Selection of the ports at HC-91 (standard)
═══

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Best viewed with Terminal font.


```
┌─────────┐
│ A7 = 0  │
│    (W)  ├── The port for system configuration,
│ A0 = 0  │      with the main adress #7E:
└─────────┘
```
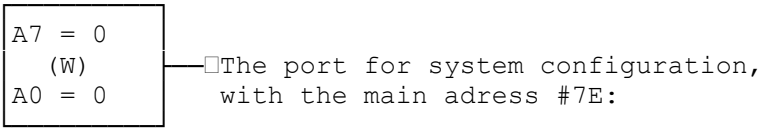
The port resets at general $\overline{RESET}$

```
┌──┬──┬──┬──┬──┬──┬──┬──┐
│x │x │x │x │b3│b2│b1│b0│
└──┴──┴──┴──┴──┴──┴──┴──┘
```

Start adress of   Adress A14 – EPROM:
video memory: / 0 = BASIC (16K);
/0 = #4000;   \ 1 = CP/M (16K);
\1 = #C000;
auto cutting-out: Adresses for EPROM selection:
/0 = active port;   / 0 = #0000 ÷ #4000;
\1 = disconnected until   \ 1 = #E000 ÷ #FFFF;
RESET;

_____

```
┌─────────┐
│ A7 = 1  │
│    (W)  ├── The standard Spectrum 'out' port, with main
│ A0 = 0  │      adress #FE
└─────────┘
```

```
┌──┬──┬──┬──┬──┬──┬──┬──┐
│x │x │x │b4│b3│b2│b1│b0│
└──┴──┴──┴──┴──┴──┴──┴──┘
```

speacker out (BEL):
/ 0 = OFF;   BORDER colour:
\ 1 = ON ;   B (blue) ;
                               R (red) ;
Tape out (MIC):   G (green);
/ 0 = OFF (0V);
\ 1 = ON (+V);

_____
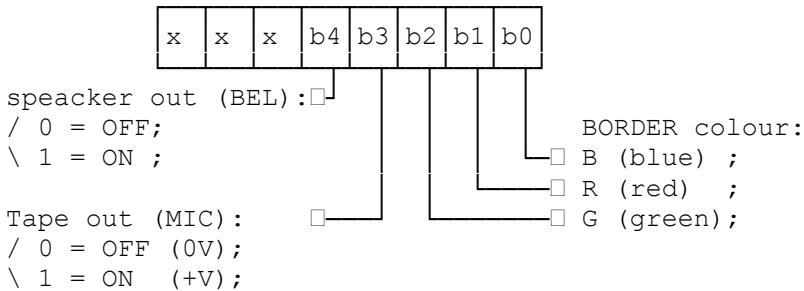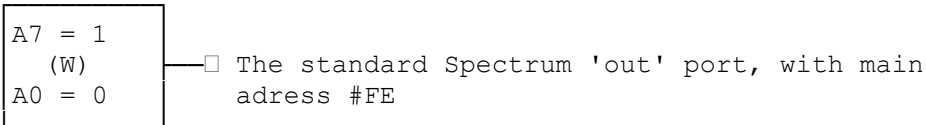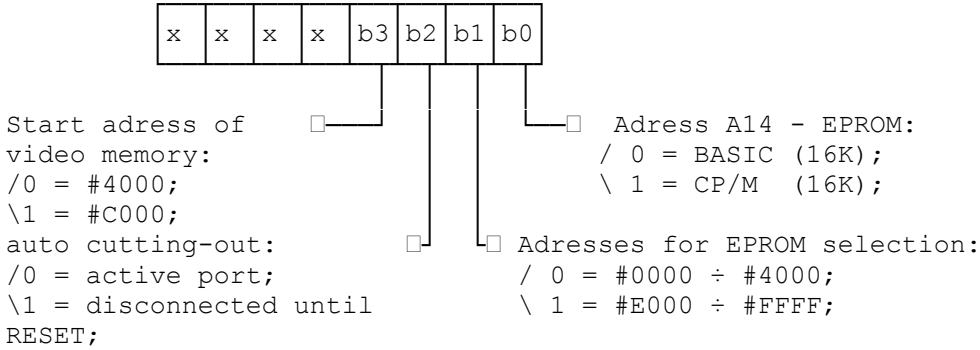
```
┌──────────┐
│ A7 = 1   │
│    (R)   │──────   The standard Spectrum 'in' port, with main
│ A0 = 0   │         adress #FE:
└──────────┘
```
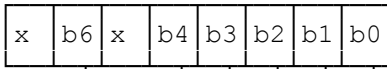
```
           ┌──┬──┬──┬──┬──┬──┬──┬──┐
           │x │b6│x │b4│b3│b2│b1│b0│
           └──┴──┴──┴──┴──┴──┴──┴──┘
                │        │  │  │  │
                │        │  │  │  └────────  Keyboard IN:
 Tape IN        │        │  │  └─────────   CS,A,Q,1,0,P,CR,SP ;
 (inverted):    │        │  └────────────   Z,S,W,2,9,O,L,SS ;
 /1 = negative; │        └───────────────   X,D,E,3,8,I,K,M  ;
 \0 = positive; └────────────────────────   C,F,R,4,7,U,J,N  ;
                                            V,G,T,5,6,Y,H,B  ;
                                            /1 = key pressed ;
                                            \0 = key not pressed;
```

───

```
┌────────────────┐
│ A3=0           │
│   (R)          │──────  Port for reading data from RS232
│ (A6A5A4)<>(000)│        or network, with main adress #F7:
│ (A7A0)=(0X) or (11)│
└────────────────┘
```
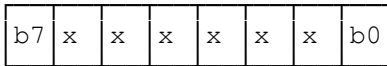
```
           ┌──┬──┬──┬──┬──┬──┬──┬──┐
           │b7│x │x │x │x │x │x │b0│
           └──┴──┴──┴──┴──┴──┴──┴──┘
             │                   │
             │                   └────────  Data IN from network (NIN):
             │                              / 0 = 0V on the line;
             │                              \ 1 = +5V on the line;
             └────────────────────────────  Data IN from RS232 (TXD):
                                             / 0 = [-12V ÷ -5V];
                                             \ 1 = [+5V ÷ +12V];
```
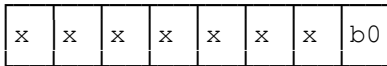
───

```
┌────────────────┐
│ A3=0           │
│   (W)          │──────  Port to select out to RS232
│ (A6A5A4)<>(000)│        or network, with main adress #F7:
│  A0 = 1        │
└────────────────┘
                           _____
 - The port isn't reseted at general RESET.
```

```
           ┌──┬──┬──┬──┬──┬──┬──┬──┐
           │x │x │x │x │x │x │x │b0│
           └──┴──┴──┴──┴──┴──┴──┴──┘
                                 │
                                 └────────  network/serial  selection:
                                            / 0 = network (default);
                                            \ 1 = serial
                                            (only for OUT);
```
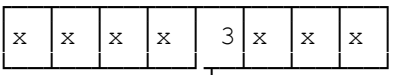
───

```
┌──────────────────────┐
│ A4=0                 │
│   (R)                │──── Port for reading the status of the
│ (A6A5) <> (00)       │     serial interface, with main adress
│ (A7A0)=(0X)or(11)    │     #EF:
└──────────────────────┘

          ┌───┬───┬───┬───┬───┬───┬───┬───┐
          │ x │ x │ x │ x │ 3 │ x │ x │ x │
          └───┴───┴───┴─┬─┴───┴───┴───┴───┘
                        │
                        └── DTR, telling if a data
                            transfer may begin:
                            /0 = [-12V ÷ -5V];
                            \1 = [+5V ÷ +12V];
```
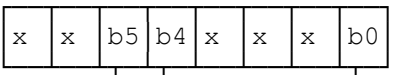
_____

```
┌──────────────────────┐
│ A4=0                 │
│   (W)                │──── Output port for controlling serial
│ (A6A5)<>(00)         │     and network interfaces, with main
│ A0=1                 │     adress #EF:
└──────────────────────┘                    ‾‾‾‾‾
- This port is resetted at general RESET, and bit b5
resets when detecting a negative pulse on the network,
indicating the bit sincronisation for sending or
receiving.
```

```
         ┌───┬───┬───┬───┬───┬───┬───┬───┐
         │ x │ x │b5 │b4 │ x │ x │ x │b0 │
         └───┴───┴─┬─┴─┬─┴───┴───┴───┴─┬─┘
                   │   │               │
Sincronisation ────┘   │               └── Data OUT, common for
for network:           │                    serial and network:
/0 = CPU passes        │                   Net: / 1 = +5V ;
 in WAIT until         │                  (Nout)\ 0 = =0V (line free);
 a 0 is detected       │                  serial/ 1 = [-12V ÷ -5V];
 on the line  ;        │                  (RXD) \ 0 = [+5V ÷ +12V];
\1 = CPU doesn't       │
 pass in WAIT ;        │

Serial status: ────────┘
OUT:
/0 = [-12V ÷ -5V]
\1 = [+5V ÷ +12V]
```

_____

OBS: Because the ports (#F7) and (#EF) are decoded incompletly,
when selected with (A3=0), and (A4=0), they may be selected
simultaneoulsly, improving the way that the bits are arranged
in the bus:

```
┌─────────────────────────┐
│ (A3=0) and (A4=0)       │
│     (R)                 │──── The ports (#f7) and (#EF) are read
│ (A6A5)<>(00)            │     simultaneously, at main adress
│ (A7A0) = (0x) or (11)   │     (#E7):
└─────────────────────────┘
```
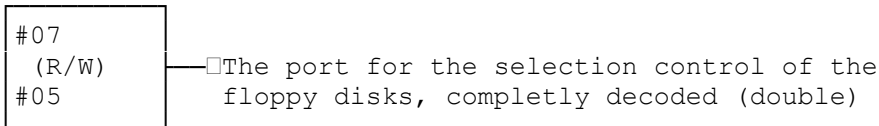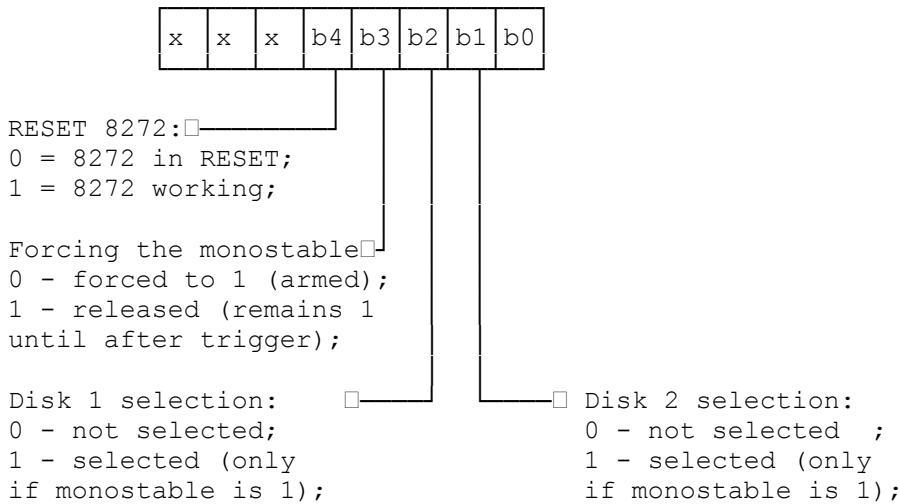
```
        ┌────┬─┬─┬─┬────┬─┬─┬───┐
        │TXD │x│x│x│DTR │x│x│NIN│
        └────┴─┴─┴─┴────┴─┴─┴───┘
```
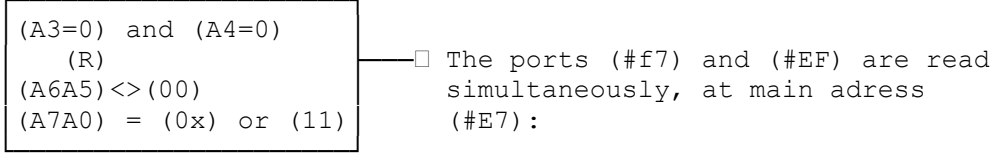
- When writing, bit 0 of port (#F7) overlaps bit 0
of port (#EF) and the simoultaneous write to (#E7)
is not longer useful.

_____

```
┌─────────┐
│ #07     │
│  (R/W)  │──── The port for the selection control of the
│ #05     │     floppy disks, completly decoded (double)
└─────────┘
```

- It is used as a hardware delay to lag the deselection
of the selected floppy disk units.   _____
- The writing register is resetted at general RESET

```
┌─┬─┬─┬─┬─┬─┬─┬──┐
│x│x│x│x│x│x│x│b0│
└─┴─┴─┴─┴─┴─┴─┴──┘
Obs│- To set a        3
───│  delay, the
   │  monostable          ── Monostable status:
   │  must be first          (Inserted reading)
   │  "armed",then           0 - Monostable armed (forced to 1)
   │  released.      /            or delaying;
                     \
                      1 - Monostable unarmed (in 0) or
                             with the delay finished;
```

```
        ┌─┬─┬─┬──┬──┬──┬──┬──┐
        │x│x│x│b4│b3│b2│b1│b0│
        └─┴─┴─┴──┴──┴──┴──┴──┘
RESET 8272: ──────┘   │   │  │  │
0 = 8272 in RESET;    │   │  │  │
1 = 8272 working;     │   │  │  │
                      │   │  │  │
Forcing the monostable┘   │  │  │
0 - forced to 1 (armed);  │  │  │
1 - released (remains 1   │  │  │
until after trigger);     │  │  │

Disk 1 selection: ────────┘  └──── Disk 2 selection:
0 - not selected;                  0 - not selected  ;
1 - selected (only                 1 - selected (only
if monostable is 1);               if monostable is 1);
```

- For the units to be selected (and with the motor on)
the corresponding selection bits must be "1" and the
monostable to be "1" (fored in "1" for arming and men-
tained forced or released, but not trigged or released
and delaying.

_____

```
┌─────────┐
│ #C5     │
│   (W)   │──── The adresses of the port for RAM bench
│ #C7     │     switching (completly decoded)
└─────────┘
```
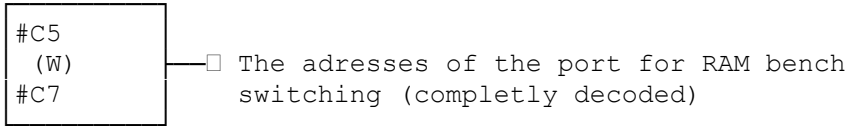
- The value written on these two ports doesn't matter
(the bits from the data bus are not used). Anyway,
because these adresses simoultaneously select also
the port (#E7), i.e. port (F7) and also port (#EF),
over the data bus is sent a value that is the same as
the initialisation value of these two ports: (#FE)

```
         ┌─┬─┬─┬─┬─┬─┬─┬─┐
#FE =    │1│1│1│0│1│1│1│0│   = DEFAULT
         └─┴─┴─┴─┴─┴─┴─┴─┘
              │ │     └──── The selection is on the network,
CPU doesn't   │ │          with the network out in 0.
HALT when it  │ │          (line is free)
receives a 0  │ │
on the network│CTS=0 inactive, HC not
              ready for transfer
```
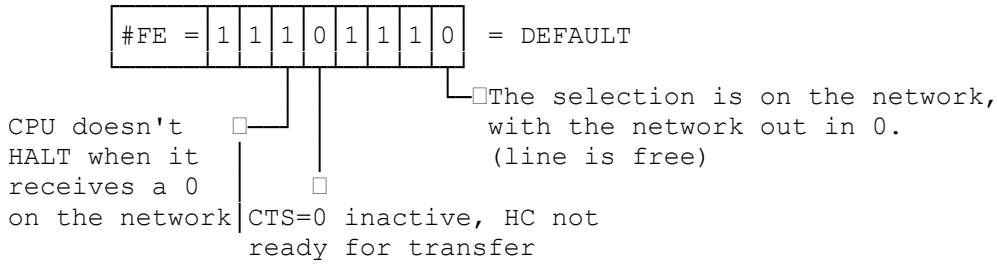
- After general RESET, the bistable controlled by (#C5) and
(#C7) will be positionned like after an OUT (#C5).
- In the case of switching with OUT (#C7), but in BASIC confi-
guration, the EPROM selection is disabled, and the RAM area
(E000 - FFFF) will also be selected in the area (C000 - E000).
Between (0000 - 4000) nothing is selected.

```
FFFF                                     FFFF
     ┌──────────────────┐                     ┌──────────────────┐
     │ EPROM 2000-4000  │                     │ EPROM 2000-4000 │
E000 ├──────────────────┤  ┌────────────┐ E000├──────────────────┬──────────────────┐
     │ RAM   E000-FFFF  │  │   VIDEO    │     │ VIDEO (CP/M)     │ RAM E000-FFFF    │
C000 ├──────────────────┤  └────────────┘ C000├──────────────────┴──────────────────┘
     │                  │  (C000 - E000)      │                  │
     │                  │                     │                  │
     │     R A M        │                     │     R A M        │
     │                  │                     │                  │
6000 ├──────────────────┤                6000 ├──────────────────┤
     │ VIDEO (BAS)      │ ──RAM               │ VIDEO (BAS)      │ ──RAM
4000 ├──────────────────┤                4000 ├──────────────────┤
2000 │_R_A_M_ _ _ _ _   │                2000 │_R_A_M_ _ _ _ _   │    The configuration
     │      (CP/M)      │                     │      (CP/M)      │    after switching on
0000 └──────────────────┘                0000 └──────────────────┘    CP/M

                                  SWITCH
                              ═══════════════
  The main CP/M config.         #C7, #C5           OUT (#C5)
 │after switch and                                    /\
 │OUT (#C7)                                            ||
 │                                                     \/
 └──────────────────┘

FFFF                                     FFFF
     ┌──────────────────┐                     ┌──────────────────┐              ┌──────────┐
     │ RAM E000-FFFF    │                     │ RAM E000-FFFF    │              │OUT(#7E)  │
E000 ├──────────────────┤  ┌────────────┐ E000├──────────────────┤              │(b0=1)    │
     │ RAM E000-FFFF    │  │   VIDEO    │     │ VIDEO (CP/M)     │              └──────────┘
     │ DOUBLED          │  └────────────┘ C000├──────────────────┘                  │
C000 ├──────────────────┤  (C000 - E000)      │                  │                  │
     │                  │                     │     R A M        │                  │
     │     R A M        │  Aberrant           │                  │                  │
     │                  │  configuration,     │                  │                  │
6000 ├──────────────────┤  due to an     6000 ├──────────────────┤                  │
     │ VIDEO (BAS)      │  OUT (#C7) from     │ VIDEO (BAS)      │ ──RAM            │
4000 ├──────────────────┤  BASIC         4000 ├──────────────────┤                  │
2000 │   Not            │ │              2000 │_ _E_P_R_O_M_ _   │                  │
     │   Selected       │ └──────────────     │      (CP/M)      │                  │
0000 └──────────────────┘                0000 └──────────────────┘                  │

                              OUT(#C5)
                            ═══════════════
                                              The configuration after   RESET
                                                     (BASIC)
```

───

┌───────┐
│ #85 │──── Port for the status of 8272, completly decoded,
│ (R) │   read only;
└───────┘

┌───────┐
│ #87 │──── Port for data/commands for 8272, completly decoded,
│ (R/W) │   read/write;
└───────┘

───

The Input/Output Map (Ports selected at each adress)

```
┌─────────────┐                        ┌─────────────┐
│ READ        │                        │ WRITE       │
└─────────────┘                        └─────────────┘

128 - 254, even = #FE                   0 - 126, even = #E7
                                        128 - 254, even = #FE


   5=#05                                   5=#05
   7=#06                                   7=#07
 16 -  23, odd+even = #F7                17 -  23, odd = #F7
 32 -  39, odd+even = #E7                33 -  39, odd = #E7
 40 -  47, odd+even = #EF                41 -  47, odd = #EF
 48 -  55, odd+even = #F7                49 -  55, odd = #F7
 64 -  71, odd+even = #E7                65 -  71, odd = #E7
 72 -  79, odd+even = #EF                73 -  79, odd = #EF
 80 -  87, odd+even = #F7                81 -  87, odd = #F7
 96 - 103, odd+even = #E7                97 - 103, odd = #E7
104 - 111, odd+even = #EF               105 - 111, odd = #EF
112 - 119, odd+even = #F7               113 - 119, odd = #F7


   133 = #85                             135 = #87
   135 = #87
145 - 151, odd = #F7                    145 - 151, odd = #F7
161 - 167, odd = #E7                    161 - 167, odd = #E7
169 - 175, odd = #EF                    169 - 175, odd = #EF
177 - 183, odd = #F7                    177 - 183, odd = #F7
193 - 199, odd = #E7                    193 - 199, odd = #E7
201 - 207, odd = #EF                    201 - 207, odd = #EF
209 - 215, odd = #F7                    209 - 215, odd = #F7
225 - 231, odd = #E7                    225 - 231, odd = #E7
233 - 239, odd = #EF                    233 - 239, odd = #EF
241 - 247, odd = #F7                    241 - 247, odd = #F7
```

Free ports in standard version

READ :	WRITE :

0, 1, 2, 3, 4, 5, 6
     PIO
8, 9, 10, 11, 12, 13, 14, 15
24, 25, 26, 27, 28, 29, 30,31
 	
56, 57, 58, 59, 60, 61, 62, 63
 	
      SIO
 	
88, 89, 90, 91, 92, 93, 94, 95
120, 121, 122, 123, 127
	1 , 3
	   PIO
	  9, 11, 13, 15
	RAM 25, 27, 29, 41
	64/128
	  57, 59, 61, 63
	
	      SIO
	
	89, 91, 93, 95
	121, 123, 127

129, 131 137, 139, 141, 143 153, 155, 157, 159 185, 187, 189, 191 217, 219, 221, 223 249, 251, 253, 255	129, 131, 133 137, 139, 141, 143 153, 155, 157, 159 185, 187, 189, 191 217, 219, 221, 223 249, 251, 253, 255