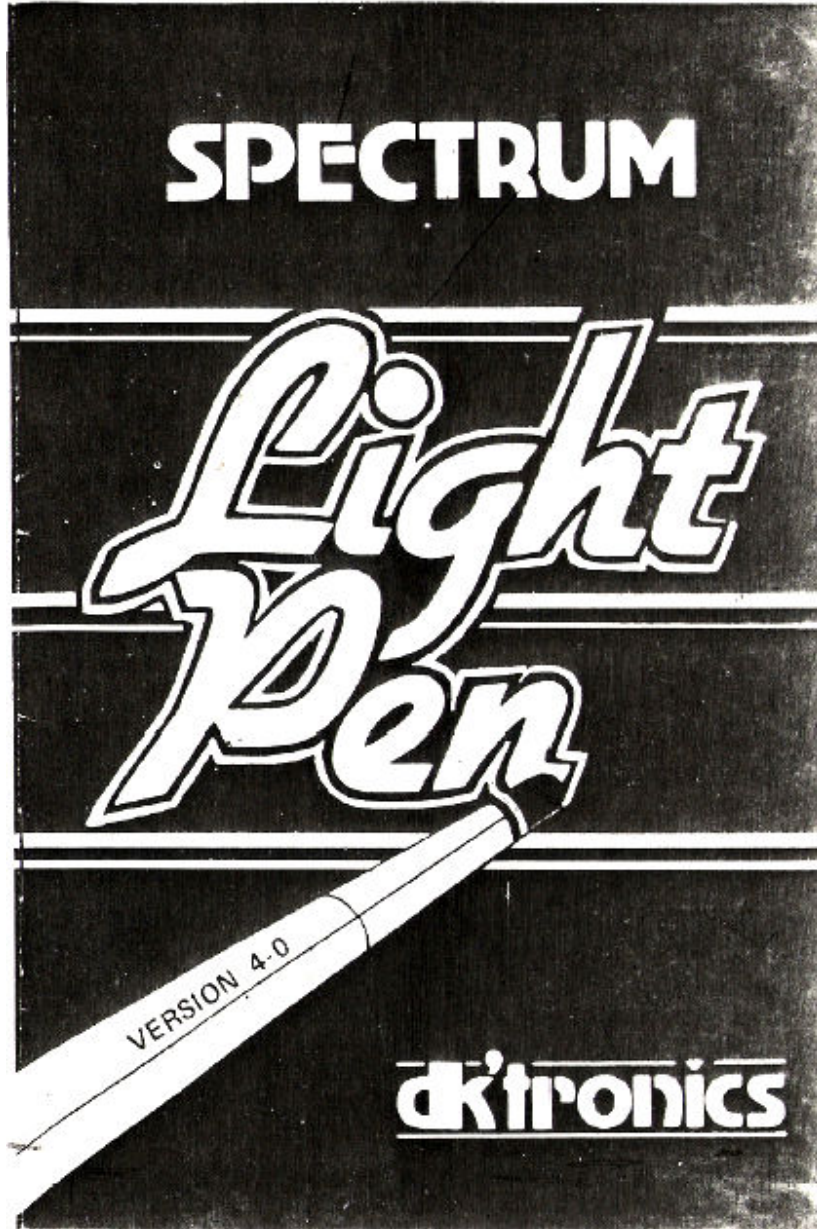


**dk'tronics Light Pen**

2004 OCR'd by Wilko Schröter



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## **ZX SPECTRUM LIGHT PEN**

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#### **1 WHAT IS A LIGHT PEN?**

The light pen is a device which will detect the light emitted by the Television screen, and will send a signal to the SPECTRUM. When used with appropriate software, it can be used to pick items from a menu, or draw designs on the screen.

It works in the following way: Since in the TV, the display is made up of a flying spot of light deflected across and down the screen at very high speed, by carefully timing the receipt of the pulse of light as the spot passes in front of the pen, the exact position of the Light-pen can be determined. The programs supplied with the Light pen use this information to calculate the

X (horizontal) and Y (vertical) co-ordinates corresponding to the point where the pen is positioned.

Alternatively, it is possible to calculate the line number for use when selection from a menu is required.

No knowledge of BASIC or machine code programming is necessary for you to use the pen and produce elegant designs, although an understanding of BASIC will help if you want to experiment and use the pen in your own programs. .

A series of machine-code routines are provided to allow the user to draw circles, lines, boxes, arcs and to fill-in shapes with any of the 8 SPECTRUM colours. For further details, see section 5.

## 2 HOW TO CONNECT THE LIGHT PEN TO THE SPECTRUM

The light pen consists of a control interface unit and the light pen which plugs into the jack socket at the top of the control interface. To connect to the SPECTRUM proceed as follows:

- (a) first connect the light pen to the interface.
- (b) ensure the SPECTRUM is switched off and push the interface box onto the expansion socket at the rear of the SPECTRUM. There is no need to disconnect the ZX printer, or Interface 1.
- (c) Switch on the SPECTRUM and load the program from tape in the normal way, entering LOAD "".

The software is in two parts - the first part is BASIC and the second is in machine code.

## 3 HOW TO USE THE LIGHT PEN

When in use, the Light pen should be held firmly against the television screen. This is to ensure a lightproof seal and to stop reflections affecting the operation of the pen.

When setting up the Light pen you may find slight inaccuracy in the position of the 'target' relative to the actual pen position. You will probably find that adjusting the brightness, contrast and colour controls on your T.V. set will correct this. However, it is possible to vary the position by pressing the I or Q keys as explained in the Calibrate Routine.

After Calibration you will be offered the chance of saving the machine code.

You should use a new tape, rather than erasing the program.

There are two basic types of operation when using the Light pen:

- (a) if using the pen to select from a menu, simply point the pen at the item required. See section 4.
- (b) if using the pen for drawing, etc., then it will usually be necessary to point the pen at the screen to the desired point and press a key to start. A black band will appear - this is normal, and is used to determine the position of the pen accurately, i. e. both the X and Y co-ordinates. See section 5 for more information.

## 4 USING THE LIGHT PEN TO CHOOSE FROM A MENU

A machine-code routine is provided to enable you to use the Light pen to pick items from a menu. The routine returns the line number of the chosen item, hence it is necessary to put each item in the menu on a separate line of the display. Which item is chosen can be determined by use of the line number returned by the machine code program. For example:

```
CHOICE 1           (line 0)
CHOICE 2           (line 2)
CHOICE 3           (line 4)
etc...
```

The MENU routine is located at 63109 (48k) or 30341 (16k) and is used as follows:

```
LET Lno=USR 63109   (48k) or
LET Lno=USR 30341   (16k)
```

On return from the machine code, Lno will contain the line number and can be tested in BASIC as follows:

```
IF Lno=0 THEN GO SUB CHOICE 1
IF Lno=2 THEN GO SUB CHOICE 2
IF Lno=4 THEN GO SUB CHOICE 3 etc. ...
```

or, if the line numbers in your program allow it, the form GO SUB Lno+100+200 could be used.

The routine will return the line number as soon as the pen detects light, and hence, in order to give you time to place the pen in the right position, you may want to insert a delay routine. The following will wait until you point the pen at the screen and then will allow a short delay before returning the line number.

```
1000 LX= 63: IF X/2 <> INT (X/2) THEN GOTO 1000
1010 PAUSE 25: REM delay to allow pen to be placed in correct position.
1020 LET Lno=USR 63109: REM or 30341 for 16k version.
```

If you wish to save the menu machine code separate from the remainder of the "Lpmc" program, this can be done as follows:

1. Load the "Lpmc" program by typing:  
CLEAR 59477 (48k) or CLEAR 26709 (16k)  
LOAD "LPMC48"CODE LOAD "LPMC16k"CODE
2. Save the MENU routine by typing:  
SAVE "menu"CODE 63030,96 (48k)  
or SAVE "menu"CODE 30262,96 (16k)
3. To re-load, type:  
CLEAR 63029 (48k)  
LOAD "menu"CODE  
or CLEAR 30261 (16k)  
LOAD "menu"CODE

## 5 DRAWING WITH THE LIGHT PEN

The program which comes with your light pen contains several routines to allow you to create pictures, graphs or sketches using the pen. This section explains how to use the various routines. There are sixteen functions provided. They are selected from a menu-type display which is given in the bottom two lines of the screen. The menu does not take up any space therefore which could be used by your drawing. The menu will look like this:

```
E D M C R F H B I P N T K r A L
■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■
```

The letters are the initial letters of the various functions and the required function is selected in the following manner:

1. Point the pen at the letter, or the box below the letter.
2. Press a key.

The selected function will then be executed.

The functions are as follows;

Erase	- rub out the line, circle box or arc just drawn
Draw	- draws a line
Move	- moves the 'ORIGIN' to the 'TARGET' (for definitions see below)
Circle	- draws a circle
Rectangle	- draws a box
Fill	- inks in a shape with the current ink colour
Hand-draw	- draw freehand
Border	- set border colour
Ink	- set ink colour
Paper	- set paper colour
New screen	- clears the screen
Tape	- allows screen to be SAVED or LOADED from tape
Keep	- copy screen to memory for later RECALL
Recall	- recall KEPT screen
Arc	- draw a curve
Letters	- insert text onto the display

It is convenient to define two terms here. In order to draw many of the shapes, two and sometimes three co-ordinates are required. For example, to draw a line, the end-points of the line need to be defined. The program uses two variables called the ORIGIN, which is indicated on the display as an 'x', and the TARGET, which is denoted by a large +. These two positions determine the end points of lines, the corners of boxes, the centre and circumference of circles, etc. More details are given in the paragraphs below.

The following paragraphs explain the functions in a bit more detail.

## **ERASE**

This command allows you to erase the line or shape (box, circle or arc) you have just drawn. If you change the position of the ORIGIN or TARGET then you may not be able to erase the item unless you are able to re-position them exactly.

To use this function, simply point the pen at the E and press a key.

## **DRAW**

This function draws a line from the ORIGIN to the TARGET. There are three steps required to draw a line using this command:

- (a) Fix one end of the line by positioning the ORIGIN (x) at the desired point (use the MOVE command);
- (b) Fix the other end of the line by moving the pen (and hence the TARGET) to the desired point and pressing a key;
- (c) Point the pen at the D and press a key.

## **MOVE**

This command moves the ORIGIN (x) to the TARGET (+) position. Use this command to move the origin about the screen. It is used in conjunction with the DRAW, CIRCLE, RECTANGLE and ARC commands to define one or the points.

To use MOVE, simply point the pen at the M and press a key.

## **CIRCLE**

This is self explanatory. There are three steps needed to draw a circle:

- (a) Fix the centre of the circle by positioning the ORIGIN (x) at the desired point (use MOVE).
- (b) Set the radius of the circle by moving the pen (and hence the TARGET (+)) to where the circumference of the circle is to be; press a key.
- (c) Point the pen at the C and press a key.

## **RECTANGLE**

There are three steps needed to draw a box:

- (a) Move the ORIGIN (x) to where one corner of the box will be (use the MOVE command);
- (b) Determine the position of the opposite corner of the box by moving the TARGET to the appropriate position.
- (c) Point the pen at the R and press a key.

## **FILL**

This feature allows you to ink in a shape with any of the eight colours (including black and white!). There are two or three steps involved:

- (a) Place the TARGET inside the shape to be filled;
- (b) If necessary, use the INK command to set the current ink colour to that desired;
- (c) Point the pen at the F and press a key.

## **HAND-DRAW**

This allows you to draw free-hand – the pen will draw as you move the pen across the screen. Don't try to move it too fast, otherwise you will find that the drawing does not keep up with the pen.

First, point the pen at the H and press a key.

Next, position the pen at the point where you want to start sketching, and press a key to start.

To stop sketching, press a key again.

## **BORDER, INK, PAPER**

These three commands work in similar ways. They allow you to change the colours of the border, ink and paper as their title suggests. You will be able to choose the colour from a strip of the available colours. Note that the paper colour, if you change it, will not change the existing screen display until you clear the screen using the New Screen command.

## **NEW SCREEN**

This command allows you to wipe the slate clean and start afresh. It will clear the screen and reset the screen to the current paper colour, which may be different to the old screen. The ORIGIN and TARGET are set to the centre of the screen.

## **TAPE**

Use this command to either SAVE the screen display to cassette tape or to load a screen image from tape. Once you select Tape by pointing the pen at the T, you will be able to choose whether to SAVE, LOAD or ABORT. In either case you will be asked to supply a name for use in the SAVE or LOAD command. If you type ENTER in response to the filename, for SAVE you will get a filename of ten spaces, and for LOAD it will load the first 'bytes' type file it finds regardless of its name.

## **KEEP**

(This will only be possible to use on the 48k version)

This function copies the screen image to memory. It can then be instantly recalled using the RECALL command. It keeps the screen above the space available to BASIC (above RAMTOP see page 179 of the BASIC SPECTRUM manual) and it is therefore safe even if you type NEW it will not be destroyed. Up to 5 screen-fulls can be kept in the 48k SPECTRUM once the BASIC program has been deleted using NEW.

To use, simply point the pen at the K and press a key.

## **RECALL**

This command allows you to instantly re-call a copy of the screen image from memory - see KEEP above.

If more than one screen display has been kept, the option of selecting one of the pages or cycling through the kept pages can be made.

The delay between pages can be varied. The delay is chosen by pointing the pen at the appropriate number and pressing a key.

The range or coarseness of the delay between pages can be altered by POKEing address 61296 (16k - 28528) with a number between 1 and 5. For example, POKE 61296,5 will give the maximum delay range.

## **ARC**

This command allows you to draw curves or arcs. Three points are needed to define the arc:

- (a) the ORIGIN - defines one end of the arc;
- (b) the TARGET - defines the other end of the arc;
- (c) the previous position of the TARGET - this sets the extremity of the arc.

Hence there are four steps needed to draw an arc:

1. Move the ORIGIN (x) to where one end of the curve is to be;
2. Define the extremity of the arc by positioning the TARGET (+);
3. Move the pen and hence the TARGET (+) to the other end of the arc; this will not affect the position defined in 2 above.
4. Point the pen at the A and press a key.

## **LETTERS**

This command allows you to insert text - letters or numbers or even graphics characters you may have defined.

The text will be placed at the current position of the TARGET. So there are three steps involved:

- (a) Position the TARGET (+) to where you want to insert the text;
- (b) Point the pen at the Land press a key;
- (c) Type the text, finishing with 'ENTER'.

## **6 USING THE MACHINE-CODE ON ITS OWN**

The machine code program "LPMC48" (and "LPMC16") can be used on its own – i. e. without having to load the BASIC program. Once you become familiar with the use of the pen, you may find it convenient to LOAD and SAVE the machine code separately. You do this as follows:  
Type:

```
48k CLEAR 59477
    LOAD ""CODE
16k CLEAR 26709
    LOAD ""CODE
```

and load from tape in the normal way.

To SAVE the program (or use the Calibrate Routine) type:

```
48k SAVE "LP48"CODE 59478,4792
16k SAVE "LP16"CODE 26710,4792
```



There are three ways to RUN the machine code program:

(a) with calibration

followed by

(b) with initialisation of colours (border, ink and paper) and setting variables to starting values.

and (c) without initialisation, so that any 'kept' screens can still be accessed. (48k only)

The addresses are as follows:

For (a) above type RANDOMIZE USR 59478 (48k) or  
RANDOMIZE USR 26710 (16k)

For (b) above type RANDOMIZE USR 59481 (48k) or  
RANDOMIZE USR 26713 (16k)

For (c) above type RANDOMIZE USR 59487

To destroy 'kept' screens use CLEAR 59477. Re-start using (b) above.

followed by running the program using option (b) above.

It is possible to use the pen in your own programs in such a way that it returns the x and y co-ordinates. This allows you to use the 'high Resolution' graphics of the SPECTRUM. Use this HIGH RES PEN routine in the following way:

LET coords=USR 62564 (48k)  
or LET coords=USR 29796 (16k)

then the y co-ordinate is calculated:

LET y= INT (coords/256)

and the x co-ordinate:

LET x= coords-256\*y

You can use the resulting values in PLOT, DRAW, CIRCLE or POINT commands, e. g. PLOT x,y

To SAVE this routine on its own, type:

SAVE "hpen"CODE 62564,1706 (48k)  
or SAVE "hpen"CODE 29796,1706 (16k)

and to re-load, type:

CLEAR 62563 (48k) or CLEAR 29795 (16k)

followed by LOAD "hpen"CODE .

## 7 ERROR CONDITIONS

Certain actions can result in errors. Some of these will not cause the machine code to return you to BASIC, but if it does, you can restart without losing the display by typing the re-start address given in Section 6 above (c).

Some of the errors possible are as follows:

**CIRCLE** - if you try and draw a circle which is too large for the screen. An appropriate message will be printed.

**KEEP** - if there is not enough room to save the screen display (and each display takes nearly 7k bytes of space) you will be told with an appropriate message.

**RECALL** - if you try to re-call a screen image before having 'kept'.

**ARC** - if the arc goes off the screen error 'B' will result.

**Difficulty in calibration.** Although it should not normally be necessary, if the pen will not calibrate correctly or misregisters over part of the screen, experimentation with the timing factors may provide a cure. These addresses are as follows:

	48k	16k
Address:	63056	30288
Normal value:	13	7