

SPECTRUM CENTRONICS AND RS 232 INTERFACE

1. INTRODUCTION

This interface which is easily connected into the Spectrum expansion port provides two communication methods: parallel Centronics and the bidirectional RS 232-C series.

The two communication methods can be connected simultaneously to two different pieces of equipment, such as a printer and a MODEM.

The software necessary for operation is written on EPROM and is placed at the high addresses of the ZX Spectrum memory (this interface is only valid for the 48K Spectrum), using the Spectrum initialisation when connecting it to the power supply.

The interface is controlled by means of the standard BASIC commands and some USR routines.

2. INTERFACE CONNECTION. CHARACTERISTICS

To connect the interface, first disconnected the Spectrum from power supply. Connect the interface into the back of the Spectrum. Since the Spectrum connector is extended behind this interface, it is possible to connect other peripherals, as long as the same input/output addresses are not used.

The wire for the Centronics connector is simply plugged in following the guides on the interface connector.

The interface uses two output ports:

251 (FB H) for Centronics output data.

127 (7F H) for output of control signals and transmission of data through the RS-232 port.

And one input port:

251 (FB H) for information about the state of the printer and data reception through the RS-232 port.

Since only one decoding line is used, the addresses with A2 or A7 at zero should not be used.

To use the RS 232 output, you must make your own cable following the diagram in [redacted] *Page 13*

The cable will have a standard DIN 5-pin connector at one end and D-type 25-pin connector at the other. The connections vary from one appliance to another. There are some examples in [redacted] *Page 14*

Ensure that the possible options of the printer are correct and finally connect the power supply of the Spectrum.

3. OPERATION. POSSIBLE MODIFICATIONS

To supply power to the interface via that supplied to the Spectrum, the necessary software is placed for interface functioning. The software in machine code is automatically protected by the RAMTOP.

In order that the interface is operated by the software, the following command should be given:

RAND USR 64973

so that some of the system variables change making the interface easily controllable from BASIC.

This software operation should always be done after giving a RUN or NEW command.

The interface has a switch on the upper part for selecting 2 types of software to cover a wide range of printers.

If the switch is at position 2, before connecting the power supply, suitable software for printers such as the NEC, EPSON, NEW PRINT, C-ITOH, LOGITEC, etc. must be made available. If it is at position 1, the software is suitable for the SEIKOSHA GP-100.

3.1. CENTRONICS

If your printer has a Centronics input, you can use the BASIC LPRINT and LLIST commands as described in the Spectrum manual and load the programs you wish for listing.

If you wish to make a copy of the screen at high resolution, remember the following:

— For NEC and C-ITOH printers, the interface will provide the graphics without modifications.

— For EPSON, NEW PRINT (ADMATE) and LOGITEC printers, you should first carry the following instruction:

POKE 64524,4

since the graphics are handled in a different way.

— For other printers which work graphically with an 8-point matrix, they probably work in the same way as one of the above.

For the SEIKOSHA GP 100 printer, you should use completely different software but it is placed on the Spectrum if, when the power supply is connected, you had already put the switch at position *1*.

3.2. RS-232 CONFIGURATION

The RS 232 input is always active but the output is interchangeable with the Centronics output. To switch from one to the other is done by "POKING" the appropriate value is indicated below:

| Required output | Address to be POKED | POKED value |
|-----------------|---------------------|-------------|
| Centronics | 64517 | 0 |
| RS 232 series | 64517 | 1 |

The software included in the interface implies a rate of 2400 bauds and a data format as follows:

DATA bits 7 (8 for graphics)
PARITY bits 1
START bits 1
STOP bits 2

The baud rate can be selected by POKing the following values at certain memory addresses:

| Baud Rate | Address for POKing | |
|-----------|--------------------|-------|
| | 64520 | 64521 |
| 50 | 125 | 20 |
| 110 | 225 | 4 |
| 150 | 165 | 4 |
| 300 | 83 | 4 |
| 600 | 41 | 4 |
| 1200 | 31 | 2 |
| 2400 | 19 | 1 |
| 4800 | 7 | 1 |

For example, to transmit at 300 bauds you must do the following:

```
POKE 64520,83  
POKE 64521,4
```

Although the above figures give speeds within the EIA standards, on some Spectrum models slight adjustment will be necessary and this should be done in steps of 1, choosing the value which does not give any character errors.

3.3. PRINTING FORMAT OPTIONS

a) Automatic line-jumping option.

If your printer does not require a line-jump character (10 or OAH) after the carriage return (13 or ODH), the software can be changed in order to avoid the line-jump being sent.

Type the following line:

```
FOR a=64928 TO 64932: POKE a, 0: NEXT a
```

In order to activate this option, type the following lines:

```
9980 FOR a= 64928 TO 64932: READ n: POKE a,  
n:NEXT  
9990 DATA 205, 253, 252, 14, 10
```

b) Tokens.

The BASIC programs are stored as simple characters instead of all the letters (see Spectrum manual, Appendix A). In order to produce a program listing, these Tokens should be extended until the complete key words are obtained.

If sending a program from one Spectrum to another for storing an subsequent execution, these Tokens

should not be extended or the Spectrum will not recognize them.

For this option, the software provides another place in the memory (64519). In order to prevent the expansion of the Tokens, type:

```
POKE 64519,1: RAND USR 64973
```

To return to normal, use:

```
POKE 64519,0: RAND USR 64973
```

This possibility can be used to send blocks of characters to some printers. Also note that the RS 232 port transmits 8 data bits but only 7 can be used to avoid problems with the parity bits sent by some equipment. This means that the "tokenised" programs should be transmitted in a hexadecimal format or a similar format to ensure the exact reconstruction of the memory data.

4. USE FROM BASIC AND IN MACHINE CODE

The program in machine code which controls the interface is stored about the RAMTOP so that it is protected by RUN and NEW. If by accident you were to execute one of these 2 commands, you would only have to renew the system variables (activate it) with the command:

```
RAND USR 64973
```

4.1. LLIST or LLIST n

When the program to be listed is loaded with LLIST, you list the complete BASIC program.

With LLIST n, where n is a natural number between 1 and 9999, you will list the program from line n to the end.

4.2. LPRINT

This command is similar to PRINT (see Chapter 21) but with the following differences:

- a) It will not recognise LPRINT AT.
- b) TAB functions normally but does not return the carriage to a new line after 32 characters.

NOTE: The characters which can be defined by the user, the graphic blocks and other characters which are not ASCII characters, should be LLISTed or LPRINTed as "?" or left blank, and the only way to get a copy on paper of them is to use the facilities of the SCREEN COPY if your printer is suitable for this.

Example:

```
10 LPRINT CHR$ 14, "DOUBLE PRINTING"  
20 LPRINT CHR$ 15, "NORMAL WIDTH"
```

4.3. PRINT

The interface can be used with already existing programs which use the command PRINT without modification. However, PRINT AT will not be recognised.

When the program which uses PRINT commands is loaded onto the memory, and the software controlling the interface is activate, type:

```
OPEN # 2, "p"
```

and begin the program using GOTO n instead of RUN.

To return to the usual mode, type: CLOSE # 2.

4.4. PRINTING OF GRAPHICS

There are two options: a "normal" output and an "extended" output in which each point is represented by 4

dots to give a figure which is double the "normal" height and width. The precision of the representation is determined by the printer which can mean that regular shapes are reproduced with slight disfiguring. Anything that can be printed or traced on the screen can be printed using this facility with suitable printers.

a) NORMAL

When the image to be copied has been obtained on the screen, type:

```
RAND USR 65044.
```

This produces on paper an image which has a width of $32 \times 8 = 256$ dots.

b) DOUBLE WIDTH

Proceed as under a) but type:

```
RAND USR 65047
```

This will produce on paper, if the printer allows, a width of $32 \times 14 = 512$ dots.

If this does not fit, the last columns will be missing.

Graphics printing is somewhat slow but it is worth the wait. The COPY commands included in a program which you wish to adapt to this interface should be substituted by the corresponding USR command.

4.5. RS 232 INPUT FUNCTIONS

a) The following points are important and should be remembered.

- 1) The input will only respond correctly to equipment which uses the indicated order of protocol. When this is not possible, it will be necessary to insert a pause between each character sent from the external equipment.

- II) Although it is possible to work with 4800 bauds, if any problems arise we recommend working with 2400 bauds.

- III) The software is written with the Spectrum as the control equipment. This means it will control a printer or a VDU but is cannot be controlled by a VDU.

- IV) The line jump characters are normally taken by the Spectrum INKEY\$ function as a STOP character and they report "STOP IN INPUT". For this reason and because much equipment sends automatic line jump codes, they are selected and ignored by the interface. The "STOP IN INPUT" report can also be produced when an ESCAPE character is received (decimal 27 or 1B hex.).

b) INPUT # 3.

The interface software uses channel 3 (the printer channel) for input and output. The use of PRINT # 3 therefore substitutes the use of INPUT from the keyboard.

Examples:

```
10 INPUT # 3 "ONE CHAIN"; a$  
20 INPUT # 3 "AND ONE NUMBER"; a  
30 PRINT a$, a
```

The rules for the INPUT are applied as described in the Spectrum manual.

c) INKEY\$ #

Their use is similar to that of INKEY\$ except that the control is not returned to the user until a character is received (see also 4.7.)

Examples:

```
10 LET a$ = INKEY$ # 3  
20 IF CODE a$ > = 32 THEN PRINT a$: GOTO 10.
```

This possibility facilitates communication at a character to character lever and is more flexible than the use of INPUT # 3. *

Examples:

```
10 LET a$ = INKEY$ # 3
20 IF CODE a$ >= 32 THEN PRINT a$;
30 LPRINT a$: REM (output echo, equivalent to
   PRINT # 3)
40 GO TO 10
```

This will not stop when the Spectrum screen is full and the "SCROLL?" message appears.

4.6. INTERFACE CONTROLLING ROUTINES

The interface uses 2 main routines in machine code for inputs/outputs and can be used directly from BASIC.

a) OUTPUT. Type the following line:

```
POKE 64525, byte: RAND USR 64761
```

where "byte" is the character code to be sent. The port to be used, and the series or parallel are determined as in section 3.3.

b) Series INPUT.

```
RAND USR 64698: LET a$ = CHR$ PEEK 64525
```

If this method is used with the interface, you do not need to activate the software as described under point 3.

4.7. USE OF THE INTERFACE IN MACHINE CODE

It is assumed that all users wishing to use the interface in this way will have a wide knowledge of machine code; therefore this section only includes reference information.

| | | Decimal Hexadec. | |
|--------------|-----------------------|------------------|---------|
| PORT ADDRESS | | Address | Address |
| Output | CENTRONICS DATA (0-7) | 251 | FB |
| Input | BUSY CENTRONICS (0) | 251 | FB |
| Input | RS-232 BUSY (1) | 251 | FB |
| Input | RS-232 RX DATA (7) | 251 | FB |
| Output | STROBE CENTRONICS (0) | 127 | 7F |
| Output | RS-232 TX DATA (1) | 127 | 7F |
| Output | RS-232 CTS (2) | 127 | 7F |

The numbers in brackets indicate the port bit used by the different functions.

Addresses where the controls are located

| USE | ADDRESS |
|------------------------------------|---------|
| RAMTOP | 64516 |
| FLAG SERIES/PARALLEL (s = 1 p = 0) | 64517 |
| TOKENS FLAG | 64519 |
| BAUDS | 64520 |
| TYPE OF PRINTER | 64521 |
| (EPS = 4 NEC = 0) | 64524 |
| BYTES TO BE TRANSMITTED | 64525 |

Addresses of Sub-routines

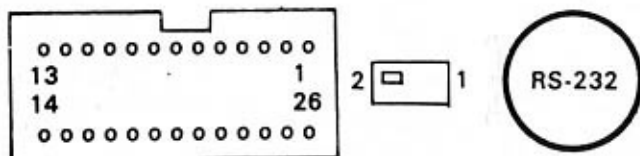
| USE | ADDRESS |
|----------------------|---------|
| OUTPUT | 64761 |
| INPUT | 64698 |
| COPY | 65044 |
| DOUBLE COPY | 65047 |
| INIT | 64973 |
| LAST BYTE USED | 65367 |

4.8. PROBLEMS ARISING IN PRINTING

- a) If you use the RS-232 port, check the baud rates.
- b) If there is a failure when copying the screen but it functions well with LLIST and LPRINT, check the type of software being used and the possible configurations, POKing at address 64524.
- c) Omission or errors in character printing. Check the BUSY line for the CENTRONICS port and the DTR line or the baud rate for the RS-232.
- d) The software for the SEIKOSHA GP 100 assumes that the printer carries out line-jumping when the carriage is returned. When listing a program, if the lines overprint, consult your printer manual since there will be a switch with which you can select.
- e) The input routine uses a double "buffering" to reduce the loss of input characters, but if the tempering of the external equipment is not the same as that of the interface, you may receive useless characters. If this happens, use the following BASIC line to cancel these characters:
 100 LET a\$ = INKEY\$ # 3: IF a\$ = " " THEN GO TO 100

5. CONNECTIONS OF BOTH PORTS.

CENTRONICS CONNECTOR



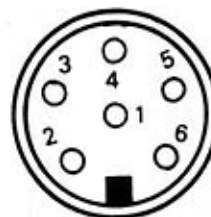
| | |
|--------------|--------|
| Pin 1 | STROBE |
| Pin 2 | 00 |
| Pin 3 | 01 |
| Pin 4 | 02 |
| Pin 5 | 03 |
| Pin 6 | 04 |
| Pin 7 | 05 |
| Pin 8 | 06 |
| Pin 9 | 07 |
| Pin 11 | BUSY |

Pins 10, 12, 13, 14, 15 are not connected.
 Pins 16-26 MASS

The wire from the Centronics output can only be connected in one way because of the guide on the connector.

RS-232 CONNECTOR

Connections of the 6 pin connector seen from above:



| | |
|-------------|-----------------------------|
| Pin 1 | NO CONNECTION |
| Pin 2 | RX DATA (Data Reception) |
| Pin 3 | RTS/DTR (or printer busy) |
| Pin 4 | GND (Mass) |
| Pin 5 | TX DATA (Data Transmission) |
| Pin 6 | CTS |

**Configuration of the D-type 25-pin connector
for the following devices:**

| Morex Interface | /Nec Printer | Seikosha | | | |
|--------------------|-----------------|-------------------|-------------------|----------------|----------------|
| | | Bryans Plotter | V.D.U. (Newb.) | General DTE | General DCE |
| GND | (1), 7 | (1), 7 | (1), 7 | (1), 7 | (1), 7 |
| TX DATA | 3 | 3 | 3 | 3 | 2 |
| RX DATA | (2) | 2 | 2 | 2 | 3 |
| RTS | 20 (DTR) | 5 | 4 | | |
| CTS | — | 6 | 5 | | |

The above connections are given only as examples; since in practice there are many possible variations, the appropriate manual should be checked. The functions of the signals are as follows:

- a. Data transmission: interface series output to peripheral.
- b. Request for sending (RTS)/data terminal ready (DTR), informs Spectrum that the peripheral is ready to accept data.
- c. Data reception: series input from peripheral to interface.
- d. Ready for sending (CTS): output to peripheral indication that the Spectrum is ready for reception.
- e. Mass: pin 7 of the type-D connector (signal ground) can be connected to pin 1 (Protective ground).

NOTE:

*DTE is for the data terminal equipment.
DCE is for the data communication equipment.*

NOTE: Incorrect connections can cause permanent damage to the interface, to the Spectrum and, in some cases, to the peripheral connected to the interface; for this reason, check your network carefully.

Ensure that pin 5 of the DIN connector (TX DATA) is connected to pin 3 (RX DATA) of the standard D-type 25-pin connector of the printer. Also, pin 3 of the DIN connector should generally be connected to number 20 of this D-type connector for the RS-232. As this can vary, consult the printer manual.

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