   00               875          NOP                     ;no operation
05F6   DD3600FF         876          LD      (IX+00H),0FFH   ;set DLOOPX time
05FA   DD360010A        877          LD      (IX+01H),00AH   ;set CLOOPX time
05FE   DD360201         878  CLOOPX  LD      (IX+02H),01H    ;set DLOOPX time
0602   21E50F           879          LD      HL,ADDH         ;point to display buffer
0605   ED57             880          LD      A,I             ;find value of IFF2
0607   EA0E06           881          JP      PE,HIGHX
060A   3600             882  LOWX    LD      (HL),00H        ;value = 0
060C   1802             883          JR      NEXTX
060E   3610             884  HIGHX   LD      (HL),10H        ;value = 1
0610   2B               885  NEXTX   DEC     HL              ;move buffer pointer
0611   34               886          INC     (HL)            ;increment ADDL
0612   ED73E20F         887          LD      (DATAL),SP      ;copy SP to buffer
0616   21B90F           888          LD      HL,LEDL         ;set for CONVDI
0619   11E50F           889          LD      DE,ADDR         ;set for CONVDI
061C   CD7CFA           890          CALL    CONVDI
061F   CD09F9           891  DLOOPX  CALL    DISPL
0622   DD3500           892          DEC     (IX+00)         ;timer for display
0625   20FB             893          JR      NZ,DLOOPX
0627   DD3502           894          DEC     (IX+02)         ;timer for display
062A   20F3             895          JR      NZ,DLOOPX
062C   DD3501           896          DEC     (IX+01)         ;timer for service routine
062F   20CD             897          JR      NZ,CLOOPX
0631   FDE1             898          POP     IY              ;restore CPU registers
0633   FD22E40F         899          LD      (ADDL),IY       ;restore state of (ADDL)
0637   3AE40F           900  OUTX    LD      A,(ADDL)        ;output the byte that was
063A   D308             901          OUT     (08H),A         ;in ADDL when interrupted
063C   FDE1             902          POP     IY              ;restore CPU registers
063E   DDE1             903          POP     IX
0640   F1               904          POP     AF
0641   E1               905          POP     HL
0642   D1               906          POP     DE
0643   C1               907          POP     BC
0644   FB               908          EI                      ;enable interrupts
0645   ED4D             909          RETI                    ;return from interrupt
                        910  ;
                        911  ;
                        912  ;
```

```
                        913  *HEADING        CHPTST
0647  3E03              914  CHPTST  LD      A,03H           ;Initialize I register in PIO
0649  D30A              915          OUT     (0AH),A
064B  D30B              916          OUT     (0BH),A
064D  2A0300            917          LD      HL,(MASKW)
0650  0I0AFF            918          LD      BC,0FF0AH       ;Set Mode 3 for ports A and B
0653  ED41              919          OUT     (C),B           ;Set Mode 3 for port A
0655  ED69              920          OUT     (C),L           ;Set I/O bits for port A
0657  0C                921          INC     C
0658  ED41              922          OUT     (C),B           ;Set Mode 3 for port B
065A  ED61              923          OUT     (C),H           ;Set I/O bits for port B
                        924  ;
                        925  ;
                        926  ;
065C  31A00F            927  REF     LD      SP,CHPSTK       ;Initialize stack pointer
065F  DD210008          928          LD      IX,REFIC        ;Initialize reference IC
                        929                                  ;map pointer
0663  010000            930          LD      BC,0000H        ;Initialize counter word
0666  CD8806            931          CALL    STORE           ;Generate the reference table
0669  00                932  'ENDREF NOP
                        933  ;
066A  31A00F            934  UNKN    LD      SP,CHPSTK       ;Initialize stack pointer
066D  DD21000C          935          LD      IX,UNKIC        ;Initialize unknown IC map
                        936                                  ;pointer
0671  010000            937          LD      BC,0000H        ;Initialize counter word
0674  CD8806            938          CALL    STORE           ;Generate the unknown IC's
                        939                                  ;output table
                        940  ;
0677  210008            941  COMPAR  LD      HL,REFIC        ;Set-up for compare using the
                        942                                  ;CPI instruction
067A  11000C            943          LD      DE,UNKIC        ;HL points to ref table, DE
                        944                                  ;points to unk IC table
067D  1A                945  NEXTB   LD      A,(DE)          ;Load unknown output byte into
                        946                                  ;accumulator
067E  EDA1              947          CPI                     ;Compare with (HL)
0680  2037              948          JR      NZ,BAD          ;If not =, we have a bad IC
0682  13                949          INC     DE              ;If =, set up to test next byte
0683  EA7D06            950          JP      PE,NEXTB        ;If P/V flag = 1 go test
                        951                                  ;next byte
0686  1833              952  GOOD    JR      START           ;If P/V flag = 0 BC is zero and
                        953                                  ;we have tested all the bytes
                        954  ;
0688  110000            955  STORE   LD      DE,0000H        ;Initialize test word
068B  2A0300            956  NTEST   LD      HL,(MASKW)      ;Load HL with mask word
068E  7B                957          LD      A,E             ;Perform 16-bit AND on mask and
                        958                                  ;test words
068F  A5                959          AND     L
0690  6F                960          LD      L,A
0691  7A                961          LD      A,D
0692  A4                962          AND     H
0693  67                963          LD      H,A
0694  7C                964  MASK    LD      A,H             ;Check if result of 16-bit
                        965                                  ;AND = 0
0695  B5                966          OR      L
0696  201B              967          JR      NZ,NXTWD        ;If not 0, go to next test byte
                        968  ;
0698  7B                969  TEST    LD      A,E             ;If = 0, it is a valid test word,
                        970                                  ;Output it to IC
```



```
0699  D308              971          OUT     (08H),A
069B  7A                972          LD      A,D
069C  D309              973          OUT     (09H),A
069E  2A0300            974          LD      HL,(MASKW)      ;Get mask word for IC
06A1  DB08              975          IN      A,(08H)         ;Input LO byte from IC
06A3  A5                976          AND     L               ;Mask it
06A4  DD7700            977          LD      (IX),A          ;Store it
06A7  DD23              978          INC     IX              ;Update IX
06A9  DB09              979          IN      A,(09H)         ;Input HI byte from IC
06AB  A4                980          AND     H               ;Mask it
06AC  DD7700            981          LD      (IX),A          ;Store it
06AF  DD23              982          INC     IX              ;Update IX
06B1  03                983          INC     BC              ;Add two to counter
06B2  03                984          INC     BC
                        985  ;
06B3  13                986  NXTWD   INC     DE              ;Get next test word
06B4  7A                987          LD      A,D
06B5  B3                988          OR      E
06B6  20D3              989          JR      NZ,NTEST        ;If DE is not zero, go back for
                        990                                  ;next test word
06B8  C9                991          RET                     ;If DE is zero full output table
                        992                                  ;is generated
06B9  1800              993  BAD     JR      START           ;Bad IC, start over
                        994  ;
06BB  18AD              995  START   JR      UNKN            ;Jump to test routine for
                        996                                  ;unknown IC
                        997  ;
                        998  ;
                        999  ;
```

NOTES:

```
                    1000  *HEADING        INITC1
06BD   ED5E         1001  INITC1  IM       2              ;Z80 Interrupt Mode 2
06BF   21000F       1002          LD       HL,TABLE       ;address of vector table
06C2   7C           1003          LD       A,H            ;hish byte of address
06C3   ED47         1004          LD       I,A            ;set interrupt register
06C5   FD216E02     1005          LD       IY,SERV1       ;service routine address
06C9   FD221A0F     1006          LD       (TABLE+1AH),IY ;set in table
06CD   3E18         1007          LD       A,18H          ;load interrupt vector
06CF   D310         1008          OUT      (10H),A        ;to CTC CHANNEL 0
06D1   08           1009          EX       AF,AF'         ;set format for CONVDI
06D2   3E40         1010          LD       A,40H
06D4   08           1011          EX       AF,AF'
06D5   3EC7         1012          LD       A,0C7H         ;set channel control word
06D7   D311         1013          OUT      (11H),A
06D9   3E05         1014          LD       A,05H          ;set time constant
06DB   D311         1015          OUT      (11H),A        ;register
06DD   C3C302       1016          JP       MAIN           ;Jump to routine MAIN
                    1017  ;
                    1018  ;
                    1019  ;
```

NOTES:


```
                    1020  *HEADING        SERCT1
06E0   C5           1021  SERCT1  PUSH     BC             ;save status of BC
06E1   0E11         1022          LD       C,11H          ;PORT 11H of CTC
06E3   C33104       1023          JP       *SERVI
                    1024  ;
                    1025  ;
                    1026  ;
```

NOTES:

```
                    1027  *HEADING        SERCT2
06E6  C5            1028  SERCT2  PUSH    BC              ;save CPU registers
06E7  D5            1029          PUSH    DE
06E8  E5            1030          PUSH    HL
06E9  F5            1031          PUSH    AF
06EA  DDE5          1032          PUSH    IX
06EC  FDE5          1033          PUSH    IY
06EE  FD2AE40F      1034          LD      IY,(ADDL)       ;save state of (ADDL)
06F2  FDE5          1035          PUSH    IY
06F4  0E16          1036          LD      C,16H           ;input from PIO port F
06F6  ED40          1037          IN      B,(C)
06F8  AF            1038          XOR     A               ;clear A
06F9  90            1039          SUB     B               ;find number of seconds
06FA  32E40F        1040          LD      (ADDL),A        ;load ADDL with PIO data
06FD  DD23          1041  DST     INC     IX              ;update data stack pointer
06FF  DD23          1042          INC     IX
0701  DD23          1043          INC     IX
0703  00            1044          NOP                     ;no operation
0704  DD3600FF      1045          LD      (IX+00H),0FFH   ;set DLOOPT time
0708  DD36010A      1046          LD      (IX+01H),00AH   ;set CLOOPT time
070C  DD360202      1047  CLOOPT  LD      (IX+02H),02H    ;set DLOOPT time
0710  21E50F        1048          LD      HL,ADDH         ;point to display buffer
0713  ED57          1049          LD      A,I             ;find value of IFF2
0715  EA1C07        1050          JP      PE,HIGHT
0718  3600          1051  LOWT    LD      (HL),00H        ;value = 0
071A  1802          1052          JR      NEXTT
071C  3610          1053  HIGHT   LD      (HL),10H        ;value = 1
071E  ED73E20F      1054  NEXTT   LD      (DATAL),SP      ;copy SP to  buffer
0722  21B90F        1055          LD      HL,LEDL         ;set for CONVDI
0725  11E50F        1056          LD      DE,ADDH         ;set for CONVDI
0728  CD7CFA        1057          CALL    CONVDI
072B  CD09F9        1058  DLOOPT  CALL    DISPL
072E  DD3500        1059          DEC     (IX+00)         ;timer for display
0731  20F8          1060          JR      NZ,DLOOPT
0733  DD3502        1061          DEC     (IX+02)         ;timer for display
0736  20F3          1062          JR      NZ,DLOOPT
0738  DD3501        1063          DEC     (IX+01)         ;timer for service routine
073B  20CF          1064          JR      NZ,CLOOPT
073D  3E2F          1065          LD      A,2FH           ;Channel 0 control word
073F  D314          1066          OUT     (14H),A
0741  3E96          1067          LD      A,96H           ;Channel 0 time constant
0743  D314          1068          OUT     (14H),A
0745  3E47          1069          LD      A,47H           ;Channel 1 control word
0747  D315          1070          OUT     (15H),A
0749  3E40          1071          LD      A,40H           ;Channel 1 time constant
074B  D315          1072          OUT     (15H),A
074D  3E47          1073          LD      A,47H           ;Channel 2 control word
074F  D316          1074          OUT     (16H),A
0751  3E00          1075          LD      A,00H           ;Channel 2 time constant
0753  D316          1076          OUT     (16H),A
0755  3EC7          1077          LD      A,0C7H          ;Channel 3 control word
0757  D317          1078          OUT     (17H),A
0759  3E01          1079          LD      A,01H           ;Channel 3 time constant
075B  D317          1080          OUT     (17H),A
075D  FDE1          1081          POP     IY              ;restore contents of ADDL
075F  FD22E40F      1082          LD      (ADDL),IY
0763  FDE1          1083          POP     IY              ;restore CPU registers
0765  DDE1          1084          POP     IX
```



```
0767  F1            1085          POP     AF
0768  E1            1086          POP     HL
0769  D1            1087          POP     DE
076A  C1            1088          POP     BC
076B  FB            1089          EI                      ;enable interrupt flip-flop
076C  ED4D          1090          RETI                    ;return from interrupts
                    1091  ;
                    1092  ;
                    1093  ;
```

NOTES:

```
                    1094  *HEADING        INITC3
076E   ED5E         1095  INITC3  IM      2               ;Z80 Interrupt Mode 2
0770   21000F       1096          LD      HL,TABLE        ;vector address table
0773   7C           1097          LD      A,H             ;high byte of address
0774   ED47         1098          LD      I,A             ;set interrupt register
0776   FD21E606     1099          LD      IY,SERCT2       ;service routine address
077A   FD22260F     1100          LD      (TABLE+26H),IY  ;set in table
077E   3E26         1101          LD      A,26H           ;load interrupt vector
0780   D314         1102          OUT     (14H),A         ;to CTC Channel 0
0782   08           1103          EX      AF,AF'          ;set format for CONVDI
0783   3E40         1104          LD      A,40H
0785   08           1105          EX      AF,AF'
0786   3E2F         1106          LD      A,2FH           ;Channel 0 control word
0788   D314         1107          OUT     (14H),A
078A   3E96         1108          LD      A,96H           ;Channel 0 time constant
078C   D314         1109          OUT     (14H),A
078E   3E47         1110          LD      A,47H           ;Channel 1 control word
0790   D315         1111          OUT     (15H),A
0792   3E40         1112          LD      A,40H           ;Channel 1 time constant
0794   D315         1113          OUT     (15H),A
0796   3E47         1114          LD      A,47H           ;Channel 2 control word
0798   D316         1115          OUT     (16H),A
079A   3E00         1116          LD      A,00H           ;Channel 2 time constant
079C   D316         1117          OUT     (16H),A
079E   3EC7         1118          LD      A,0C7H          ;Channel 3 control word
07A0   D317         1119          OUT     (17H),A
07A2   3E01         1120          LD      A,01H           ;Channel 3 time constant
07A4   D317         1121          OUT     (17H),A
07A6   C3C302       1122          JP      MAIN
                    1123  ;
                    1124  ;
                    1125  ;
```

NOTES:


```
                    1126  *HEADING        INITC2
07A9   FD21E006     1127  INITC2  LD      IY,SERCT1       ;service routine address
07AD   FD22180F     1128          LD      (TABLE+18H),IY  ;set in table
07B1   3EC7         1129          LD      A,0C7H          ;Channel 0 control word
07B3   D310         1130          OUT     (10H),A
07B5   3E01         1131          LD      A,01H           ;time constant register
07B7   D310         1132          OUT     (10H),A         ;for channel 0
07B9   C3BD06       1133          JP      INITC1
                    1134  ;
                    1135  ;
                    1136  ;
07BC                1137          DEFS    10H
                    1138  ;
                    1139  ;
                    1140  ;
F000                1141          ORG     0F000H
```

NOTES:

```
                    1142  *HEADING        BLKMVE
                    1143  ORIGIN  EQU     100H
                    1144  LENGHT  EQU     0700H
                    1145  ;
                    1146  ;
                    1147  ;
F000   FB           1148  BLKMVE  EI
F001   218EF0       1149          LD      HL,RESTART
F004   F3           1150          DI
F005   110001       1151          LD      DE,ORIGIN
F008   010007       1152          LD      BC,LENGHT
F00B   EDB0         1153          LDIR
                    1154  ;
                    1155  ;
                    1156  ;
                    1157  ;
                    1158  ;
                    1159  ;
```

NOTES:


```
                    1160  *HEADING        NANOR2
F00D   DD21000C     1161  NANOR2  LD      IX,DSTACK       ;set IX to RAM
                    1162                                  ;counter location
F011   2142F0       1163          LD      HL,STRING
F014   11B80F       1164  MOVE    LD      DE,LEDH         ;and DE to display buffer
F017   010A00       1165          LD      BC,0AH          ;BC=no of bytes to move
F01A   E5           1166          PUSH    HL              ;Save character pointer
F01B   EDB0         1167          LDIR                    ;Move first 10 bytes
F01D   DD3600FF     1168          LD      (IX),0FFH       ;Preset counter
F021   DD360101     1169          LD      (IX+1H),01H     ;for display scanspeed
F025   3E00         1170          LD      A,00H
F027   32B80F       1171          LD      (LEDH),A        ;Mask off LED displays
F02A   32B90F       1172          LD      (LEDH+1H),A
F02D   CD09F9       1173  DS      CALL    DISPL
F030   DD3500       1174          DEC     (IX)            ;Time...
F033   20F8         1175          JR      NZ,DS           ;    ...delay
F035   DD3501       1176          DEC     (IX+1H)         ;...and
F038   20F3         1177          JR      NZ,DS           ;   ...display
F03A   E1           1178          POP     HL              ;Retrieve character pointer value
F03B   23           1179          INC     HL              ;And increment
F03C   7E           1180          LD      A,(HL)          ;Check character for end code
F03D   FE01         1181          CP      01H             ;'01', otherwise move along
F03F   20D3         1182          JR      NZ,MOVE
F041   FF           1183          RST     38H             ;Return control to the
                    1184                                  ;Nanocomputer operating system
                    1185  ;
                    1186  ;
                    1187  ;
F042   00           1188  STRING  DEFB    000H            ;Leading blanks
F043   00           1189          DEFB    000H
F044   00           1190          DEFB    000H
F045   00           1191          DEFB    000H
F046   00           1192          DEFB    000H
F047   00           1193          DEFB    000H
F048   00           1194          DEFB    000H
F049   00           1195          DEFB    000H
F04A   00           1196          DEFB    000H
F04B   00           1197          DEFB    000H
F04C   B6           1198          DEFB    0B6H    ;S
F04D   BC           1199          DEFB    0BCH    ;G
F04E   B6           1200          DEFB    0B6H    ;S
F04F   02           1201          DEFB    002H    ;-
F050   EE           1202          DEFB    0EEH    ;A
F051   1E           1203          DEFB    01EH    ;T
F052   9E           1204          DEFB    09EH    ;E
F053   B6           1205          DEFB    0B6H    ;S
F054   00           1206          DEFB    000H    ;
F055   EC           1207          DEFB    0ECH    ;N
F056   EE           1208          DEFB    0EEH    ;A
F057   EC           1209          DEFB    0ECH    ;N
F058   FC           1210          DEFB    0FCH    ;O
F059   00           1211          DEFB    000H
F05A   0A           1212          DEFB    00AH    ;R
F05B   3A           1213          DEFB    03AH    ;O
F05C   3B           1214          DEFB    03BH    ;U
F05D   1E           1215          DEFB    01EH    ;T
F05E   20           1216          DEFB    020H    ;I
F05F   2A           1217          DEFB    02AH    ;N
```

```
F060  9E          1218          DEFB    09EH    ;E
F061  B6          1219          DEFB    0B6H    ;S
F062  00          1220          DEFB    000H    ;
F063  0A          1221          DEFB    00AH    ;R
F064  9E          1222          DEFB    09EH    ;E
F065  1C          1223          DEFB    01CH    ;L
F066  9E          1224          DEFB    09EH    ;E
F067  EE          1225          DEFB    0EEH    ;A
F068  B6          1226          DEFB    0B6H    ;S
F069  9E          1227          DEFB    09EH    ;E
F06A  00          1228          DEFB    000H
F06B  DA          1229          DEFB    0DAH    ;2
F06C  02          1230          DEFB    002H    ;-
F06D  DA          1231          DEFB    0DAH    ;2
F06E  00          1232          DEFB    000H
F06F  1C          1233          DEFB    01CH    ;L
F070  FC          1234          DEFB    0FCH    ;O
F071  EE          1235          DEFB    0EEH    ;A
F072  7A          1236          DEFB    07AH    ;D
F073  9E          1237          DEFB    09EH    ;E
F074  7A          1238          DEFB    07AH    ;D
F075  00          1239          DEFB    000H
F076  00          1240          DEFB    000H
F077  00          1241          DEFB    000H
F078  00          1242          DEFB    000H
F079  00          1243          DEFB    000H
F07A  00          1244          DEFB    000H
F07B  9C          1245          DEFB    09CH    ;C
F07C  60          1246          DEFB    060H    ;I
F07D  EE          1247          DEFB    0EEH    ;A
F07E  FC          1248          DEFB    0FCH    ;O
F07F  00          1249          DEFB    000H
F080  00          1250          DEFB    000H
F081  10          1251          DEFB    010H    ;-
F082  00          1252          DEFB    000H
F083  10          1253          DEFB    010H    ;-
F084  01          1254          DEFB    001H
F085  10          1255          DEFB    010H    ;-
F086  00          1256          DEFB    000H
F087  00          1257          DEFB    000H
F088  00          1258          DEFB    000H
F089  00          1259          DEFB    000H                ;trailing blanks
F08A  00          1260          DEFB    000H
F08B  00          1261          DEFB    000H
F08C  00          1262          DEFB    000H
F08D  00          1263          DEFB    000H
                  1264  RESTART
                  1265  ;
                  1266  ;
```



```
ADD7   0FBA     56  318
ADDH   0FE5     45  152  160  169  174  317  399  409  433  443  489
                    497  531  542  663  671  777  785  879  889 1048
                   1056
ADDL   0FE4     44  170  587  652  655  681  759  764  795  870  899
                    900 1034 1040 1082
BAD    06B9    993  948
BAUD   F9F2     61  285
BAUDRT 0FAE     53
BLKMVE F000   1148
CHECK  012F    129
CHECKB F99D     54  301  321
CHPSTK 0FA0     62  927  934
CHPTST 0647    914
CLOOP1 0285    398  417
CLOOP3 0382    530  550
CLOOPG 0453    662  679
CLOOPM 0531    776  793
CLOOPN 0330    488  505
CLOOPT 070C   1047 1064
CLOOPX 05FE    878  897
COMPAR 0677    941
CONVDI FA7C     51  161  175  319  410  445  498  543  672  786  890
                   1057
CWORD  04F4    741
DATAH  0FE3     47  158  171
DATAL  0FE2     48  156  172  309  407  441  495  540  669  783  887
                   1054
DATALP 01CA    256  281
DDRIVE 01B6    231
DECODE 010A     87
DELAY  01E3    283  271
DISAB  02E6    444
DISPL  F909     52  162  176  320  411  446  499  544  673  787  891
                   1058 1173
DISTST 01C7    253
DLOOP  02EA    446  448
DLOOP1 02A6    411  413  415
DLOOP3 03A4    544  546  548
DLOOPG 0472    673  675  677
DLOOPM 0550    787  789  791
DLOOPN 034F    499  501  503
DLOOPT 072B   1058 1060 1062
DLOOPX 061F    891  893  895
DREGL  01E6    285  294
DS     F02D   1173 1175 1177
DS1    0276    392
DS3    0373    524
DSG    0444    656
DSM    0522    770
DSN    0321    482
DSPLAY 0208    320  322
DST    06FD   1041
DSTACK 0C00     60  431 1161
DSX    05EF    872
ENABG  044A    659
END    0164    165  144
ENDREF 0669    932
```

```
SYMBOL  VAL M DEFN REFS

ENPIO   03DD    576
ERRLP   015F    162  163
ERROR   0144    146  135
GETNO   01F3    304  324
GOOD    0686    952
HIGH    02DB    438  435
HIGH1   0295    404  401
HIGH3   0392    536  533
HIGHG   0463    668  665
HIGHM   0541    782  779
HIGHN   0340    494  491
HIGHT   071C   1053 1050
HIGHX   060E    884  881
INIT0   021B    342
INIT1   0231    355
INIT1N  02F6    459
INIT2   0247    368
INITC1  06BD   1001 1133
INITC2  07A9   1127
INITC3  076E   1095
INITDC  05AA    836
INITID  03F4    597
INITOC  03C1    563
INITPB  0495    694
INITPM  04D4    726
INITPP  0573    808  859
KBSCAN  F8DB     55  304
KBTST   01EE    301  302  307
LEDH    0FB8     49 1164 1171 1172
LEDL    0FB9     50  159  173  408  442  496  541  670  784  888 1055
LENGHT  0700   1144 1152
LOOP1   0100     70   73
LOOP2   0104     79   82
LOOP3   010E     93   96
LOOP4   0120    117  143
LOOP5   019D    205  213
LOOP6   01A0    206  209
LOW     02D4    436
LOW1    0291    402
LOW3    038E    534
LOWG    045F    666
LOWM    053D    780
LOWN    033C    492
LOWT    0718   1051
LOWX    060A    882
MAIN    02C3    430  350  363  381  449  471  580  613  721  748  831
                    1016 1122
MASK    0694    964
MASKW   0003     57  917  956  974
MEM1    011E    116  182  186
MOVE    F014   1164 1182
NANOR2  F00D   1161
NEXT    02DA    439  437
NEXT1   0297    405  403
NEXT3   0394    537  535
NEXTB   067D    945  950
NEXTG   0465    669  667
NEXTM   0543    783  781
```



```
SYMBOL  VAL M DEFN REFS

NEXTN   0342    495  493
NEXTT   071E   1054 1052
NEXTX   0610    885  883
NEXXT   013E    142  136
NTEST   068B    956  989
NXTLOC  0135    133  139
NXTWD   06B3    986  967
OK      017F    176  177  182
ORGIN   0100     41   42
ORIGIN  0100   1143 1151
OUTPUT  01CD    260  274
OUTSIM  0212    330
OUTX    0637    900
PCNTR   01AD    220  225
PSEL    0000     46  235
PULSR   0112    102
REF     065C    927
REFIC   0800     58  928  941
RESTAR  F08E   1264 1149
SERCT1  06E0   1021 1127
SERCT2  06E6   1028 1099
SEROCX  05E1    864
SERV1   026E    386  344  357  372  466 1005
SERV2   02F5    454  374
SERV3   036B    518  376
SERVI   0431    646  620  627  634  641 1023
SERVIC  0419    618  700  812
SERVID  041F    625  601  814
SERVIE  0425    632  840
SERVIF  042B    639  842
SERVM   0505    753  730
SERVN   0319    476  461
SERVOC  03E8    585  567  698
START   068B    995  952  993
STORE   0688    955  931  938
STRING  F042   1188 1163
TABLE   0F00     43  104  369  373  375  377  564  568  598  602  695
                     699  701  727  731  809  813  815  837  841  843
                    1002 1006 1096 1100 1128
TEST    0698    969
THROW   03E3    579
UCINM   01AB    219
UCINP   0190    194
UNKIC   0C00     59  935  943
UNKN    066A    934  995
WAIT    019A    204  195  223
XFER    0184    182
```

NOTES:

NOTES: