

High Resolution Graphics

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Revised Disk Loading Instructions

The diskette supplied after 17/03/82 is no longer self-booting. The auto command will load the file STR3/CMD on power-up.

At DOS READY prompt type BASIC press <ENTER>

To HOW MANY FILES question press <ENTER>

To MEM SIZE question type

60000 <ENTER> (48k memory) or 43616 <ENTER> (32k memory)

At READY prompt type RUN"BEGIN" press <ENTER>

Execution will then be under programme control. Follow the instructions in 'Getting started' (Disk demonstrations) on Page 4.

Routine to Load Character Sets saved using the Setup Programme

```

10 REM TO BE USED WITH SYSTEMS AFTER 17/03/82
20 CLEAR5000:IFMEM<20000THENOS=0ELSEOS=&H4000
30 CLS:INPUT"ENTER GRAPHICS NAME ";QQ$
40 IFRIGHT$(QQ$,4)<>" /PIC"THENQQ$=QQ$+" /PIC"
50 GOSUB19000:CLS:OUT155,1:FORX=128TO255
60 PRINTX;CHR$(X);:NEXT
70 PRINT:PRINT:INPUT"PRESS ENTER TO RE-RUN ";A
80 GOTO30

19000 M=1:GOSUB20000:FORX=0TO6:GET1,X+1:AB$=AC$
19005 V=VARPTR(AB$):POKE16425,1:POKE16424,X:Y9=USR9(V)
19010 NEXT:CLOSE:DEFUSR1=&HB81D+OS:X=USR1(0):RETURN
20000 AB$=STRINGS(252,32):DEFUSR9=&HB82C+OS:OPEN"R",1,QQ$
20010 IFLOF(1)=0ANDM=1THENCLOSE:KILLQQ$:ERROR 55:GOTO20030
20020 FIELD1,252ASAC$
20030 RETURN

```

Introduction

TRS-80 Model 1 graphics are ROM based and limited to the 3 down by 2 across block patterns represented by character codes 128 to 191 inclusive (Hex 80-BF)

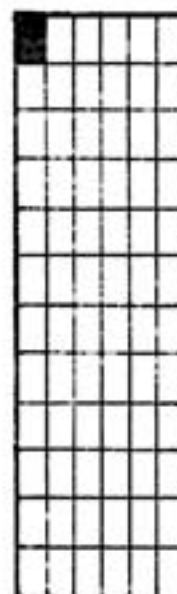
High resolution RAM based graphics supplement the existing graphics on the TRS-80 by allowing the user to create as many sets of up to 128 high resolution graphic characters as the imagination will allow. Each set may be saved to disk or tape for recall as desired.

The screen of the TRS-80 is divided into 1024 print locations, 64 horizontally on each of 16 vertical lines, each of these 1024 positions can display one character, (graphic or otherwise). As stated, a graphic character consists of a combination of the 3 down by 2 across block pattern which makes up the display area

i.e. Printing CHR\$(129) would display the top left hand block of the 6 blocks available at the print location.



**Original
Graphics**



**Enhanced
Graphics**

Examination of this display would show that the illuminated portion consists of 4 horizontal scanning lines (rows) with 3 dots per row; as the total character display area consists of 6 of these blocks it necessarily follows that there are a total of 12 rows each with 6 dots, i.e. a 12x6 dot matrix. Control of each of these dots improves the resolution of the display by a 12 to 1 ratio.

High resolution RAM based graphics achieves this and even more. In addition to providing such high resolution graphics over the character code range 128 to 191 the facility is extended to overlay the compression code area of 192 to 255 (Hex C0-FF) giving 128 characters in each set created.

Whilst the full set of Tandy graphics are retained and available on power up or by making a simple "OUT 150,1" statement, they cannot be displayed on the screen at the same time as the high resolution graphics. However as 128 high resolution graphics characters are available it is possible for the user to reproduce the Tandy set together with 64 other characters.

When the lower case driver supplied is loaded all 128 high resolution characters (Codes 128 to 255 (Hex 80-FF)) can be POKED, PRINTED SINGLY or PRINTED in STRINGS onto the screen using ordinary BASIC statements or ASSEMBLY code.

NOTE :- When lower case has been loaded, transfer between upper and lower case is possible by simultaneously pressing the <SHIFT> and <SPACE BAR> or <SHIFT> and <0>.

General Description

The modification necessary to achieve these high resolution graphics involves:-

The provision of additional RAM (supplied in a separate expansion box).

The fitting of an additional ribbon cable to the keyboard and the installation of a fully descending lower case modification. If a different lower case mod. has been fitted it will be replaced.

The minimum machine requirement for this modification is :-

4K (level II, (16K level II up is recommended))

None of the 4 to 48K of RAM in the Computer configuration is required to provide the high resolution graphics facility, as all of the RAM required is contained in the expansion box supplied.

Assembly of the modified units is quite simple.

- (1) Assemble the Computer in the normal configuration.
- (2) Plug the new ribbon cable from the keyboard into the RAM expansion box supplied.
- (3) For a Keyboard only system, plug the wider ribbon cable from the RAM expansion box into the Keyboard Expansion Port.

For an Expansion Interface system, plug the wider ribbon cable from the RAM expansion box into the Interface Expansion Port.

- (4) Power up as normal.

Please refer to appropriate picture on page 14.

All necessary driver programmes are supplied on a self booting diskette or a self running cassette. As far as it is possible to say all existing software will continue to perform in the same manner as before with this modification installed.

How It Works

The 128 graphic characters available are only accessible by means of "OUT" statements. This is due to the fact that they overlay the same memory location as ROM. Normally ROM cannot be written to in the TRS-80 but by using 4 of the 256 available ports, the high resolution graphics RAM can be accessed and written to.

The "OUT" statements used with the high resolution graphics are:-

```
OUT 130 , 1 = Display high resolution graphics.
OUT 140 , 1 = Allow writing to RAM graphics.
OUT 150 , 1 = Display Tandy graphics (default on power up and
              reset).
OUT 155 , 1 = Access high resolution RAM graphics.
```

The character codes which may be used to display high resolution graphics are 128 to 255 inclusive.

The memory locations used by the high resolution graphics RAM are from 0 to 2047 decimal. As only 12 lines of data are used to form a graphic character, it is necessary to skip 4 memory locations between the programming of each character. This means that memory locations 0-11 will hold the first character, 16-32 the second character and 32-43 the third character etc..

Each memory location holds one graphic line. Therefore to programme a single line across a character the decimal number representing the first 6 binary digits must be POKED into the memory location. The decimal number will be between 0 and 63. POKE-ing 0 will leave a blank line whereas POKE-ing 63 will white out that line. An example of this technique is demonstrated in a programme on page 13.

128	129	130
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
10	10	10
11	11	11
16	16	16
17	17	17
18	18	18
19	19	19
20	20	20
21	21	21
22	22	22
23	23	23
24	24	24
25	25	25
26	26	26
27	27	27
32	32	32
33	33	33
34	34	34
35	35	35
36	36	36
37	37	37
38	38	38
39	39	39
40	40	40
41	41	41
42	42	42
43	43	43

At this juncture disk users can skip the following section and continue reading overleaf at the section headed "GETTING STARTED :- Disk Demonstration."

Getting Started (Cassette Based Graphics)

1. Power up computer and answer "Memory Size" by pressing <ENTER>.
2. Put "GRAPH" side of tape into recorder and ensure it is rewound.
3. To "READY" prompt type SYSTEM and press <ENTER>.
4. To "**?" prompt type GRAPH, put recorder into PLAY, press <ENTER>.
5. Following a successful load, a "READY" prompt will appear.
6. Turn tape over to "SETUP" side and rewind.
7. Press PLAY, type CLOAD and press <ENTER>.
8. On completion of load type RUN and press <ENTER>.

You are now in the setup mode and can begin to experiment and create your own high resolution graphic characters. You are now advised to read the section headed "USING THE SYSTEM" on page 5 relating to the use of option 3. All commands explained are useable with the exception of those indicated by (Disk Only) and the <S>ave command.

To save your character set, use a new or erased tape and type <S>. The screen will clear and full instructions will be displayed at the top. The programme written to tape will have the system name "GRAPH". Should you wish to load a previously saved character set, press <E>nd and answer Y to exit question and then follow load instructions 3 to 8. NOTE :- The system name "GRAPH" must always be CAPITAL letters.

Getting Started (Disk Demonstrations)

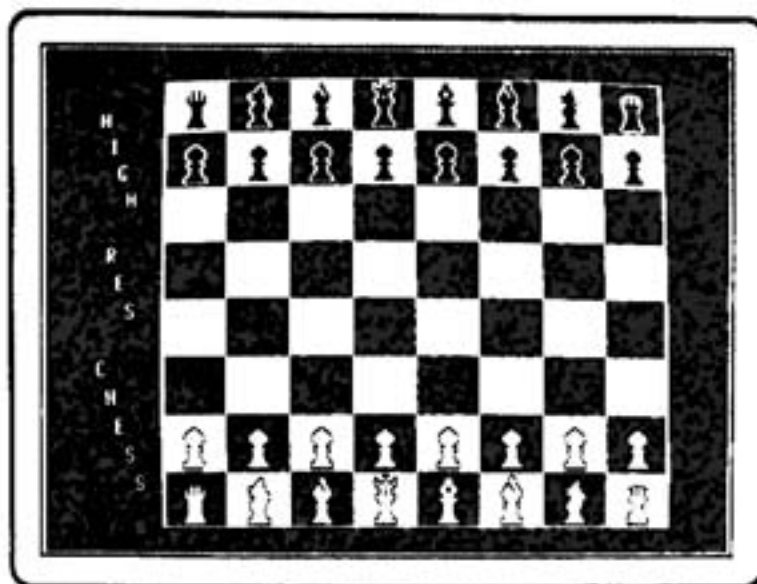
Load the diskette (supplied with the high resolution graphics modification) into disk drive 0 and press the reset button.

As the diskette is self booting this operation will result in the display of a menu offering 4 options. The user is requested to enter a choice, - simply type in the number of your choice - (the menu choice acceptance relies on an INKEY routine so there is no requirement to press <ENTER>).

Press number 1 and see what happens!.

There it took a little while but the screen now displays a chess board pattern & a full set of chess piece images.

This is a demonstration to show the user the quality and potential available from the high resolution graphics facility. The set of characters used to create this chess picture are those always loaded by default when accessing option 4.



Now press any key and see another demonstration.

The screen now depicts a circuit diagram of a DC power supply. Once again this is only a demonstration but it shows quite clearly the advantages to be derived from the high resolution graphics facility.

The graphics used to create this picture are available on the diskette supplied and may be accessed from option 4 by <L>oading character set COMP3.

The demonstrations so far have indicated the quality and the static possibilities of high resolution graphics.

Let us now see what can be done to bring life to the system.

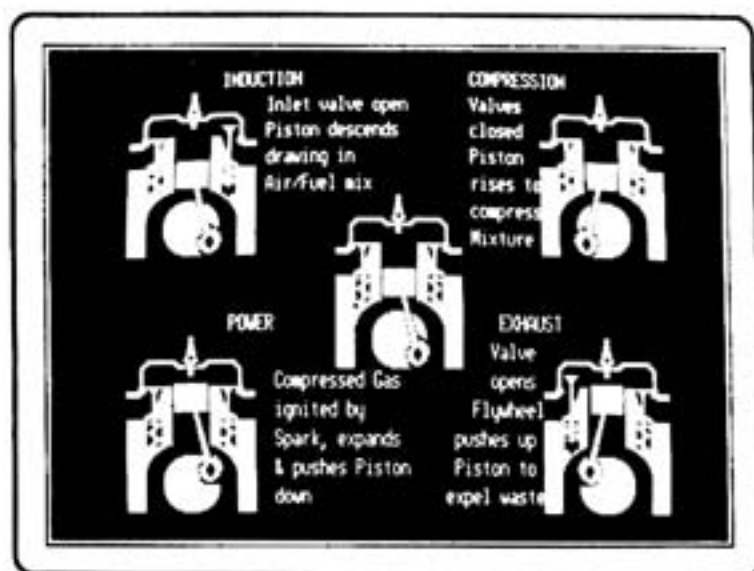
Press the letter <E> and hold it down for a few seconds. This will break from option 1 and return you to the main menu.

Now select option 2.

Initially the screen will display a few sentences describing what is to follow. Take a good look at this because it shows an example of the fully descending lower case modification built into the system.

Hold down the <SPACE BAR> to change the display.

Five displays of a sectionised internal combustion engine will appear on the screen. The four outer displays depict the individual strokes of a "Four Stroke Engine". The centre display shows an animated version of the complete cycle of operation, i.e. The revolution of the crankshaft, the rise and fall of the piston and the opening and closing of the inlet and exhaust valves.



At this point typing in a number from 0 to 9 will control the speed at which the engine runs.

So high resolution graphics are not limited to the display of set patterns, in addition to creating better quality graphics, they can be animated as required.

These demonstrations will have indicated some of the possibilities using RAM based high resolution graphics. Obviously the range is limited only by the imagination of the user. Press <E> to return to the main menu.

Character Setup (Option 3)

Creating Graphic Characters and Pictures.

After reading the manual it is recommended that you, the operator, use and experiment with the system to familiarise yourself with the commands. In this way you will quickly become conversant with the creative potential of the system.

Now lets get down to creating some new and personal high resolution graphic characters.

First of all sketch out a pattern or picture on a copy of the grid layout in Appendix "A" of this manual. The heavy lines on the grid layout which split the grid into a 12 x 6 cell pattern, indicate the limits of each character block.

Then number each of the 12 x 6 blocks that your picture uses starting at number 128.

Using option 3 in the main menu - and following the instructions relating to that option (see page 6). The user can create the graphic characters required to reproduce the picture sketched.

When creating a character it is necessary to set each of the individual cells in the 12 x 6 block that has a sketch line drawn through it.

Sketching the layout of the graphic characters prior to creating them will save a considerable amount of editing time when you get around to assembling the picture.

Selecting option 3. Allows the user to set up graphic characters as required. On pressing <3> at the main menu the screen will clear and display :-

Enter start character (128-255)

Enter the number required and press <ENTER>. Pressing <ENTER> only will default to character 128. The screen will clear and display :-

Character (C) or Immediate (I) update

Pressing <C> will enable the user to construct a character in the left hand set up grid. When <ENTER> is pressed, to accept the character formed, the true size character will appear above its number on the extreme right hand top of the display. Pressing <I> has the same effect as <C> with the added advantage that, as every position in the grid is set it is duplicated, real size, on the right hand top of the display. This mode of character construction is slightly slower than using the <C> option. Upon selection of either of the above options the screen will once more clear and display :-

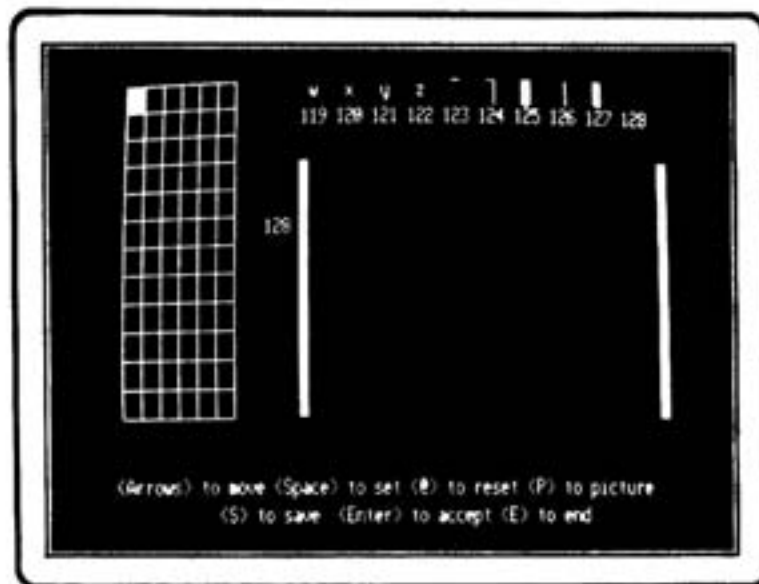
Now Character set <N> or Re-enter programme <R> (Disk Only)

Pressing <N> will clear all character positions in the graphics box memory. Selecting <R> will allow the user to re-enter the set up mode to access or update a previously loaded or constructed character set.

Note

It is recommended that <N> be selected the first time option 3 is used following initial power up.

When one of the options above has been selected, the screen will clear and display :-



The grid, on the left side of the screen measuring 6 cells by 12 cells, represents the size of a single graphic character. With a blank space bounded by two vertical white lines on the right hand side representing a central portion of the video screen and designated the "Picture" area.

Across the bottom of the screen are the commands necessary to create and save graphic characters. Whilst at the top right, above the picture area, will be displayed a range of ten character code numbers and the graphic characters they represent.

A cursor will be flashing in the top left cell of the setup grid. If the right hand graphic code number represents an existing graphic character then the shape of that character will be displayed in the setup grid if the <U>update key is pressed.

To create a graphic character, decide on the image you wish to create then move the cursor to the cell position you wish to set and press the <SPACE BAR>. This will white out the cell position at which the cursor was set and the cursor will move to the next cell on the right of the same row or to the first cell on the left of the next row down. Continue moving the cursor and setting the cells until the desired character is complete. Should an incorrect cell be set, place the cursor on the incorrect cell location and press the <&> key. This will reset the cell.

Once a character is completed, pressing <ENTER> will set the character, allocate it a character code number and clear the setup grid ready for the creation of the next character. To ensure that each character matches its adjacent one when used to create a picture, they can be

assembled in the "Picture" area on the right. To do this press <P>, a cursor will flash below the right hand graphic character at the top of the screen.

Pressing <ENTER> will insert this character into the top left hand corner of the picture area and it may be moved into the required position with the <ARROW> keys.

Pressing the <SPACE BAR> will set the character in this position, leaving the same character available to be moved to another location and set as required.

Pressing <ENTER> will set the character into position and return the cursor to the graphic character selection at the top of the screen so the same procedure may be followed until a complete picture is compiled. Use of the <;> or <-> keys enables the user to select the character required for use.

To erase a character or clear a block on the "Picture" area, set the cursor in the correct location and either overwrite with a new character or press to clear.

Should the characters created not match or should additional characters need to be created you can return to the setup procedure by pressing <E>.

NOTE :-

If a character is displayed in the "Picture" area and a change is made to the format of that character using the <U>date facility, the change will be reflected in the picture.

When compiling a picture it may prove easier to display the graphics as black on white (Inverse).

To do this - after pressing <P> press <W>.

In this mode pressing will return you to a blank picture area.

To <S>ave or <L>oad (Disk Only) a character set, the cursor MUST be in the left hand setup grid.

Once the range of graphic characters is complete type <S> and the screen will prompt :-

ENTER DISK NAME OR <@> TO EXIT

Pressing <@> will return the user to the graphics setup.

Typing in a name, of up to eight letters, and pressing <ENTER> will save a set of 128 graphic characters to a disk file of that name ready for recall at any time.

To reload and edit a "Graphic Character Set" previously saved to disk - type <L>, enter the name given to the character set when saved and press <ENTER>. The required character set will then become available for editing. Simply select the required character using the <;> or <-> keys and <U>date the cells of the character as required.

Dont forget to save your edited version to disk!!!

To exit from this option press the <E> key. A flashing display will appear at the bottom of the screen asking :-

ARE YOU SURE YOU WISH TO EXIT TO START (Y/N)

Answer as appropriate. This facility has been included to prevent accidental loss of the current character set. Answering "Y" will return you to the main menu.

Disk Screen Editor (Option 4)

Selecting option 4 at the main menu will clear the screen and display:-

A range of commands, across the top of the screen.

A set of graphic characters, across the bottom of the screen. The chess character set is always loaded by default.

A cursor will be flashing in the top left hand corner of the screen and it will be seen that this cursor is in the form of the character displayed at the bottom centre of the display. Each character selected acts as its own cursor.

From this position and using the commands displayed, the picture of your choice can be created on the screen.

To do this, move the flashing character selected to the required position on the screen and set it into position by pressing the <SPACE BAR>. If the same character is required in another position, simply move the cursor to the new position and press the <SPACE BAR> again. Changing character is achieved using the <-> or <,> keys. The cursor will also change to represent the character chosen. If the <CLEAR> key is pressed after entering option 4, then the ASCII characters, direct from the keyboard, may be incorporated in the picture display. Pressing <CLEAR> again will return control to the graphics set currently loaded. Follow this procedure until the picture is complete.

The completed picture can be saved to disk for future recall and display by using the <S>ave command.

As the displayed commands show, an alternate, previously saved set of characters can be loaded onto the screen so any desired picture can be created.

After typing <L>, reply to the screen request to load either a character set or a picture and then press <ENTER>. It is important that if a picture is loaded, its corresponding character set is also loaded. Failure to follow this may give unpredictable results.

Should the name typed in be incorrect, the screen will display the message :-

CAN'T LOAD FILE : CHECK NAME !

and after a short pause return to the request for the name of the graphic set required.

To exit from the <L>oad option press the <@> key. Exit from option 4 and return to the main menu is achieved by pressing <E>.

A summary of commands for both option 3 and 4 are listed on the following pages. Try them and you will soon appreciate their function.

Graphic Character Setup (Option 3)

LEFT HAND GRID (Character Formation Mode).

<+>	Move cursor one cell to right
<->	Move cursor one cell to left
<+>	Move cursor one cell down
<↑>	Move cursor one cell up
<SPACE BAR>	Set (white-out) cell
<@>	Reset cell
<ENTER>	Accept character (as formed in grid)
<E>	Exit option 3
	Blank out character grid
<I>	Invert existing character in grid
<L>	Load graphic character set
<P>	Move to "Picture" area
<R>	Rotate character about centre axis in grid
<S>	Save graphic character set
<U>	Update character in grid (indicated by number)
<W>	White out character grid

Graphic Character Setup (Option 3)

PICTURE AREA (Form Picture Mode).

CHARACTER SELECTION :-

<+> or <+> or <+>	Select next higher numbered character
<-> or <=> or <->	Select next lower numbered character
<↓>	Select 9th character lower
<↑>	Select 9th character higher
<ENTER>	Place selected character onto "Picture" area
	Blank out "Picture" area
<W>	White out "Picture" area

PICTURE LAYOUT :-

<→>	Move cursor one space to right.
<←>	Move cursor one space to left.
<↓>	Move cursor one space down.
<↑>	Move cursor one space up.
<SHIFT →>	Move cursor 5 spaces to right.
<SHIFT ←>	Move cursor 5 spaces to left.
<SPACE BAR>	Set character and move cursor to next space retaining same character.
<ENTER>	Set character and return cursor to graphic selection.
	Erase character at cursor location
<E>	Return to left hand grid.

Full Screen Editor (Option 4)

< >	Move cursor one space to right.
< <	Move cursor one space to left.
< ↑	Move cursor one space up.
< ↓	Move cursor one space down.
< SHIFT >	Move cursor 5 spaces to right.
< SHIFT <	Move cursor 5 spaces to left.
< ;	Increment character by 1.
< -	Decrement character by 1.
< +	Increment character by 15.
< =	Decrement character by 15.
< SPACE BAR	Set character in position and move cursor to next space on right.
< ENTER	Set character in position and leave cursor at same location.
< CLEAR	Toggle between ASCII and graphics mode
< B	Erase character at cursor location
< E	Exit Option 4.
< L	1 = Load graphic character set 2 = Load saved "Picture"
< S	Save picture to disk.
< g	Allows exit from < L >oad command

Example Programmes

The following programmes demonstrates how easy it is to access, display and update part character sets. The update technique can be utilised within a basic programme to create your own characters.

NOTE :- Tape users must ensure that their original "GRAPH" programme is first loaded.

```

10 REM ** ROUTINE TO ALTER ANY CHARACTER LINE (128 TO 255)
20 CLS: CLEAR500: DEFINT A-Z
30 OUT155,1: REM ** SET IN HIGH RESOLUTION MODE
40 FOR X=128 TO 255: PRINT X; CHR$(X);: NEXT X: REM ** PRINT CHARACTERS
50 L=0: C=0: A=0: REM ** RESET FLAGS
60 INPUT "ENTER CHARACTER NUMBER (128-255) "; B: GOSUB 130
70 B=B-128: C=B*16: REM ** CALCULATE ADDRESS TO UPDATE
80 INPUT "ENTER DECIMAL NUMBER TO CHANGE (0-63) "; A: GOSUB 130
90 INPUT "ENTER LINE NUMBER (0-11) OR <ENTER> "; L: GOSUB 130
100 OUT140,1: REM ** SET IN HIGH RESOLUTION WRITE MODE
110 POKE C+L,A
120 OUT130,1: GOTO 50
130 PRINT @896, CHR$(31);: RETURN
140 END

```

```

5 REM ** ROUTINE TO DRAW A DIAGONAL LINE ON SCREEN
10 CLS: CLEAR500: DEFINT A-Z: N=1
20 OUT140,1
30 FOR X=0 TO 5: POKE X,N: POKE X+22,N: N=N+N
40 NEXT X
50 OUT130,1
60 FOR X=0 TO 1023 STEP 66
70 PRINT @X, CHR$(128)+CHR$(129);
80 NEXT X
90 GOTO 90

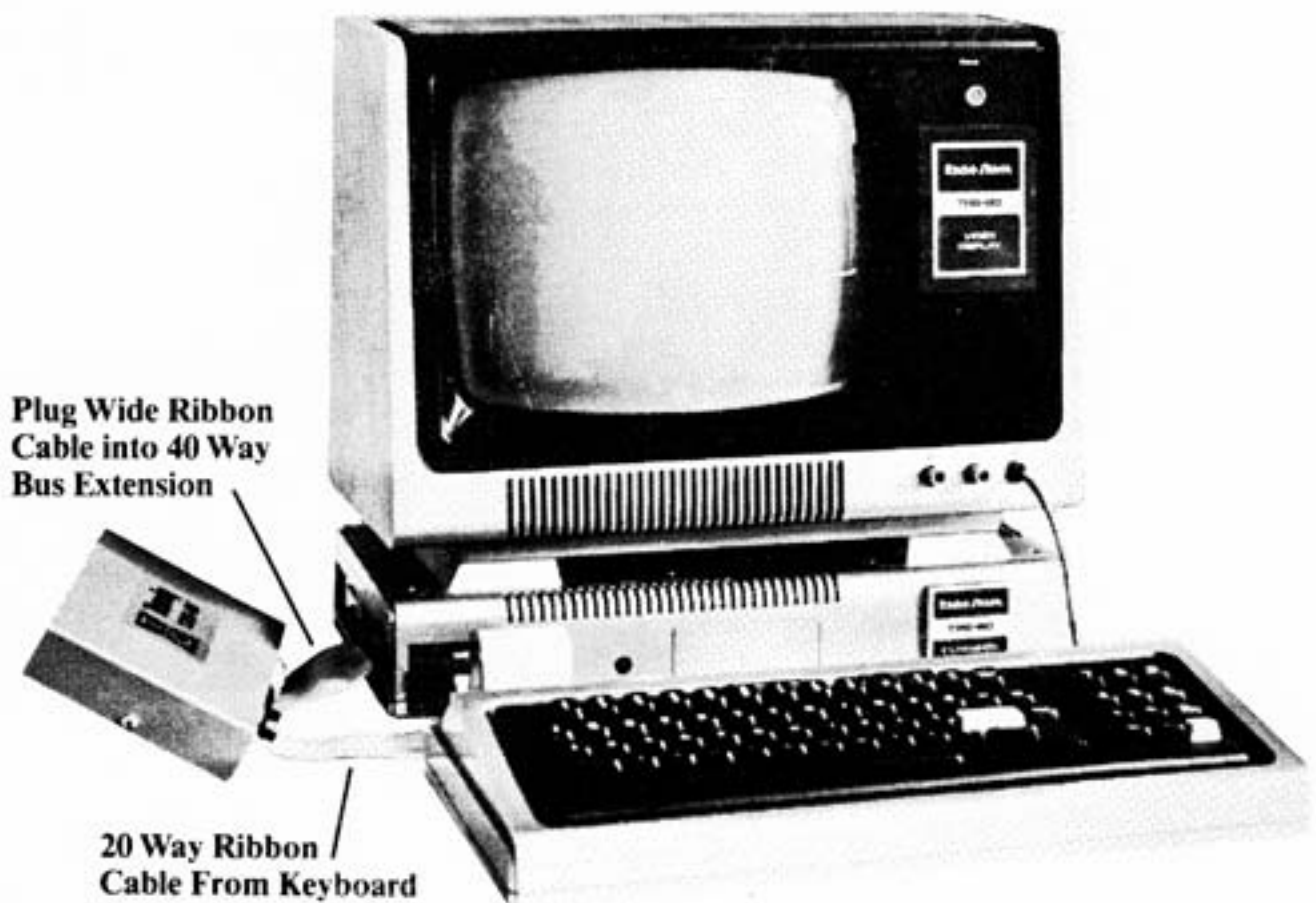
```

```

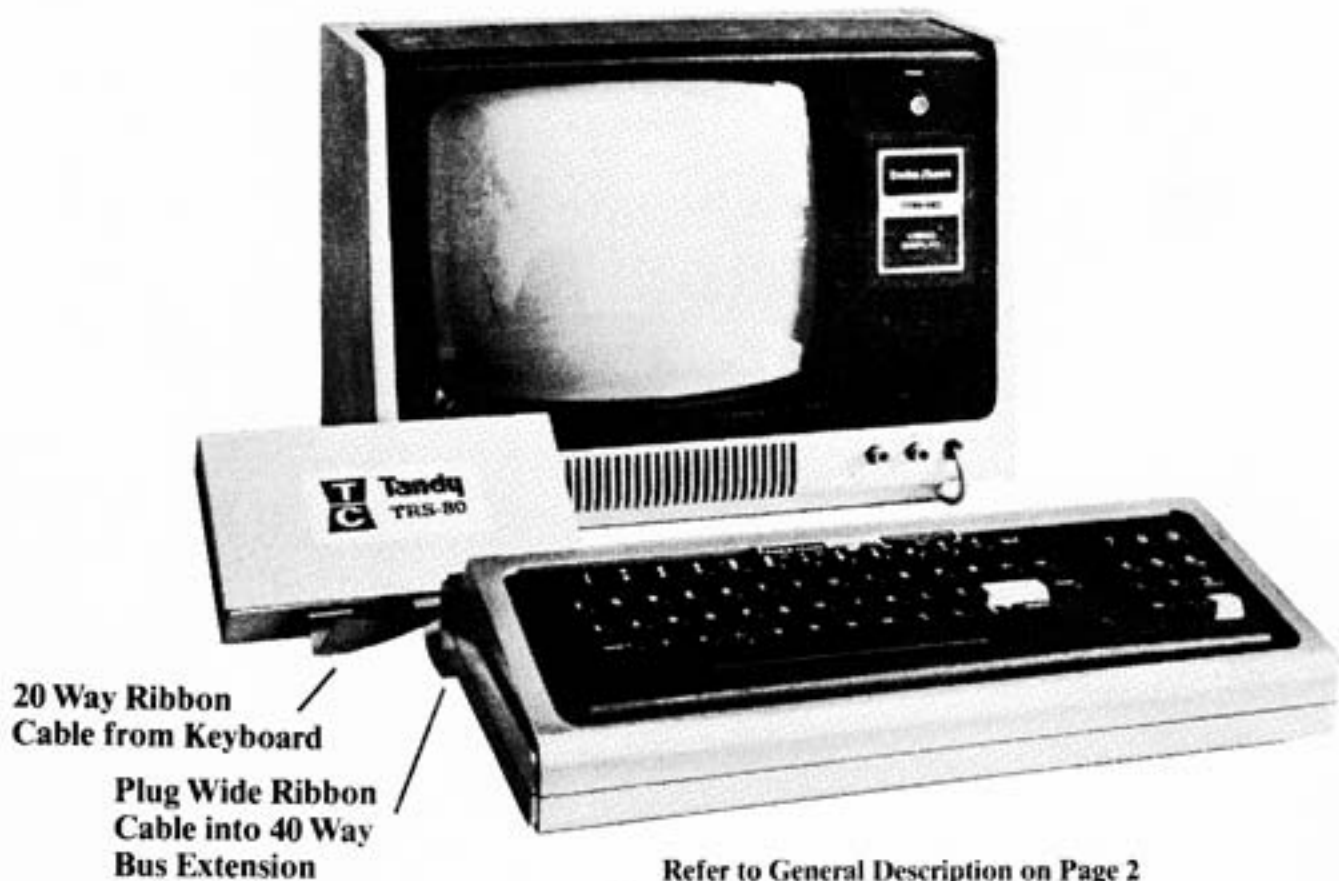
5 REM ** ROUTINE TO DRAW SQUARE OR RECTANGLE
10 CLS: CLEAR500: DEFINT A-Z
20 OUT155,1: OUT140,1
30 FOR X=0 TO 11: POKE X,1: POKE X+16,32: NEXT X
40 POKE 32,63: POKE 58,63
50 OUT130,1
60 PRINT @0,;: INPUT "ENTER NUMBER OF CHARACTERS ACROSS "; A$
70 IF VAL(A$)<1 OR VAL(A$)>62 THEN PRINT @0, CHR$(31)
80 GOTO 60 ELSE A=VAL(A$)
90 PRINT @128,;: INPUT "ENTER NUMBER OF CHARACTERS DOWN "; D$
100 IF VAL(D$)<1 OR VAL(D$)>13 THEN PRINT @128, CHR$(31)
110 GOTO 90 ELSE D=VAL(D$)-1
120 CLS
130 PRINT TAB(1) STRING$(A,131);
140 FOR Y=0 TO D: PRINT @((Y+1)*64, CHR$(128));
150 PRINT @((Y+1)*64)+A+1, CHR$(129);
160 NEXT Y
170 PRINT @((D+2)*64)+1, STRING$(A,130);
180 IF INKEY$="" THEN 180 ELSE 10

```

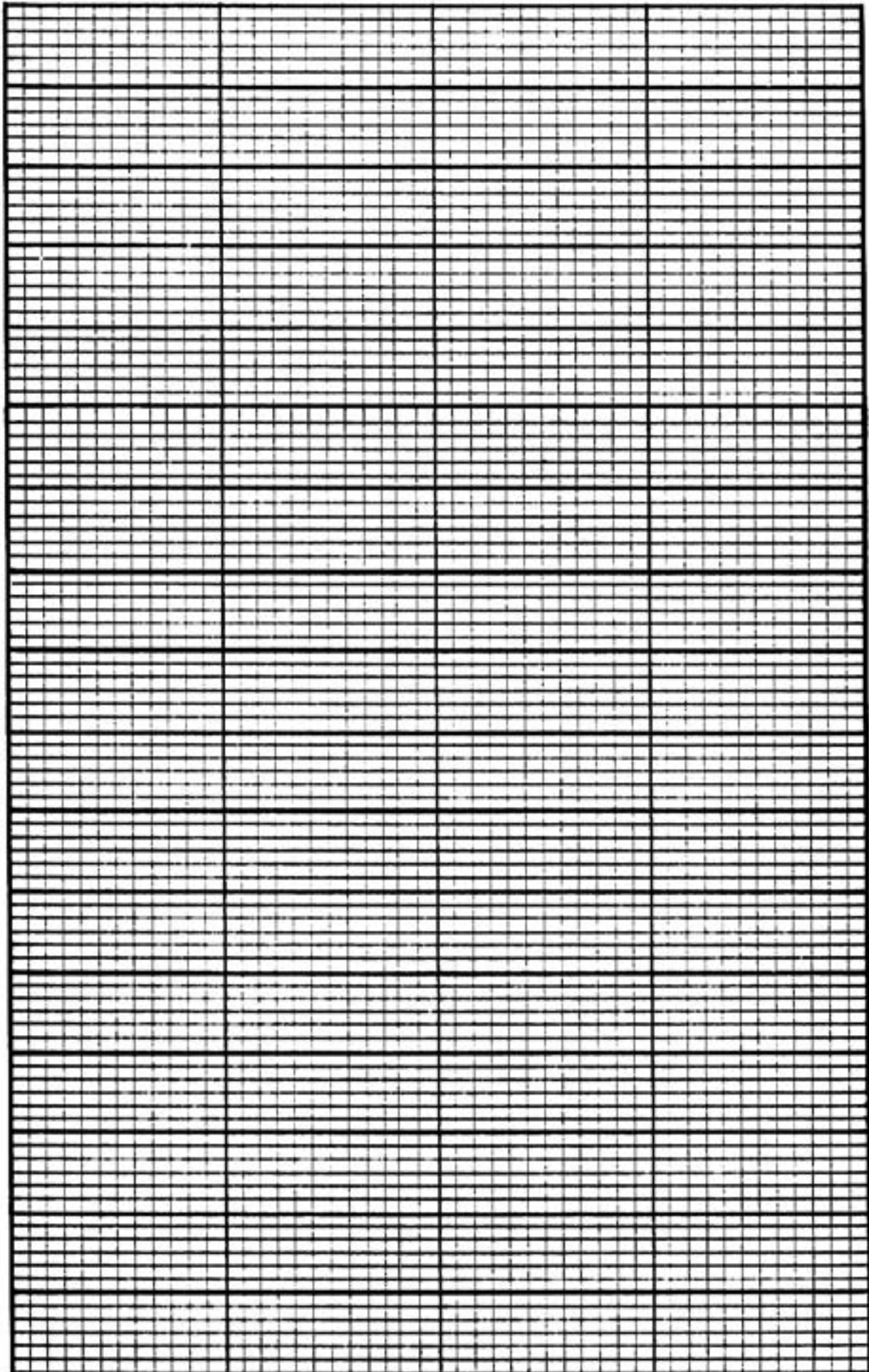
Keyboard With Interface



Keyboard Without Interface



Graphic Character Setup Sheet (Appendix A)



High Resolution Graphics SETXY AND PRINTER DRIVER PROGRAMME

HIGH RESOLUTION SETXY AND PRINTER DRIVER

This software is only intended to be used in conjunction with the TRS-80 Model I high resolution graphics upgrade 260-9800. A minimum of 48k of memory is necessary for disk based systems. Tape based systems may have 16k, 32k or 48k of memory.

HIGH RESOLUTION SETXY FEATURES

- | | |
|-----------------------|---|
| 1. CMDC | Clears the screen & all characters above 127. |
| 2. CMD(X,Y) | Sets an individual pixel. |
| 3. CMD*(X,Y) | Resets an individual pixel. |
| 4. &P(X,Y) | Returns the status of a pixel. |
| 5. LSET(X,Y,X1,Y1) | Draws a line from X,Y to X1,Y1. |
| 6. LSET*(X,Y,X1,Y1) | Resets a line from X,Y to X1,Y1. |
| 7. RSET(X,Y,X1,Y1) | Draws a rectangle from X,Y to X1,Y1. |
| 8. RSET*(X,Y,X1,Y1) | Resets a rectangle from X,Y to X1,Y1. |
| 9. RSETF(X,Y,X1,Y1) | Draws a rectangular block as above. |
| 10. RSETF*(X,Y,X1,Y1) | Resets a rectangular block as above. |

The above commands can be implemented in BASIC once SETXY has been initialised. They can either be entered in command mode or embedded in programme lines.

HIGH RESOLUTION PRINTER DRIVER

This machine language routine provides the facility to print a hard copy of high resolution graphics characters from a screen image. The setxy screen images may also be printed.

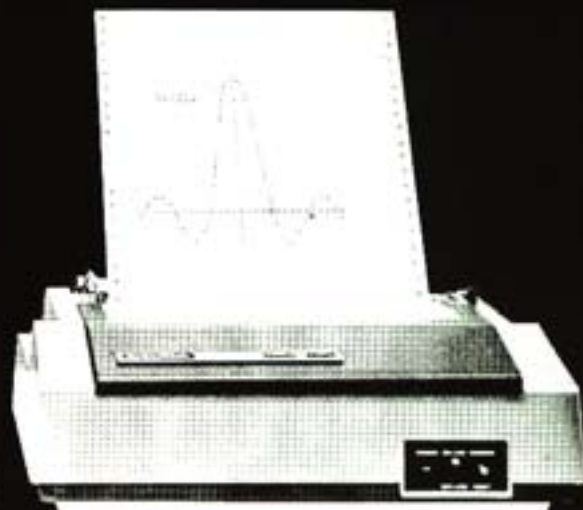
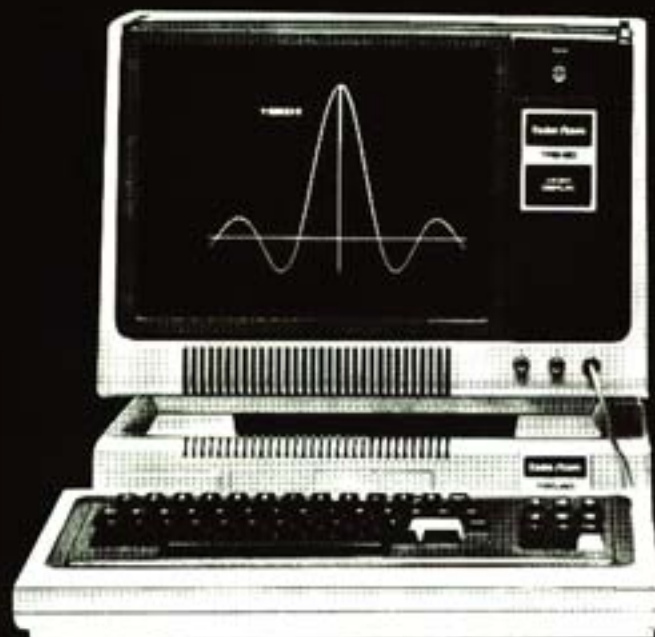
NOTE: The cassette version of SETXY has the printer driver routine appended. Thus PRINT need not be loaded separately. The high resolution printer driver routine supports the LP7 and LP8 lineprinters.

Both high resolution graphics and ASCII characters (32 to 124) can be printed from a screen image.

Vertical scale can be doubled on printout.

The Break key will abort printout at the end of a line.

This routine is accessed by a USR call.



Custom manufactured in the UK for Tandy Corporation

Setxy

Setxy is a machine language programme which can be loaded optionally from disk or cassette tape.

Individual pixels can be set or reset. It is also possible to detect the status of individual pixels, this is similar to the standard point routine but requires a different syntax. Although setxy allows plotting there are still only 128 graphics characters which can be allocated. To optimise on character allocation setxy maintains internal control and reuses redundant characters. Even so it is necessary to consider the size, complexity and repetition of characters.

If a design or picture utilises all 128 characters an out of memory error will occur. If this error occurs whilst setxy is drawing on the screen then rationalise on your design and re-run your program. A divide by zero error will occur if the co-ordinates given for a rectangle are on the same horizontal or vertical plane. The only other error message generated by setxy is a function call error. This will occur if a point is accessed outside of the screen range for the version of setxy being executed (see Appendix B).

Facilities have been included in setxy to :-

- a) allow the screen to be cleared and all characters to be reallocated.
- b) allow a point to be set or reset on the screen.
- c) allow vectors to be plotted or reset.
- d) allow status of a point to be returned.
- e) allow rectangles to be drawn or reset.
- f) allow filled rectangles to be drawn or reset.

NOTE : Disk users do not need to load STR3/CMD to use setxy. Tape users must not load the GRAPH tape when using setxy. To print existing characters created using setup load the appropriate GRAPH tape and then load the PRINT side of the cassette supplied.

Loading Setxy Tape

1. Power up computer as normal.
2. Answer Memory Size by pressing <ENTER>.
3. Put SETXY side of tape into recorder and rewind.
4. At Ready prompt type SYSTEM and press <ENTER>.
5. At *? prompt type SETXY, put recorder into play, press <ENTER>
6. On completion of a successful load the screen will clear, Setxy initialised will appear.
7. At the Ready prompt load or type in your programme.

Loading Print Tape

NOTE : PRINT is appended to SETXY therefore it need only be loaded separately if characters created by SETUP are to be printed.

Follow loading instructions 1 and 2 as above

3. Put "GRAPH" side of tape into recorder and rewind.
4. At Ready prompt type SYSTEM and press <ENTER>.
5. At *? prompt type GRAPH, put recorder into play, press <ENTER>
6. On completion of a successful load the Ready prompt will appear.
7. Put "PRINT" side of tape into recorder and rewind.
8. At Ready prompt type SYSTEM and press <ENTER>.
9. At *? prompt type PRINT, put recorder into play, press <ENTER>
10. On completion of a successful load the Ready prompt will appear.
11. Load or type in your programme.

The above "GRAPH" tape should be a user created character set.

Loading Setxy (Disk) and Printer Driver

1. Load SETXY disk into drive 0 and press reset.
The auto command will load STR3/CMD on power-up.
2. At the DOS READY prompt type LOAD SETXY/CMD (only if SETXY is to be used)
PRINT/CMD will work with either SETXY or characters created using SETUP
3. At the DOS READY prompt type LOAD PRINT/CMD press <ENTER>
4. Follow the revised loading instruction sheet.

NOTE : 1. 48k disk systems only.
2. option 5 at main menu initialises SETXY.
3. Upgrades prior to 17/03/82 may not have the enclosed errata sheet.

COMMAND	DESCRIPTION
CMD	Clears out all 128 characters, sets all pointers to zero and clears the screen.
CMD(X,Y)	Draws a dot at position X,Y Examples :- CMD(100,100) CMD(A,B)
CMD*(X,Y)	Resets the dot at position X,Y Examples :- CMD*(100,100) CMD*(A,B)
&P(X,Y)	Returns the status of the dot at position X,Y. Dot on returns -1 Dot off returns 0. Examples :- ?&P(100,100) C=&P(A,B)
LSET(X,Y,X1,Y1)	Draws a vector (line) between X,Y and X1,Y1 Examples :- LSET(0,0,100,100) LSET(A,B,C,D)
LSET*(X,Y,X1,Y1)	Resets the vector (line) between X,Y and X1,Y1 Examples :- LSET*(0,0,100,100) LSET*(A,B,C,D)
RSET(X,Y,X1,Y1)	Draws a rectangle using points X,Y and X1,Y1 as opposing corners. Examples :- RSET(0,0,100,100) RSET(A,B,C,D)
RSET*(X,Y,X1,Y1)	Resets a rectangle using points X,Y and X1,Y1 as opposing corners. Examples :- RSET*(0,0,100,100) RSET*(A,B,C,D)
RSETF(X,Y,X1,Y1)	Draws a filled in rectangle using points X,Y and X1,Y1 as opposing corners. Examples :- RSETF(0,0,100,100) RSETF(A,B,C,D)
RSETF*(X,Y,X1,Y1)	Resets a filled in rectangle using points X,Y and X1,Y1 as opposing corners. Examples :- RSETF*(0,0,100,100) RSETF*(A,B,C,D)

Note :- All the above coordinates must be within the range, listed in Appendix B, for your machine.

Appendix B

SCREEN LIMITS

X Coordinate Model I = 0 to 383

Y Coordinate Model I = 0 to 191

USEFUL ADDRESSES

DESCRIPTION (SETXY)	HEX ADD	DEC ADD	DISK/TAPE
INITIALISATION ADDRESS	P920	63776	DISK
SYSTEM ENTRY ADDRESS	P97D	63869	DISK
LOCASE ENTRY ADDRESS	P955	63829	DISK
LOCASE ENTRY ADDRESS	5306	21254	TAPE
PROTECT MEMORY	EA61	60000	DISK
START OF ROUTINE	EA61	60000	DISK
START OF ROUTINE	4C01	19457	TAPE
END OF ROUTINE	FF82	65410	DISK
END OF ROUTINE	5675	22133	TAPE

USR POKES FOR TAPE PRINT ROUTINE POKEL6526,105:POKEL6527,78

ERROR CONDITIONS

Error Code.	7
Error Message.	Out of Memory.
Probable Cause.	All 128 Characters used.
Remedy.	Type OMDC <ENTER> rationalise on your design and re-run your programme.
Error Code.	5
Error Message.	Illegal Function Call.
Probable Cause.	(X,Y) Coordinates out of range.
Remedy.	Check Appendix B (screen limits) alter coordinates and re-run your programme.
Error Code.	11
Error Message.	Divide by Zero.
Probable Cause.	X=X1 or Y=Y1 in any RSET parameters.
Remedy.	Alter RSET parameters and re-run your programme.

Setxy Example Programmes

```

5 'ROUTINE TO PRINT RANDOM DOTS IN A BOX
10 CMD:DEFINT A-Z:RANDOM
20 X0=100:Y0=47:X1=284:Y1=93
30 RSET(X0,Y0,X1,Y1):RSET(X0+1,Y0+1,X1-1,Y1-1)
40 X=RND(X1-6-X0):Y=RND(Y1-6-Y0):X=X+X0+2:Y=Y+Y0+2
50 IF&P(X,Y)=-1THENCMD*(X,Y):GOTO40
60 CMD(X,Y):GOTO40

```

```

5 'ROUTINE TO DRAW NESTED RECTANGLES
10 CMD:DEFINT A-Z
20 X=0:Y=0:X1=383:Y1=191:I=6
30 RSET(X,Y,X1,Y1)
40 X=X+I:Y=Y+12:X1=X1-I:Y1=Y1-12
50 IFY1>0THEN30
60 IFINKEY$=""THEN60ELSE10

```

```

5 'ROUTINE TO DRAW AN ELLIPSE WITH VECTORS
10 CMD:DEFINT X,Y
20 X=175:Y=95:R=35:O=2:A=177:B=129
30 FORT=0.1TOATN(1)*8STEPATN(1)/4
40 X1=X+O*R*SIN(T):Y1=Y+R*COS(T)
50 LSET(A,B,X1,Y1):LSET(X,Y,X1,Y1)
60 NEXT
70 IFINKEY$=""THEN70ELSE10

```

Printer Driver

The high-resolution graphics printer driver routine allows ASCII and high resolution graphics characters to be printed on either a line printer 7 or line printer 8. The routine dumps the current screen image to the line printer. Note low resolution graphics cannot be printed.

To print the screen content use the following routine :-

```
10 DEFUSR=&HEA61:REM DISK BASED SYSTEMS
20 POKE16526,105:POKE16527,78:REM TAPE BASED SYSTEMS
30 X=USR(A)
40 REM where 'A' is the argument passed to the print routine
```

ARGUMENT -----	PRINTER -----	VERTICAL SCALE -----
71	LP7	One dot per pixel.
72	LP7	Two dots per pixel.
81	LP8	One dot per pixel.
82	LP8	Two dots per pixel.

NOTE. Due to the limitation of linefeed control when printing ASCII characters some printouts may give a slightly uneven appearance. Unfortunately this is unavoidable if ASCII characters (characters 32-124) are to be used with this high-resolution print routine. This is not so apparent if 'A'=72 or if 'A'=82.

Holding the <BREAK> key down during printout will terminate the print and return control to the command mode of BASIC.

ERROR CONDITIONS -----

If the printer is not ready when the print routine is called control will immediately be returned to BASIC.

If an argument other than the four listed above is passed to the print routine, control will immediately be returned to BASIC with the error message M.O. error or Missing Operand.



INITIALISATION OF SETXY EPROM.
SYSTEM
7?/12288

TO SET LOWERCASE ONLY.
SYSTEM
/12300

$$12288 = 3000_{16}$$

$$12300 = 300C_{16}$$

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NOTE: The operating system on the supplied diskette has been altered specifically for the enhanced graphics and should not be used for other applications.